Modelling Methodology

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C O N T E N T

1 Introduction

1.1 About this document

The ebIX methodology is written mainly as a guide for ebIX projects and working groups, to help them in their work. The methodology describes items such as how to do modelling according to ebIX rules, how to make changes to models and business documents, etc.

1.2 New in version 2.0

Main changes from previous version:

- The ebIX Methodology is upgraded to follow the UN/CEFCAT Modelling Methodology version 2 (UMM), which is a complete recast of the previous version 1.
- The methodology outline in chapter Appendix A is updated to be in line with UMM 2.0.
- The extract from UMM is updated to version 2.0 and moved to Appendix D.
- Chapter 3, Modelling within ebIX is completely rewritten and includes among others examples of the UML structure for CuS (and partly EMD).
- The extract from UML, Appendix E, is updated to version 2.1.2.
- The term *Business information model* is replaced with the term *Business collaboration model* in most of the places used.
- The chapter containing CC information has been removed. The information (CC/BIE definitions) can be found in Appendix C, Definitions and glossary.
- The chapter that contained *Layout of ebIX documents* has been removed. The layout will be added to new chapters related to BRSs and RSMs.

1.3 Objective

A deregulated European energy market consists of several different business areas operated by a number of parties with different roles. Each of these business areas has their own business experts with an in-depth knowledge of the business processes and information flows within their area. Making common electronic data exchange standards for these different business areas, involving different business experts, requires a common methodology to assure that standards are made in a harmonised way.

The objective of ebIX is to define appropriate electronic data interchange standards for the different business processes. In order to come to stable and coherent interchange standards, precise modelling in a syntax independent way is needed. Accordingly, this has led to the development of a methodology, which defines the rules for how to make ebIX business collaboration models and related technical documents for specification of the exchange of electronic documents. The methodology is based on the UMM (UN/CEFACT Modelling Methodology) and UML (Unified Modelling Language).

The objective of this document is to give an introduction to basic standards and other documents that are relevant for the ebIX work. This includes the different UN/CEFACT standards, such as UMM, UPCC, UCM and NDR, but also other documents such as the harmonised role model from ebIX, EFET and ETSO.

The audience for the document is mainly modelling experts participating in ebIX Technical Committee (ETC), but parts of it, such as the description of the UMM *Business Requirements View*, may be useful for business people participating in the development of business models.

1.4 ebIX requirements for the methodology

Given the objective described above we have reasons to decide on a methodology consisting of:

- Model independent of syntax and derive syntax dependent information exchanges from these models.
- Reuse common objects (information elements).
- Allow for national extensions and customisation.

- Fit the ebIX models and information exchanges into the broader UN/CEFACT standards.

This implies:

- use UML for object oriented modelling
- taking CCTS (Core Components Technical Specification) as source of reusable information elements
- adopting UMM as the basis for the ebIX methodology
- adopting MDA (Model Driven Architecture) for deriving syntax dependent structures

1.5 ETC, ebIX Technical Committee

The ebIX methodology is maintained by ETC. If there is comments or suggestions to the methodology please contact any member of ebIX/ETC.

For comments to the document, please contact the ebIX® secretary at secretary@ebix.org.

1.6 References

[1] UN/CEFACT Unified Modelling Methodology (UMM), version 2.0, see http://www.untmg.org/

[2] UN/CEFACT Core Component Technical Specification (CCTS), see http://www.untmg.org/

[3] UML Profile for Core Components (UPCC), see http://www.untmg.org/

[4] Core Components Message Assembly (CCMA), see http://www.untmg.org/

[5] UN/CEFACT Business Requirements Specification (BRS) Documentation Template, see http://www.uncefactforum.org/ICG/

[6] UN/CEFACT Requirements Specification Mapping (RSM) Documentation Template and Conformity Rules, see http://www.uncefactforum.org/ICG/

[7] ebIX model for customer switching, see http://www.ebix.org/

[8] ebIX models for metered data, see http://www.ebix.org/

[9] The Harmonised Role Model – ETSO, ebIX and EFET, see www.edi.etso-net.org
Note:
The Role model describes a model identifying all the roles that can be played for given domains within the electricity market. The roles are of a logical nature (such as a trade responsible party), which act within a given domain (such as a balance area) and shall always define specific responsibility. A prerequisite for the identified roles is that the responsibilities of the roles must be mutually exclusive in the model. The document covers the roles as identified in current development being carried out in information exchange. It will naturally grow or evolve as this work progresses.

[10] ebIX Common rules and recommendations, see http://www.ebix.org/

[11] ebIX Domain model, see http://www.ebix.org/
Note:
The purpose of the Business Domain Model is to show the structure and dynamics of the European energy industry. It ensures that all users, standards developers and software providers have a common understanding of the business domain with no special focus on an electronic commerce solution. The domain is divided into sub domains showing UseCase analysis on each sub domain. All modelling done within ebIX will be carried out on a part of the business domain model. The Business Domain Model

shows the scope of the business domain, business domain UseCase diagram and description and business domain activity diagram.

[12] ebIX Core Components (CC), see http://www.ebix.org/

[13] Unified Modeling Language™ (UML®), version 2, see http://www.omg.org/technology/documents/modeling_spec_catalog.htm

[14] UN/CEFACT XML Naming and Design Rules (NDR), see http://www.uncefactforum.org/ATG/ATG_Home.htm

[15] ebIX Recommendations for acknowledgement and error handling) see http://www.ebix.org/

1.7 Change log

Ver.	Rel.	Rev.	Date	Changes
Draft for 2	0	A	February 27th 2009	Draft version. Update of appendix E.1, Terms and definitions and E.4, Classes and Class diagram.
Draft for 2	0	A	December 10nd	Draft version. Changes according to ETC meeting December 9-10 2008
Draft for 2	0	A	October 28nd	Draft version. Changes according to ETC meeting October 2008
Draft for 2	0	A	October 2nd	Draft version. Main changes can be found in chapter 1.2.
Draft for 2	0	A	August 18th 2008	Draft version. Main changes can be found in chapter 1.2.
Draft for 2	0	A	July 2008	1st draft for version 2.0. Changes not tract.
1	1	-	January 2006	Restructured version
1	0	-	March 31st, 2004	First version

2 Overview of the ebIX Methodology

As a basic principle the ebIX methodology shall be used for all ebIX projects. This methodology is based on:

- UN/CEFACT Modelling Methodology (UMM) [1]
- UN/CEFACT Core Components Technical Specification (CCTS) [2]
- UML Profile for Core Components (UPCC) [3]
- Core Components Message Assembly (CCMA) [4]
- A project methodology made together with ETSO [9]
- ebIX rules and recommendations [10]

2.1 Introduction to the ebIX Modelling methodology

The basis for all modelling within ebIX is the UN/CEFACT Modelling Methodology (UMM). The UMM employs a "step by step" approach to capture the business knowledge from business analysts in non-technical terms, independent of any specific modelling tool. The energy business environment is large and complex. Any basic understanding of this environment begins with information and documentation. The UMM is an incremental business process and collaboration model construction methodology that provides levels of specification granularity suitable for communicating the model to business practitioners, business application integrators, and network application solution providers. The UMM provides the conceptual framework to communicate common concepts.

The UMM is targeted to the modellers and facilitators working with the business experts to extract their business knowledge. They need a high-level understanding of the concepts behind OO modelling, business process modelling, and knowledge of UML in order to utilize the UMM.

ebIX business collaboration models will always reflect the core business need for a majority of the countries participating in the ebIX project. National exceptions and additions will not be a part of a core ebIX business collaboration model.

The complete model is more than just pictures accompanying text. Behind the pictures and the accompanying text there should always be a UMM compliant model that can be read and understood by relevant software and among others be used for automation of the creation of messages in specific syntaxes, such as XML and EDIFA~~I~~CT.

Within UMM the *Business Requirements View* is normally modelled top-down, while the *Business Choreography View* normally is modelled bottom-up. ~~In modelling one can distinguish two basic principles: cascading and iteration. Cascading means that you start one phase and complete it before you move on to the next phase. Iteration means that you go back and forth between two (or even more) phases until each phase is completed. In UMM you start with a cascade and iterate when needed.~~ It shall always be possible to go back one or more steps if we find errors or omissions in previous phases.

~~2.2 From model to business document~~

~~Once a model is completed, we have not yet finished, as the ultimate objective of a project is to specify the actual exchange of information. This means that finally we have to:~~

- ~~translate the class diagrams into EDIFACT messages, XML schemas or other means of transportation;~~
- ~~translate activity diagrams into procedures.~~

~~2.3 Combining common elements~~

~~Once we have started the modelling we will find some elements appearing again and again in most diagrams. In ebIX it is the task of ETC (ebIX Technical Committee) to define those common elements for all ebIX projects, for example confirmation and rejection procedures and related business documents. And, we have *ebIX Common rules and recommendations* [10] to define basic principles for the business documents.~~

~~2.4~~2.2 Room for national standards

This chapter will be reviewed when the first ebIX models from CuS and EMD are published.

In doing this we shall always have to bear in mind that ebIX aim at specifying the common elements for all participants in the European energy market. There are, however, special needs within the national markets, such as special rules and procedures, so we have to leave room for national detailing. Nevertheless it should be our aim to harmonise as much as possible, since each national specialty means an obstacle for a truly open European market.

Since ebIX models are open for national extensions, the creation of national standards based on ebIX models should follow ~~the following~~ these steps:

1. pick up the appropriate ebIX technology independent model
2. add national extensions like special codes and elements
3. decide on technology:
    a. document based or web services
    b. syntax (XML, EDIFACT)
    c. channel requirements influencing the information exchange
4. generate a complete set of business documents reading syntax independent model, including extensions, regarding interchange channel information and the syntax selected.

3 Modelling within ebIX

3.1 The structure of a business collaboration model

The structure of the ebIX business collaboration model shall be in line with the ebIX Domain model [11], i.e. the top level of the model is the European energy market, the second level is named by the relevant domain from the ebIX domain model and the lower levels corresponds to the UMM outline [1], see example below.

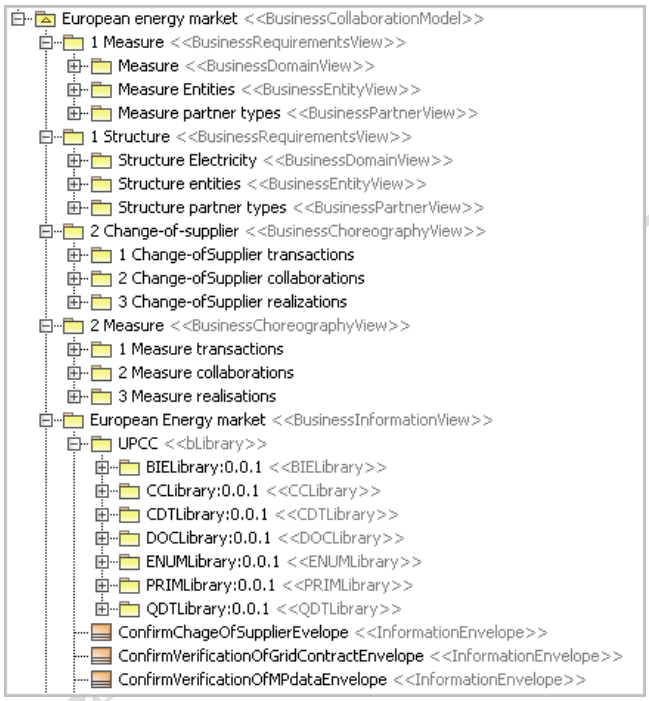


Figure 1 Example of UMM structure for the ebIX Domains Measure and Structure

A UMM business collaboration model is a special kind of an UML model, based on the UML meta model. It provides a UML Profile consisting of stereotypes, tagged definitions and constraints. Stereotypes (shown within brackets, << >>) are showing the type of UMM element used and works as a placeholder for tagged values. The stereotypes are also used to show the organisation of the model and for transformation to syntax specific information exchanges.

UMM specifies three main views, the two first including three sub-views each:

- *Business Requirements View*
  - *Business Domain View*
  - *Business Entity View*
  - *Business Partner View*
- *Business Choreography View*
  - *Business Transaction View*
  - *Business Collaboration View*
  - *Business Realisation View*
- *Business Information View.*

The audience for the *Business Requirements View* is the business users, while the audience for the *Business Choreography View* and the *Business Information View* is technical persons that will implement the modes in their software systems. These views will be further described later in this chapter.

The *Business Requirements View* is used for capturing the business collaborations and information entities and uses common business terms. This view is not meant to be readable by electronic data systems, only by human readers.

The *Business Choreography View* and the *Business Information View* will ~~however~~ be modelled in such a way that electronic data systems can read and understand the model, e.g. for automatic configuration of communication systems.

Below is shown an example of the different views used within UMM.

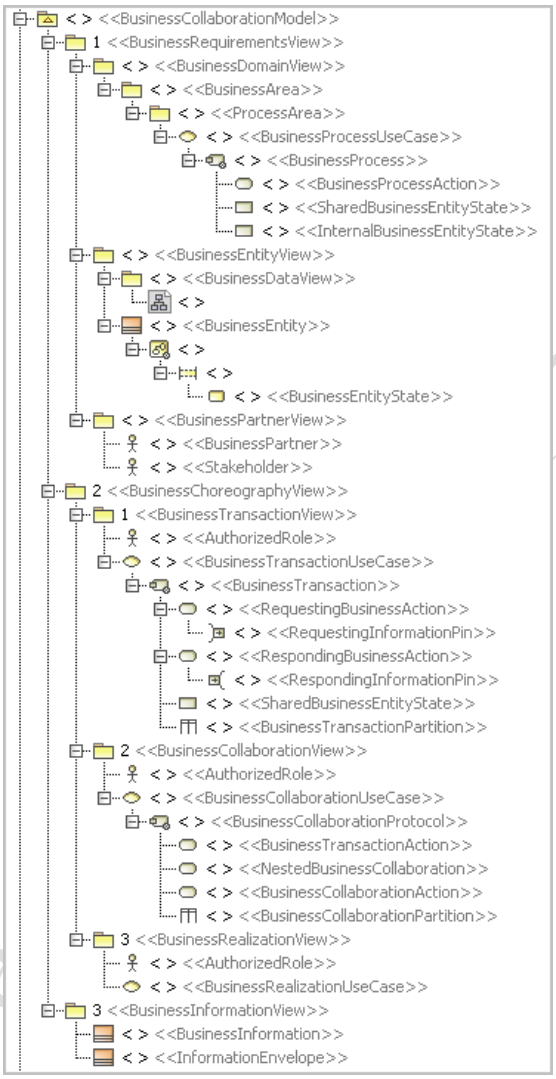


Figure 2 Structure of UMM views

3.2 Business Requirements View

The *Business Requirements View* consists of:

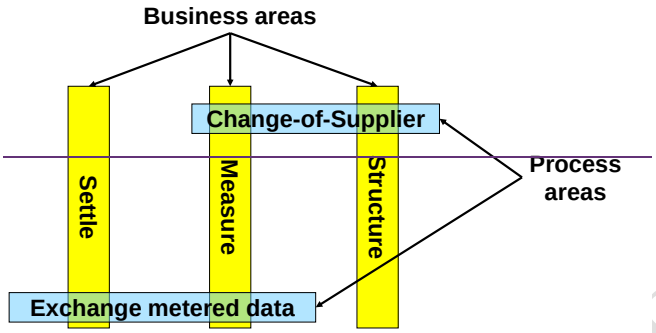
- *Business Domain View*
- *Business Entity View*
- *Business Partner View*

3.2.1 Business Domain View

The *Business Domain View* is used to discover business process UseCases that are of relevance in a project, and to elaborate these UseCases in related activity diagrams. In this view the terms used should be as close as

possible to the terms used within the business area. These terms shall later on, in the *Business Choreography View and the Business Information View*, be mapped to standardised terms from the *Harmonised role model* [9] and the UN/CEFACT Core Component Library (CCL).

The *Business Domain View* will be described using ~~a part of, or the whole of, a~~ *Business areas* ~~or a~~ and *Process areas*. ~~Note that a *Business area* may be orthogonal to a *Process area*.~~



~~**Figure 3** Business areas and Process areas~~

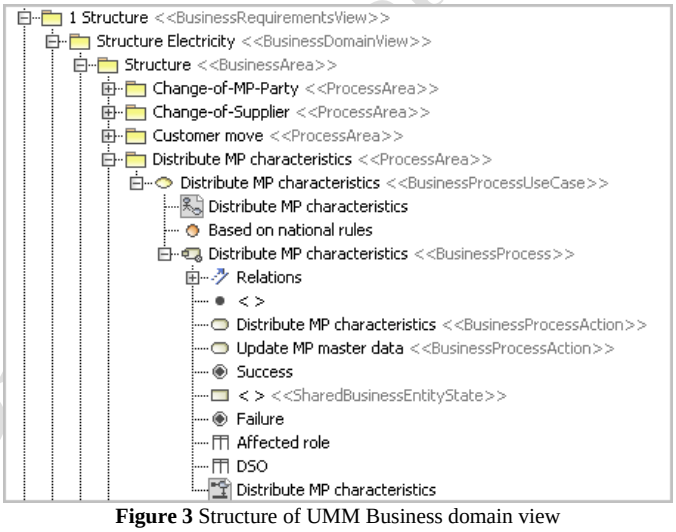


Figure 3 Structure of UMM Business domain view

3.2.2 Business Entity View

In the *Business Entity View* all relevant entities are elaborated and documented. The entities may be candidates for business documents, object classes used within the business documents and more abstract entities used for describing a lifecycle.

The abstract entities, which shall include business entity states, are placed directly below the *business entity view package*, while the candidates for business documents are placed in separate *Business Data View packages* (below the *business entity view package).*

Also in this view the terms used should be as close as possible to the terms used within the business area. These terms shall later on, in the *Business Choreography View and the Business Information View*, be mapped to standardised terms from the *Harmonised role model* [9] and the UN/CEFACT Core Component Library (CCL).

Candidates business documents are shown in class diagrams placed below the *Business Data View packages.*

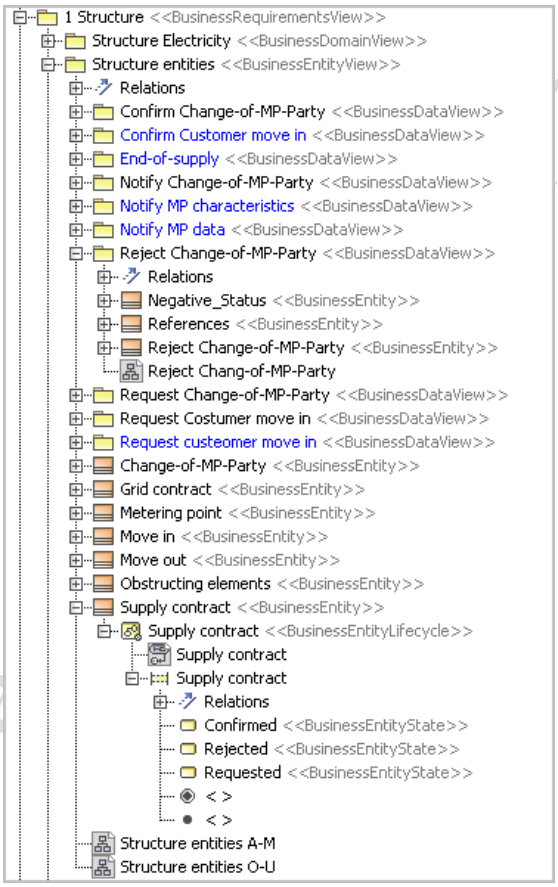


Figure 4 Structure of UMM Business entity view

3.2.3 Business Partner View

In the *Business Partner View* all relevant roles are elaborated and documented.

Also in this view the terms used should be as close as possible to the terms used within the business area. These terms shall later on, in the *Business Choreography View and the Business Information View*, be mapped to standardised terms from the *Harmonised role model* [9]. The *ebIX, EFET and ETSO Harmonised role model* itself is placed on the top level of the MagicDraw project, in parallel with the ebIX *Business collaboration model*.

Figure 5 Structure of UMM Business partner view

Note that ebIX has added ~~some~~ an additional stereotype~~s to the *Business partner view*~~ for roles from the *Harmonised role model*, i.e.:

<<HarmonisedRole>>	A role taken from the Harmonised European energy market role model from ebIX, ETSO and EFET [9].
~~<<BusinessActor>>~~	~~A role defined within the model itself. This may be a candidate for addition to the Harmonised role model or a specialisation of a role from the Harmonised role model.~~
~~<<ModelRole>>~~	~~A generic role (generalisation) of roles, used to simplify the model.~~

3.3 Business Choreography View

The *Business Choreography View* consists of:

- *Business Transaction View*
- *Business Collaboration View*
- *Business Realisation View*

3.3.1 Business Transaction View

In the *Business Transaction View* relevant transactions are modelled. A transaction will always have two *Authorised roles* placed within its *Business Transaction View package*.

A transaction view should be modelled in a generic way, such that the transaction can be reused in the *Business Collaboration View* and the *Business Realisation View.* This also means that the *Authorised roles* often will be abstract (generic) roles, later on mapped to real roles in the *Business Collaboration View* and the *Business Realisation View.*

The following generic roles may be used in *Business transactions*.

Role	***Transaction pattern (see below)***
Responsible role	Commercial Transaction, Request/Confirm, Query/Response, Request/Response, Notification and Information Distribution
Linked role	Notification and Information Distribution
Initiating role	Commercial Transaction, Request/Confirm, Query/Response and Request/Response
Affected role	Notification and Information Distribution

Note that a Business transaction only concerns two roles at the time.

The transaction documented will always be one of six UMM transaction patterns:

1. Commercial Transaction
2. Request/Confirm
3. Query/Response
4. Request/Response
5. Notification
6. Information Distribution

The business transaction type determines a corresponding business transaction pattern. A business transaction pattern provides a language and grammar for constructing business transactions. The business transaction type follows one of the following six property value conventions:

(1) Commercial Transaction	used to model the "offer and acceptance" business transaction process that results in a residual obligation between both parties to fulfil the terms of the contract.
(2) Query/Response	used to query for information that a responding partner already has e.g. against a fixed data set that resides in a database.
(3) Request/Response	used for business contracts when an initiating partner requests information that a responding partner already has and when the request for business information requires a complex interdependent set of results.
(4) Request/Confirm	used if an initiating partner asks for information that requires only confirmation with respect to previously established contracts or with respect to a responding partner's business rules.
(5) Information Distribution	used to model an informal information exchange business transaction that therefore has no non-repudiation requirements.
(6) Notification	used to model a formal information exchange business transaction that therefore has non-repudiation requirements

The following figure provides a set of decision criteria for selection of business transaction patterns.

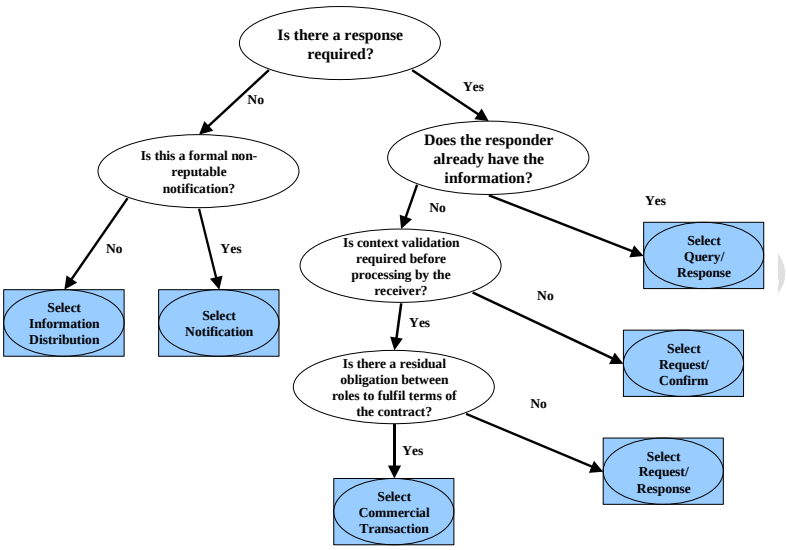


Figure 6 Decision criteria for selection of business transaction patterns (from UMM)

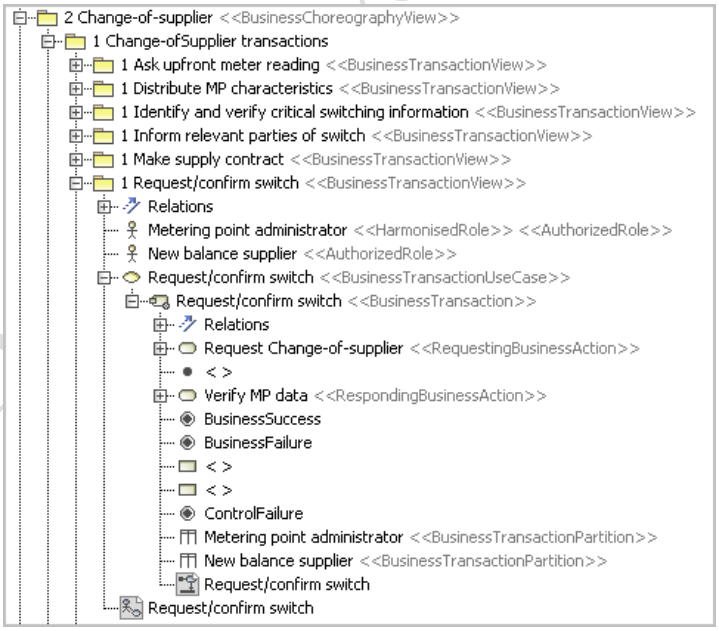


Figure 7 Structure of UMM Business transaction view

3.3.2 Business Collaboration View

A Business Collaboration View is used to define the business choreography of exactly one business collaboration. This business choreography is specified by the concept of a *Business Collaboration Protocol*. The requirements of a *Business Collaboration Protocol* are captured by a *Business Collaboration UseCase*. The *Business Collaboration View* is composed of exactly one *Business Collaboration UseCase* and one *Business Collaboration Protocol*.

Business collaboration UseCases may optionally have multiple parent *Business Collaboration UseCases* and may include multiple *Business Transaction UseCases*. A *Business Collaboration UseCase* may also be extended by additional *Business collaboration UseCases*

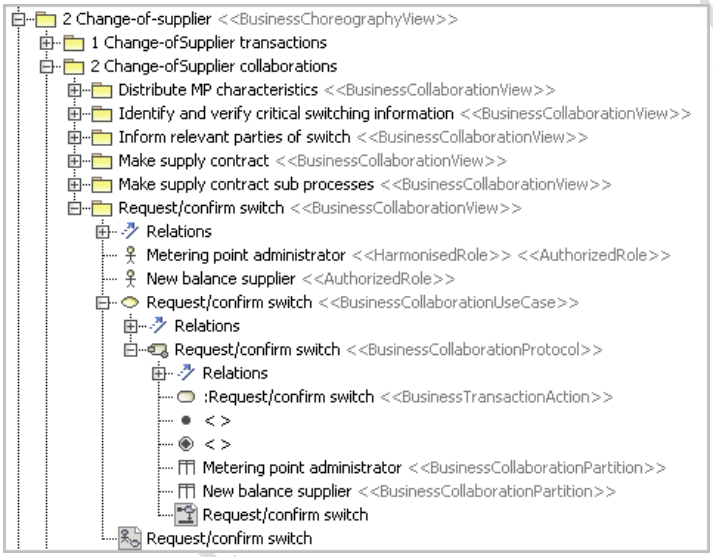


Figure 8 Structure of UMM Business collaboration view

3.3.3 Business Realization View

Business partners identified in the previous *Business Requirements View* must not directly be associated with *Business Collaboration UseCases* and *Business Transaction UseCases*. In order to specify that a specific set of *Business partners* collaborate, we use the concept of a *Business realization*. Each *Business realization* is defined in its own *Business Realization View*. A *Business realization* realizes exactly one *Business Collaboration UseCase, but e*ach *Business Collaboration UseCase* may be realized by multiple business realizations.

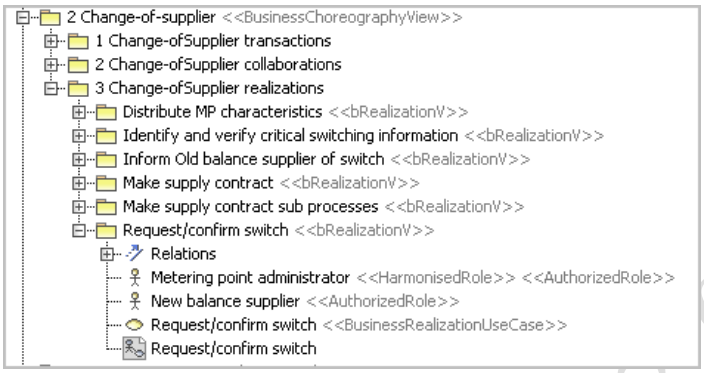


Figure 9 Structure of UMM Business realization view

3.4 Business Information View

UMM strongly recommends using the UN/CEFACT UML Profile for Core Components (UPCC) [3] as the basis for the *Business Information View*, which also reflects the ebIX position. UPCC specifies how to implement and how to deploy the following two standards into a UMM compliant UML model:

- Core Components Message Assembly (CCMA) [4]
- UN/CEFACT Core Component Technical Specification (CCTS) [2]

The UN/CEFACT's Core Components Technical Specification (CCTS) [2] specifies how to create Core Components (CC) and the Core Components Message Assembly (CCMA) [4] specifies how these CCs can be assembled into messages.

A *Business Information View* is a container of artefacts that describe the information exchanged in a *Business Transaction*. *Requesting Information Pins* and *Responding Information Pins* (from the *Business Transaction View*) are classified by an *Information Envelope*, which serves as an abstract container for all of the information exchanged between the *Requesting Action* and the *Responding Action* or vice versa.

The main objective of the *Business Information view* is to describe the *Business documents* to be exchanged.

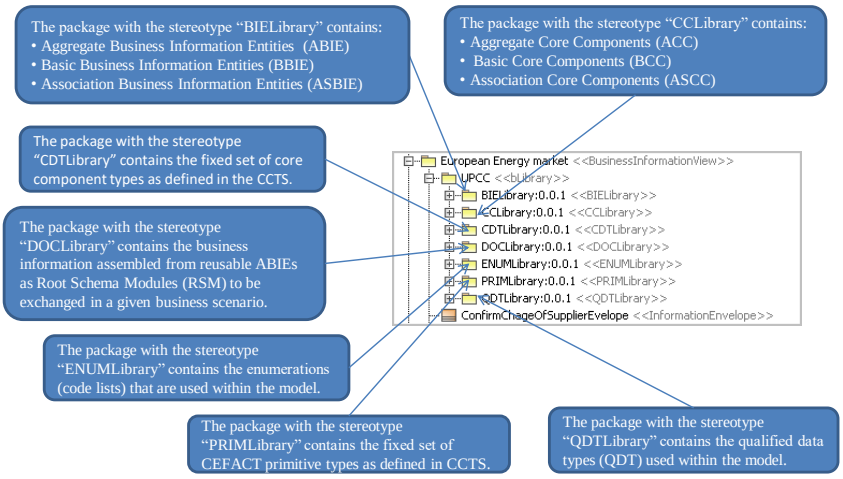


Figure 10 Structure of UMM Business information view

The table below shows the main content and responsibilities related to UPCC structure.

Library	Content	Responsible	Stereotypes
PRIMLibrary	Fixed set of CEFACT primitive types as defined in the CCTS.	UN/CEFACT	<<PRIMLibrary>> <<PRIM>>
ENUMLibrary	Enumerations (code lists) used within the model.	UN/CEFACT, ~~and~~ ebIX and others	<<ENUMLibrary>> <<ENUM>> <<CodeListEntry>>
CDTLibrary	Fixed set of core component types as defined in the CCTS.	UN/CEFACT	<<CDTLibrary>> <<CDT>> <<CON>> <<SUP>>
QDTLibrary	Qualified data types (QDT) used within the model.	ebIX	<<QDTLibrary>> <<QDT>> <<CON>> <<SUP>>
CCLibrary	ACCs represented as UML classes, consisting of BCCs and ASCCs.	UN/CEFACT	<<CCLibrary>> <<ACC>> <<BCC>> <<ASCC>>
BIELibrary	ABIEs represented as UML classes, consisting of BBIEs and ASBIEs. The BIEs are made from restricted CCs, using "basedOn" dependencies.	ebIX	<<BIELibrary>> <<ABIE>> <<BBIE>> <<ASBIE>>
DOCLibrary Will be further elaborated *	Business information assembled from reusable ABIEs as Root Schema Modules (RSM) to be exchanged in a given business scenario.	ebIX	<<DOC~~BIE~~Library>> <~~<RSM>>~~ <<MA>> <<MBIE>>

* Rules related to a possible "MALibrary" (Message Assembly Library) and how to handle a common payload for several syntaxes will be added when the first ebIX *Business Information View* is finished.

4 UMM acknowledgement and process behaviour principles

This chapter contains an extract from the UMM documentation and will be reviewed after finalisation of a complete CuS and/or EMD model.

UMM ~~are~~is using tagged values to specify different needs for how the behaviour of a *Business transaction* should be. These tagged values can be found in the different objects within the *Business Transaction View.*

4.1 Acknowledgements

UMM recognises two types of acknowledgements: *Acknowledgement of receipt* and *Acknowledgement of processing*. The usage of acknowledgements is implicit specified using tagged values, expressing time to acknowledge, in the *Business actions* in the *Business transaction view*. The actual acknowledgement *business information* (e.g. messages) is not shown in any of the UMM views. The actual content of the acknowledgement *business information* and business rules used within ebIX can be found in the ebIX Recommendation for acknowledgement and error ~~handling~~ handling [15].

4.1.1 Time to Acknowledge Receipt (Time expression)

The tag *TimeToAcknowledgeReceipt* related to the stereotype *Business Action* is used for specifying the time to acknowledge receipt.

Both partners may agree to mutually verify receipt of business information within a specific time duration. Acknowledgements of receipt may be sent for both the requesting business information and the responding business information. This means the sender of the business information may be the requesting authorized role as well as the responding authorized role – it depends on whether requesting or responding business information is acknowledged. Similarly, the affirmant may be the requesting *authorized role* as well as the responding *authorized role* – again depending of which *business information* is acknowledged. Inasmuch we use the terms sender and affirmant in the explanation of acknowledgement of receipt semantics.

An affirmant must exit the transaction if they are not able to verify the proper receipt of a *business information* within agreed timeout period. A sender must retry a *business transaction* if necessary or must send notification of failed business control (possibly revoking a contractual offer) if an affirmant does not verify properly receipt of a *business information* within the agreed time period. The time to acknowledge receipt is the maximum duration from the time a *business information* is sent by a sender until the time a verification of receipt is "properly received" by the sender (of the business information). Accordingly, the time to acknowledge receipt is always specified by the sender's business action, i.e. time counted on the sender side. This verification of receipt is an auditable business signal and is instrumental in contractual obligation transfer during a contract formation process (e.g. offer/accept).

4.1.2 Time to Acknowledge Processing (Time expression)

The tag *TimeToAcknowledgeProcessing* related to the stereotype *Business Action* is used for specifying the time to acknowledge processing.

Similarly to the *timeToAcknowledgeReceipt*, the sender of a *business information* might be the requesting *authorized role* as well as the responding *authorized role* – depending whether a requesting or a responding *business information* is acknowledged. Also the affirmant may be one of the two *authorized roles*. Thus, we use again the terms sender and affirmant in the explanation of the acknowledgment of processing semantics.

Both partners may agree to the need for an acknowledgment of processing to be returned by a responding partner after the requesting business information passes a set of business rules and is handed over to the application for processing. The *time to acknowledge processing* of a business information is the duration from the time a sender sends a business information until the time an acknowledgement of processing is "properly received" by the sender (of the business information).

Accordingly, the *time to acknowledge processing* is always specified by the sender's business action, i.e. time counted on the sender side. An affirmant must exit the transaction if they are not able to acknowledge processing of business information within the maximum timeout period. A sender must retry a business transaction if necessary or must send notification of failed business control (possibly revoking a contractual offer) if an affirmant does not acknowledge processing of business information within the agreed time period.

4.2 Business Transaction

A *business transaction* is the basic building block to define choreography between *authorized roles*. If an *authorized role* recognizes an event that changes the state of a business object, it initiates a *business transaction* to synchronize with the collaborating *authorized role*. ~~It follows that~~As a consequence is a *business transaction* ~~is~~ an atomic unit that leads to a synchronized state in both information systems.

The following tags all apply to the stereotype *Business Transaction:*

- Business Transaction Type
- Secure Transport

4.2.1 Business Transaction Type (Enumeration)

The tag *Business Transaction Type* may have one of these p~~P~~ossible values:

- Commercial Transaction
- Request/Confirm
- Query/Response
- Request/Response
- Notification
- Information Distribution

4.2.2 Secure Transport (Boolean)

Both partners must agree to exchange *business information* using a secure transport channel. The following security controls ensure that business document content is protected against unauthorized disclosure or modification and that business services are protected against unauthorized access. This is a point-to-point security requirement. Note that this requirement does not protect business information once it is off the network and inside an enterprise. The following are requirements for secure transport channels.

Authenticate sender identity – Verify the identity of the sender (employee or organization) that is initiating the interaction (authenticate). For example, a driver's license or passport document with a picture is used to verify an individual's identity by comparing the individual against the picture.

Authenticate receiver identity – Verify the identity of the receiver (employee or organization) that is receiving the interaction.

Verify content integrity – Verify the integrity of the content exchanged during the interaction i.e. check that the content has not been altered by a 3rd party.

Maintain content confidentiality – Confidentiality ensures that only the intended receiver can read the content of the interaction. Information exchanged during the interaction must be encrypted when sent and decrypted when received. For example, you seal envelopes so that only the recipient can read the content.

4.3 Business Action (abstract)

A *business action* is executed by an *authorized role* during a *business transaction*. *Business action* is an abstract stereotype. This means a *business action* is either a *requesting business action* or a *responding business action*.

The following tags all apply to the stereotype *Business Transaction:*

- isAuthorizationRequired: boolean
- isIntelligibleCheckRequired: boolean
- isNonRepudiationReceiptRequired: boolean
- isNonRepudiationRequired: boolean
- timeToAcknowledgeProcessing: TimeExpression
- timeToAcknowledgeReceipt: TimeExpression

4.3.1 Authorization (Boolean)

If an authorized role needs authorization to request a business action or to respond to a business action then the sender must sign the business document exchanged and the receiver must validate this business control and approve the authorizer. A receiver must signal an authorization exception if the sender is not authorized to perform the business activity. A sender must send notification of failed authorization if a receiver is not authorized to perform the responding business activity.

4.3.2 Non Repudiation of Receipt (Boolean)

The *isNonRepudiationOfReceiptRequired* tag requires the receiver of a *business information* to send a signed receipt. If the *isNonRepudiationOfReceiptRequired* tag is false, this indicates that an involved party must not be able to repudiate the execution of sending the signed receipt.

4.3.3 Non Repudiation (Boolean)

The *isNonRepudiationRequired* tag is used to indicate that an involved party must not be able to repudiate the execution of the business action that input/outputs business information.

~~4.3.3~~4.3.4 Intelligible Check (Boolean)

In order to define the *isIntelligibleCheckRequired* semantics, we use again the terms sender and affirmant. Both partners may agree that an affirmant must check that business information is not garbled (unreadable, unintelligible) before verification of proper receipt is returned to the sender (of the business information). Verification of receipt must be returned when a document is "accessible" but it is preferable to also check for garbled transmissions at the same time in a point-to-point synchronous business network where partners interact without going through an asynchronous service provider.

4.4 Process behaviour related to *Requesting Business Action* (abstract)

A *requesting business action* is a *business action* that is performed by an *authorized role* requesting business service from another *authorized role*.

4.4.1 Time to Respond (Time expression)

A *business transaction action* has to be executed within a specific duration. The initiating partner must send a *failure notification* to a responding partner on timeout.

A responding partner simple terminates its activity. The time to perform is the maximum duration between the moment the *requesting authorized role* initiates the *business transaction action*, i.e. sending the *requesting business information envelope*, and the moment the *requesting authorized role* receives a substantive response. The substantive response is the *responding business information envelope* if there is any. In case not, it is the *acknowledgement of processing*, if any. If not it is the *acknowledgement of receipt*, if any.

4.4.2 Retry Count (Integer)

The requesting *authorized role* must re-initiate the *business transaction* so many times as specified by the *retry count* in case that a time-out-exception – by exceeding the time to *acknowledge receipt*, or the time to *acknowledge processing*, or the *time to respond* – is signaled. This parameter only applies to time-out signals and not document content exceptions or sequence validation exceptions – i.e., failed business control exceptions.

4.5 Process behaviour related to *Information Pin* (abstract)

The abstract concept *information pin* represents the incoming/outgoing point for *business information* in a *business action*. *Business information* is sent from the *requesting authorized role* to the *responding authorized role* or the reverse way. The actual exchanged information is represented using the type *business information*. Both concrete stereotypes *requesting information pin* and *responding information pin* inherit from the abstract stereotype *information pin*.

4.5.1 Confidential (Boolean)

If the flag is set, the exchanged information is encrypted so that unauthorized parties cannot view the information**.**

4.5.2 Tamper Proof (Boolean)

If the flag is set, the exchanged information has an encrypted message digest that can be used to check if the message has been tampered with. This requires a digital signature (sender's digital certificate and encrypted message digest) associated with the document entity.

4.5.3 Authenticated (Boolean)

If the flag is set, there is a digital certificate associated with the document entity. This provides proof of the signer's identity.

5 Versioning

5.1 Versioning of XML schemas

ebIX will follow the rules given by in the UN/CEFACT XML Naming and Design Rules (NDR) related to versioning scheme, consisting of:

- Status of the XML Schema file,
- A major version number,
- A minor version number and
- A revision number.

These values are declared in the version attribute in the xsd:schema element. The major version number is also reflected in the namespace declaration for each XML Schema file.

The **xsd:schema** version attribute MUST use the following template:

<xsd:schema ... version="<major>"p"<minor>|"p"<revision>|">

Where:

<major> = sequential number of the major version.
<minor> = sequential number of the minor version.
<revision> = optional sequential number of the Revision.

5.1.1 Major Versions

A major version of a UN/CEFACT XML Schema file constitutes significant non- backwards compatible changes. If any XML instance based on an older major version of UN/CEFACT XML Schema attempts validation against a newer version, it may experience validation errors. A new major version will be produced when non- backward compatible changes occur. This would include the following changes:

- Removing or changing values in enumerations
- Changing of element names, type names and attribute names
- Changing the structures so as to break polymorphic processing capabilities
- Deleting or adding mandatory elements or attributes
- Changing cardinality from mandatory to optional

Major version numbers will be based on logical progressions to ensure semantic understanding of the approach and guarantee consistency in representation. Non- negative, sequentially assigned incremental integers satisfy this requirement.

Every XML Schema File major version number MUST be a sequentially assigned incremental integer greater than zero.

5.1.2 Minor Versions

The minor versioning of an XML Schema file identifies its compatibility with the preceding and subsequently minor versions within the same major version.

Within a major version of an UN/CEFACT XML Schema file there can be a series of minor, or backward compatible, changes. The minor versioning of an UN/CEFACT XML Schema file determines its compatibility with UN/CEFACT XML Schema files with preceding and subsequent minor versions within the same major version. The minor versioning scheme thus helps to identify backward and forward compatibility. Minor versions will only be increased when compatible changes occur, i.e

- Adding values to enumerations
- Optional extensions
- Add optional elements

Minor versioning MUST be limited to declaring new optional XML content, extending existing XML content, or refinements of an optional nature.

Minor versions will be declared using the xsd:version attribute in the xsd:schema element. It is only necessary to declare the minor version in the schema version attribute since instance documents with different minor versions are compatible with the major version held in the same namespace. By using the version attribute in each document instance, the application can provide the appropriate logic switch for different compatible versions without having knowledge of the schema version which the document instance was delivered.

Minor version changes are not allowed to break compatibility with previous versions within the same major version. Compatibility includes consistency in naming of the schema constructs to include elements, attributes, and types. UN/CEFACT minor version changes will not include renaming XML Schema constructs.

For a particular namespace, the major version and subsequent 975 minor versions and revisions create a linear relationship.

Rules related to the minor version number:

- Minor versions MUST NOT rename existing XML Schema defined artifacts.
- Changes in minor versions MUST NOT break semantic compatibility with prior versions having the same major version number.
- XML Schema Files for a minor version XML Schema MUST incorporate all XML Schema components from the immediately preceding version of the XML Schema File.

5.2 Versioning of UMM models

To be done.

~~5~~6 Submissions to UN/CEFACT

The submission of ebIX business collaboration models to UN/CEFACT shall be in line with the requirements from:

- UN/CEFACT Business Requirements Specification (BRS) Documentation Template [5]
- UN/CEFACT Requirements Specification Mapping (RSM) Documentation Template and Conformity Rules [6]

~~6~~7 ebIX transformation rules

This chapter will be rewritten!

~~6.1~~7.1 Business document type

A business document has a business document type that is defined by:

- the nature of the business transaction where it is being used,
- the role responsible for the information in the business transaction and
- the direction of the information flow.

A business document has a certain structure that is determined by:

- the Business document type,
- the Business sector (e.g. electricity or gas),
- the Ancillary-role (the role explicitly included in the header part of the business document),
- the "Reason for transaction" (i.e. in which business process the business transaction is used) and
- the Business document function code (e.g. add, change or delete).

The following rules apply for the business document type:

- There can only be one responsible role for the information components in a business document type.
- The actual information content of a business document may be a subset of the total information components structure of a certain business document type, dependent on the business sector, the "non-responsible" role, the attribute "Reason for transaction" and the Business document function code.
- The "responsible" role in the business transaction is implicit given by the business document type.
- The "non-responsible" role is explicitly specified in the header section of the business document.
- A business document may contain several instances of transactions, of the same type.

Transaction pattern	***Responsible role included in the document type***	***Ancillary-role (explicit given in the business document header)***
Commercial Transaction		
Request/Confirm		
Query/Response	The "Responsible role" is the role receiving the initiating document.	Sender role in the initiating document Receiver role in the responding document
Request/Response	See above	Sender role in the initiating document Receiver role in the responding document
Notification	The "Responsible role" is the role sending the document.	Receiver role
Information Distribution		

Notice that it may be different *Reasons for transactions* and/or *Business document function* codes within a business document, dependent on the requirements given in the class diagram for the business document. The responsible role (sender or receiver) is implicit given by the business document type.

Each business document is specified using a UML class diagram. The class diagram shall describe the classification of the attributes as required (no cardinality – default cardinality) or dependent (0..1). A general rule within ebIX is to see all optional elements as dependent and describe the dependency in a dependency matrix associated with the business document. If an element is dependent on national rules the attribute must be specified in national user guides. This shall be stated in the ebIX business collaboration model.

~~6.2~~7.2 Dependency matrix

The ETC meeting 10081002 proposes to remove this chapter.

Given the principles specified above, it might be possible to use dependency matrices for specifying how to reuse business documents within a given syntax. A specific business document, identified by a business document type, might be used in different business processes, dependent on the syntax. A dependency matrix is set up to show the dependency for different usage. The attribute *Reason for transaction* will specify in which business process the business document is used. Different usage of attributes or classes will often be related to the relevant *Reason for transaction*.

Dependency matrices are typically used for simplifying the implementation of syntax specific messages and may be used for specifying the usage of attributes dependent on other attributes in the messages or to specify allowed codes.

~~6.3~~7.3 Business Document Set

In the present ebIX models we find Business Documents being specified in the Class Diagrams. For efficiency reasons we may still want to be able to combine Business Documents in a set for the exchange with another party, for certain syntaxes. So in the models, the information to be exchanged could be regarded as bottom-up defined, since the business defines the information, which is only later combined in a set.

Several Business Documents may be combined in one Business Document Set:

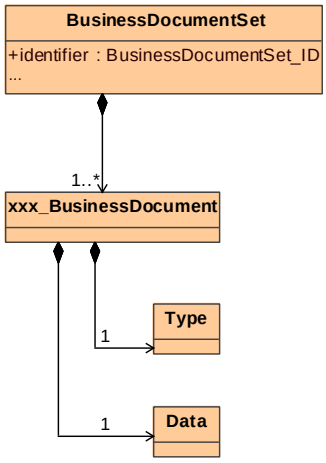


Figure 11 Business Document Set (overview)

There are conditions that have to be met in order to combine Business Documents in one set. Business Documents may only be combined in one Business Document Set if they have the same information the two upper Classes in the Class Diagram (the Class “xxx_BusinessDocument” and the Class “BusinessDocumentType”). Additionally there may be special conditions related to the chosen syntax.

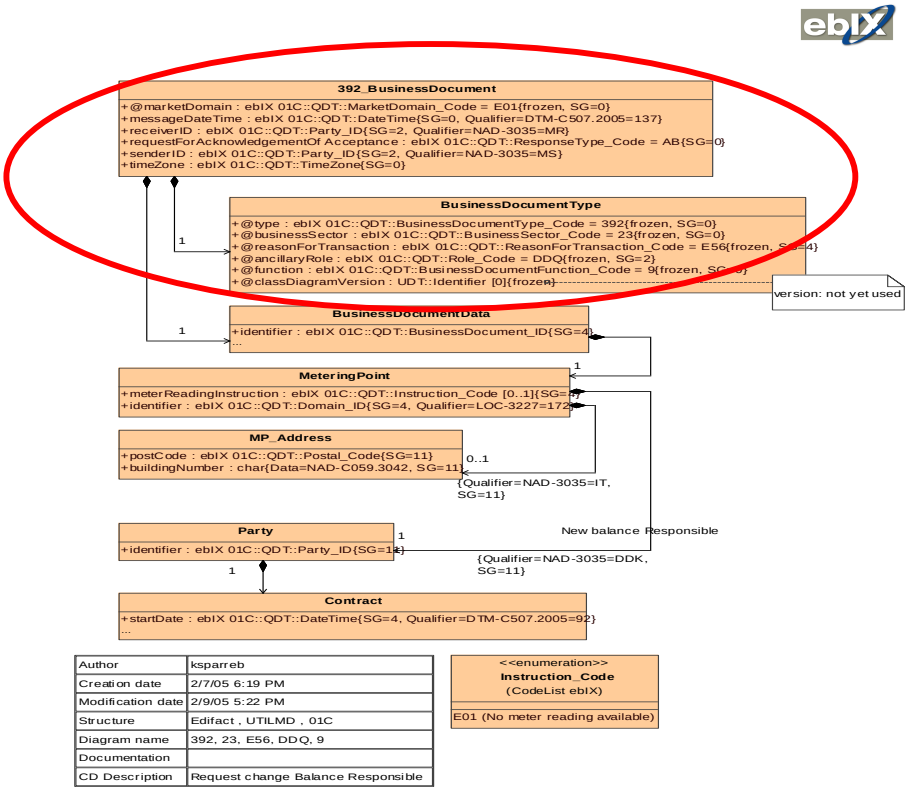


Figure 12 Business Document Set (details)

This condition is represented in the model below. As you see:

- a set may only contain one instance of the class Exx_BusinessDocument
- a set may only contain one instance of the class BusinessDocumentType
- the only information the BusinessDocumentSet adds to the combination of BusinessDocuments is the ID for the BusinessDocumentSet.

This enables us to combine several sets of “data” in one BusinessDocumentSet, as long as they have the two classes that describe the information in common.

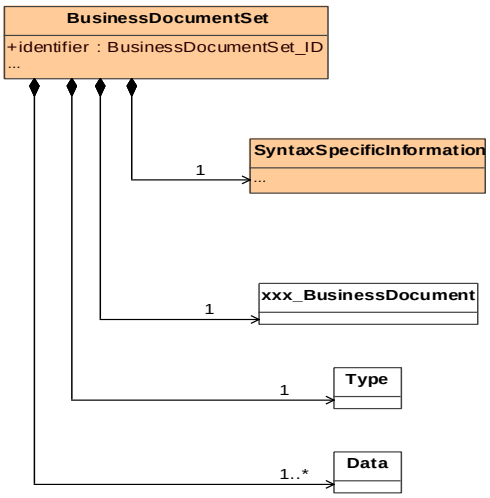


Figure 13 Business Document Set (mapped to syntax)

~~6.47.4~~ How to combine bottom up modelling and reusable elements?

TBD

~~6.5~~7.5 Relations between versioned modelling elements

To be updated.

ebIX model versions are determined by the versions of the components used in the model. The figure below shows the relations between the various elements used in the modelling.

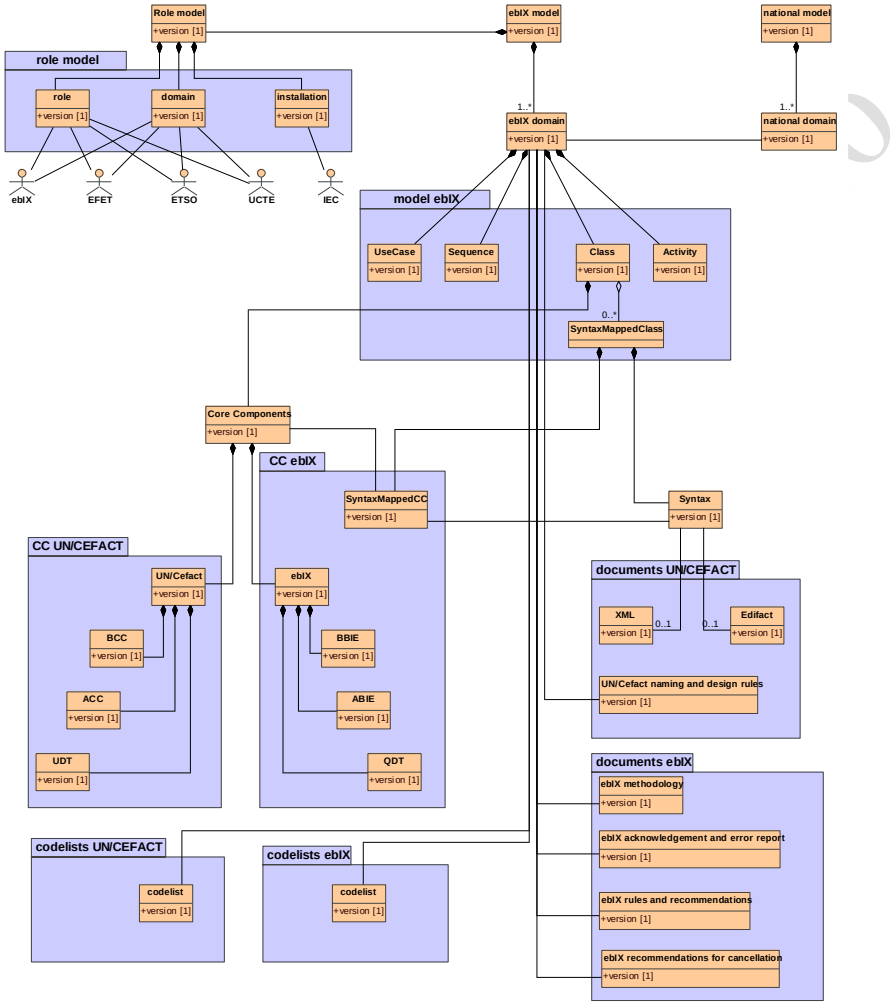


Figure 14 Relations between versioned modelling elements

~~7~~8 ~~Syntax specific documents~~Technology specific requirements

~~7.1~~8.1 Introduction

We have channel requirements and syntax requirements. The channel requirements relate to the type of communication used, while the syntax requirements relate to which syntax to use, e.g. XML or EDIFACT.

Channel requirements do have a strong impact on Acknowledgements and process behaviour. Chapter 4 is outlining how process behaviour and acknowledgement can be determined by stereotypes and tagged values to keep this channel related information apart from the process models itself.

~~7.2~~8.2 Channel requirements

As a principle, information from the channel itself shall not be interpreted in a way that is not defined within the channel. For instance file names shall never be used to transport relevant information. However the channel can supply relevant information if defined explicitly within the channel. For instance:

- A channel that is limited to only one business document type, e.g. WS (WEB-service).
- The sender id for channels that require authentication of the sender.

The ebIX Methodology is not mandating any special standard for message envelopes, such as SOAP or ebXML-MS or the European Communication Platform (ECP) from ETSO. However channels can demand the use of a specific header structure, such as SOAP, ebXML-MS or ECP.

~~7.2.1 Asynchronous or synchronous channels requirements~~

~~7.2.2 Christoph and Kees: make some sentences~~

Different communication channels require different information in the header part of a business document. For example in the case of a WS the receiver part will be known through the address of the WS and if authentication of the sender is required also the sender id will be given directly from the WS. This means that the requirements for header information will vary by the type of communication cannel and syntax. For this reason the header part of a business document will never be modelled in the UMM *Business requirements View*. Business document header specifically made for each communication cannel and syntax will be added in the *Business Information View*. The content of a header may include sender and receiver id, document type, relevant dates and references.

Similar to different requirements for header information, also the requirements for bundling of the detail section of the business documents may vary between different communication channels and syntaxes. For this reason the cardinality between the document header and the detailed sections may be specified as 1 or 1..* in the *Business Information View*, depending on the syntax and communication channel.

In case of asynchronous communication channel (e.g. SMTP) every business document exchanged shall be acknowledged, either by an *acknowledgement of receipt*, an *acknowledgement of processing* or a *responding business document*. This rule does not apply for the acknowledgements themselves. Maintaining this rule is ensuring that both communication partners have a synchronous knowledge of the transaction.

- ~~Adding header~~
- ~~Adding references~~
- ~~Bundling or sets~~
- ~~Belgian revolution rules~~
- ~~Dealing with acknowledgements~~
- ~~Filling envelope, e.g. SOAP.~~

~~7.2.3~~8.2.1 Choreography

Where to put WS specifications (tagged values in the *Business transaction actions?*).

~~Kees: make some sentences~~To be done.

~~7.3~~8.3 Syntax mapping

~~7.3.1~~8.3.1 XML

XML schemas shall be based on the UN/CEFACT XML Naming and Design Rules (NDR) [14].

~~7.3.2~~8.3.2 EDIFACT

~~7.3.2.1~~8.3.2.1 *Basic rules*

The current solution for mapping between a UML Class diagram and EDIFACT requires the following steps:

1) Find a suitable EDIFACT message:
   a) Compare the functional definition of the process and business document with the definitions of EDIFACT messages, preferably EDIFACT messages made for the energy industry, such as UTILMD or UTILTS. If a definition matches or matches satisfactorily, take the EDIFACT message as a basis and request extension of the EDIFACT functional definition with the missing functions. Otherwise, request a new EDIFACT message.
   b) For each class and attribute within this class, find segment groups and segments of which the definition matches, possibly at a more generic level of abstraction. If no segment matches, request a new (generic) segment.
   c) Ensure that the segments used within the EDIFACT structure are in the same level as in the Class diagram. If the level within the EDIFACT message not matches the levels in the class diagram, and workarounds are not possible, request an EDIFACT message structure change.
   d) If the segment found is qualified, look in the segment's qualifier code list for a qualifier that matches the specific definition of the attribute. If none is found, request a new one. If the definition of an existing qualifier may be slightly adapted, request a change.
   e) Check the structure of the segment. In many cases the structure will not match the structure of the class/attribute. If the element and sub-element structure of the segment match the attribute, and if the definitions also match, use the elements. Request changes and additions to the segment structure where appropriate.
2) Document the relationship between the Class diagram (ABIE/BBIE) and the EDIFACT message:
   a) Add the appropriate EDIFACT elements; Segment group, Segment, Composite element, Data element, and Qualifier, to the Class diagram.

~~7.3.2.2~~8.3.2.2 *EDIFACT structure as UML tagged values*

ebIX has created a set of tagged values and rules to facilitate the creation of syntax dependent interchange formats for EDIFACT. The use of tags is differentiated over the mapping levels, i.e.:

- Class diagram
  - Relation
  - Class
    - Attribute
      - Qualified data type (QDT)

The following rules apply:

- In a Class Diagram the common structural mapping values for a set of elements shall be linked to the next higher level;
- Mapping values for data shall preferably be linked to the Qualified data types (and so become reusable).

The following tagged values have been defined by ebIX:

Tag	Comments
Structure	• The tag “Structure” is used for mapping on class diagram level Structure =<syntax>, <UNSM>, <version> <syntax> = EDIFACT <UNSM> = UTILMD or UTILTS <version> 01C, 02B or 07B
Diagram name	• The tag “Diagram name” is used for mapping on class diagram level Structure =<syntax>, <UNSM>, <version> <syntax> = EDIFACT <UNSM> = UTILMD or UTILTS <version> 01C, 02B or 07B
SG	• The tag “SG” (Segment Group) is used for mapping on relation- and data-level • The values for SG include all numbers of segment groups as required. SG=<group number>
Qualifier	• Tagged values for “Qualifier” are only used for information that is syntax dependent and for which in EDIFACT qualifiers have to be used. Qualifier=<Segment-*Composite data eleme*nt.data element=<*value*>>)
Data	• For attributes for which the data type is not qualified the data itself have to be mapped on attribute level using the tag “Data” and optionally qualifying information. • The mapping on Qualified Data Type level regards the data itself and uses the tag “Data” and optionally qualifying information (see above) Data= <Segment-*Composite data element*.data element=<*value*>>

Comments to the table:

- Text in *Italic* is optional.
- The delimiter used between Segment and Composite Data Element is *hyphen* ‘-‘.
- The delimiter used between Composite Data Element and the Data Element or between Data Elements within one Composite Data Element is *full stop* ‘.‘.
- Each data element has a separate value for the tags “Qualifier” and “Data”.
- The tagged values for a Class Diagram as such (“Structure”) are represented in the “Diagram Information” in the Class Diagram.

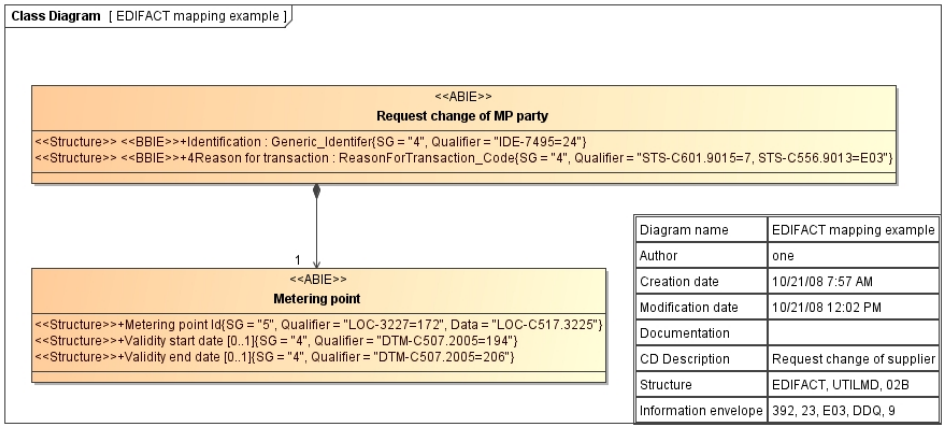


Figure 15 Example of mapping to EDIFACT

Questions and comments:

- The tag *Diagram name* is changed to *Information envelope* (*Diagram name* is used by MagicDraw)
- Should we move the *Structure* tag to the "Root class" instead of adding it to the "Diagram information box" (Stereotype <<RSM>> or <<MA>>)?
- In the example the EDIFACT characteristics are related to the stereotype <<*Structure*>> - Should we move them to <<*BBIE*>> instead?

~~8~~9 Table of figures

Appendix A ebIX projects

The ebIX modelling methodology is a further development (extension) of the methodology agreed between ebIX, ETSO and EFET and requires among others the use of UMM to describe the business processes in question. It is aimed at the creation of ebIX business collaboration models for defined business process areas, or parts of a business process area, within the energy market. It is a 9-step process with 5 key milestones that concludes with a business collaboration model and a set of translation guides, approved and posted to the ebIX web site for implementation.

This chapter should be reviewed by everyone:

- It is a mixture of project and modelling rules
- It's based on at harmonised model between ETSO and ebIX, but changed by ebIX
- Is it here from historical reasons?
- Deliverables from ebIX projects (user documentation)
    - How to structure?
    - Made for whom?
    - BRS/RSM?
    - Let the work groups decide?

A.1 The ebIX Modelling project outline

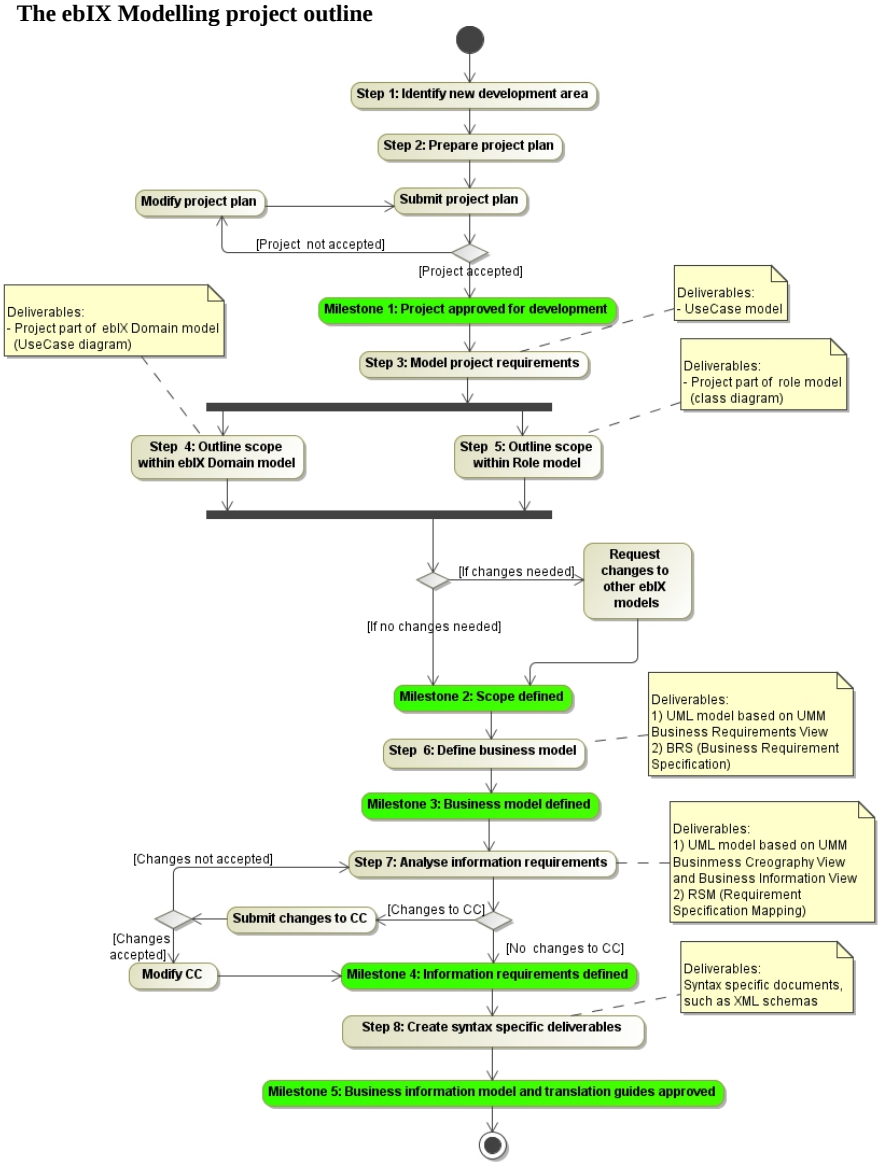


Figure 16 ebIX methodology outline

Each of the 8 steps can be resumed as follows:

1. Prior to any project development a *Business area*, or a *Process area* (part of a business area), for development has to be identified and approved. Any ebIX participating member may submit a development area for consideration. The submission method or content has not been formalised. It is the

knowledge within the evaluation team of business practises covering several countries that will determine the validity or not of setting up a project.

2. Once the development area is approved a project team is set up to prepare a detailed *project plan*. This plan once approved will form the basis of all future development work. It provides a perspective of the area that is to be covered and the expected deliverables. Once the project plan has been approved the ***first milestone of development*** has been reached. This is project management and should probably not be a part of the ebIX methodology.
3. Project development then begins and *UseCase diagrams* are produced which detail the project requirements.
4. The UseCase diagrams from step 3 must be compared with the relevant part of the *ebIX Domain model, [11],* to see if the UseCase diagrams are aligned. In the case where the *ebIX Domain model, [11]*, does not cover all the processes defined within the project a modification request is initialised in order to adjust the *ebIX Domain model, [11]*.
5. In the case where the role model does not cover all the roles or domains necessary to satisfy the project requirements a modification request is initialised in order to adjust the *Role model* once the business process development has confirmed their use.
   Once the project requirements have been scoped within the *Domain model* and the *Role model* the ***second milestone of development*** has been reached.
6. The business processes are then developed within the frame of the UMM *Business Requirement View* using *UseCase diagrams, activity diagrams,* and/or *state diagrams*. Through these diagrams the workflow of the business processes in question is developed. This process refines the project's scope. If additional roles or domains are identified, a maintenance request is submitted to the *Domain model [11]*or the *Harmonised role model, [9]*, maintenance group. The *Role model* and *Domain model* adjustments may be an iterative process and will continue until the project's scope has been successfully integrated into it. This process may additionally require modifications to the project requirements. The main deliverable from this activity is a *Business Requirement Specification* (BRS), which shall be in line with the UN/CEFACT BRS Documentation Template. The approval of the business processes signifies that the ***third milestone of development*** has been reached.
7. From the business processes and workflow diagrams, the required set of information requirements can be identified. Each business document identified between two roles that are determined as being a candidate for automation is modelled within the UMM *Business Choreography View* and the *Business Information View*. The business processes will be shown as *UseCase diagrams* and *Activity* diagrams, while the actual information exchanged will be presented using *class diagrams*. The *ebIX core components* are interrogated to make use of existing objects or core components. New core components are added to the repository if necessary. The approval of the collaboration model signifies that the ***fourth milestone of the development*** has been reached.
8. From the class diagrams syntax specific documents, such as XML schemas and EDIFACT guides are made. The main deliverable from this activity is a *Requirement Specification Mapping* (RSM), which shall be in line with the UN/CEFACT RSM Documentation Template and the layout key for ebIX documents. The approval of the syntax specific deleverables signifies that the ***fifth and final milestone of development*** has been reached. The approved business collaboration model is then inserted in the ebIX web site for implementation.

The requirements necessary to satisfy each of the milestones will be covered in more detail in the next chapters of this document. In relation to the UMM one can easily see that the *inception phase* which addresses the workflows of business modelling and requirements are covered by the first six milestones, and the *elaboration phase* which addresses the workflows of analysis and design are covered with the seventh milestone. The eight milestone is not addressed within the UMM.

A.2 Milestone requirements

A.2.1 Milestone 1. Project approved for development

This is project management and should probably not be a part of the ebIX methodology.

The initial phase of starting up an ebIX process is to prepare a *project plan*. A project plan can only be developed against an approved development area.

The project plan will contain the following:

1. Presentation of the project,
2. Outline of the goals and benefits
3. Explanation of how it is going to be organised,
4. Description of the deliverables,
5. Establishment of the initial timetable,
6. Declaration of needed resources,
7. Presentation of the development costs.

The presentation of the project will describe a single and complete business area, or process area. It will provide the framework for the future development.

The goals must be clearly stated and measurable.

The organisation of the project will identify a project leader and the team that is going to work on the project. The members of the team must have a commitment from their organisation that they, or their replacement, will follow the project through to completion.

The deliverables, which are generally one business collaboration model and a set of translation guides, will define what is to be expected when the project has been terminated.

The initial timetable will be built identifying the key development milestones. For example, the four milestones of development could be used as the principal milestones for the development of the deliverables. The milestones are not necessarily limited to those outlined in this methodology. However, the basic milestones must be outlined as a minimum.

If external consulting resources are to be used these should be identified here along with any travel costs that may be required. ebIX members finance the project through their time, where their expected contribution is over and above the normal time necessary for meeting preparation and meeting time then this should be identified.

The key deliverable of this milestone is the project plan, which has to receive official ebIX approval before the project itself can be launched. It is recommended that the approval process in question be identified in the project plan.

A.2.2 Milestone 2: Scope defined

The initial task of the project is to situate it within its general context and in more detail. Once the context has been defined through the development of *UseCases*, all the roles necessary to complete the task and the models placement within the ebIX Domain model will have been identified.

ebIX has together with ETSO/TF-EDI and EFET developed the *Harmonised role model*, [9], that is used to identify areas of interest and all the roles and domains necessary to satisfy them. This role model is a living model that outlines all the roles and domains with their principal interactions within the industry. It is consequently not necessary in the preparatory stages to spend a significant amount of time working on the overall business domain. This task is already catered for within the role model.

However, during the development of the project requirements it may happen that roles that have not previously been identified may appear. The project should prepare a maintenance request to change the role model. This request will be confirmed during the next development phase.

The key deliverables at this milestone is as follows:

- An outline of the project scope identifying all the roles and domains in the role model that will come into play in the project;
- A reference to where the model fits within the ebIX Domain model.
- The initial version UseCases describing the requirements and their explanatory text.
- An eventual revised version of the role model along with the maintenance requests outlining the revisions;

A.2.3 Milestone 3: Business process defined

The business process analysis stage builds on the UseCases that have been developed during the project requirements stage. It introduces *activity diagrams*, *state diagrams* and optionally *sequence diagrams* that show the interactions between the various roles. These are placed in the context of the UseCases previously defined.

The *UseCases* may be refined at this milestone, as more information becomes available. This provides clarification to more detailed points that are not necessary during a requirements development process. For example more detailed *UseCases* may be developed to show up particular contexts that are necessary in order to describe completely the business process in question.

However, if a *UseCase* described during the requirements step is completely put into question then it may be necessary to reiterate the requirements phase completely.

This stage of the methodology will also identify the workflow requirements for the business process. It will identify all the information flows (business documents) between the different roles that are necessary to satisfy the requirements. The relationships between the information flows will also be developed.

The need for any new *roles* or *domains* is confirmed and appropriate maintenance requests are submitted to the role model maintenance group. The role model maintenance process may immediately approve the new role or they may require clarification or suggest the use of another role. This is an iterative process that shall continue until the project has a satisfactory solution to the roles that it wishes to present in its project requirement and business collaboration models.

The key deliverables at this milestone are as follows:

- A *Business Requirement Specification* (BRS), made in accordance to the *UN/CEFACT BRS Documentation Template*, i.e.:
  - The finalised version of the business process UseCases and the associated explanatory test.
  - The activity diagrams and optional state diagrams and sequence diagrams, and associated text describing the interactions between the roles. This includes workflow requirements for the business process and business documents between roles necessary to satisfy the business requirements.
- If any, the finalised role model maintenance requests.

During this activity the first versions of the needed information should be made as simple class diagrams. Knowing the rough content of the business documents makes it easier for the project group to discuss the sequence and activity diagrams. Note that these class diagrams only are meant for helping the project group in defining the business processes. Final class diagrams, to be used for generating syntax specific information exchanges, will be developed in the next steps.

A.2.4 Milestone 4: Information requirements defined

The workflow of the business processes from the *UMM Business Requirements View* is elaborated in accordance to the requirements from the *UMM Business Choreography View*. The deliverables from the *UMM*

Business Choreography View is a business process model, which may be read and executed by electronic means (i.e. a software system).

All the business documents that have been identified will be further analysed to identify their content and documented according to requirements from the *UMM Business Information View* and the *UN/CEFACT Profile for Core Components* (UPCC). *Class diagrams* will be used for this purpose.

During this analysis the ebIX core components will be examined in order to determine whether or not existing objects or components will satisfy the requirements. If so, they will be introduced into the model. If a core component could satisfy the requirement with the adjustment of the definition then a maintenance request should be placed against the ebIX core components repository. Ask ETC (ebIX Technical Committee) for a new core component if an equivalent core component cannot be found. For certain core components there are associated code lists. Ask ETC for a code if a new code is required.

The key deliverable from this activity is a *Requirement Specification Mapping* (RSM), which shall be in line with the *UN/CEFACT RSM Documentation Template* and the layout key for ebIX documents.

A.2.5 Milestone 5: Business collaboration model and translation guides approved

ebIX project chooses which technologies to be used, e.g. XML, Web services or EDIFACT. The deliverables from this milestone will depend on the syntax chosen.

Appendix B ebIX MagicDraw CC/UMM profile

When working with the ebIX MagicDraw CC/UMM profile, one of the following projects should be opened:

- Measure.mdzip
- Operate.mdzip
- Plan.mdzip
- Structure.mdzip
- Settle.mdzip
- Trade.mdzip
- Harmonised role model.mdzip

Opening one of the above projects will automatically open the following profiles:

- UML_Standard_Profile.xml
- UMM Base Module Profile.mdzip
- Harmonised role model Profile.mdzip
- BCSS ebIX Profile.mdzip
- BCSS CEFACT Profile.mdzip
- UMM Profile.mdzip
- Generic Processes.mdzip
- Local Extensions The Netherlands.mdzip

And the following model:

- European Energy Market.mdzip

Alternatively, if you open the model European Energy Market.mdzip, all domain-projects will be opened automatically.

Appendix C Definitions and glossary

The following definitions are compatible with the current UMM and UN/CEFACT definitions.

Business collaboration:	An activity conducted between two or more parties for the purpose of achieving a specified outcome.
Business document:	Also named *Message.* A set of information components that are interchanged as part of a business activity. It is a set of information components used in one type of business transaction and exchanged between two or more roles. An occurrence of a business document may contain several instances of the same kind.
Business document type:	A business document type is defined by the type of business transaction where it is being used, the role responsible for the information in the business transaction, the direction of the information flow, the sector (electricity or gas) and the Business document function code. A business document type has a certain structure. The structure can however be enhanced or reduced dependent on the business sector (electricity or gas), the Ancillary-role (the role explicitly included in the header part of the document) and the "Reason for transaction" (i.e. in which business process the business transaction is used).
Business entity:	Something that is accessed, inspected, manipulated, produced, and worked on in the business.
Business Information Entity (BIE):	A piece of business data or a group of pieces of business data with a unique business semantic definition. A Business Information Entity can be a Basic Business Information Entity (BBIE), an Association Business Information Entity (ASBIE), or an Aggregate Business Information Entity (ABIE). A BIE is a Core Component, restricted for usage within a specific context. See also the definition of Core Components.
Business Collaboration model:	A model that references all meta-information associated with specific Business Processes or Process areas. The Business Collaboration model references Business Entities, Business Information Entities, and Business Information Objects to accomplish that task.
Business Object:	An unambiguously identified, specified, referenceable, registerable and re-useable scenario or scenario component of a business transaction. The term business object is used in two distinct but related ways, with slightly different meanings for each usage: • In a business model, business objects describe a business itself, and its business context. The business objects capture business concepts and express an abstract view of the business's "real world". The term "modelling business object" is used to designate this usage. • In a design for a software system or in program code, business objects reflects how business concepts are represented in software. The abstraction here reflects the transformation of business ideas into a software realization. The term "systems business objects" is used to designate this usage.
Business process:	The means by which one or more activities are accomplished in operating business practices. The Business Process as described using the UN/CEFACT Catalogue of Common Business Processes.
Business transaction:	A business transaction is a set of business information and business signal exchanges amongst *two* business partners that must occur in an agreed format, sequence and time period. A business transaction is a logical unit of business conducted by two parties that generates a computable success or failure state. The community, the partners, and the process, are all in a definable, and self-reliant state prior to the business transaction, and in a

	new definable, and self-reliant state after the business transaction. In other words if you are still 'waiting' for your business partner's response or reaction, the business transaction has not completed.
Business transaction pattern:	A business transaction pattern provides a language and grammar for constructing business transactions. The business transaction type follows one of the following six property-value conventions: 1. Commercial Transaction 2. Request/Confirm 3. Query/Response 4. Request/Response 5. Notification 6. Information Distribution
Core Components (CC):	A building block for the creation of a semantically correct and meaningful information exchange package. It contains only the information pieces necessary to describe a specific concept. There are four different categories of Core Components defined by UN/CEFACT/ebXML: *Basic Core Component (BCC):* A Core Component, which constitutes a singular business characteristic of a specific Aggregate Core Component that represents an Object Class. It has a unique Business Semantic definition. A Basic Core Component represents a Basic Core Component Property and is therefore of a Data Type, which defines its set of values. Basic Core Components function as the Properties of Aggregate Core Components. *Association Core Component (ASCC):* A Core Component, which constitutes a complex business characteristic of a specific Aggregate Core Component that, represents an Object Class. It has a unique Business Semantic definition. An Association Core Component represents an Association Core Component Property and is associated to an Aggregate Core Component, which describes its structure. *Core Component Type (CCT):* A Core Component, which consists of one and only one Content Component, that carries the actual content plus one or more Supplementary Components giving an essential extra definition to the Content Component. Core Component Types do not have Business Semantics. *Aggregate Core Component:* A collection of related pieces of business information that together convey a distinct business meaning, independent of any specific Business Context. Expressed in modelling terms, it is the representation of an Object Class, independent of any specific Business Context.
Implementation guide:	Within ebIX the term Implementation guide (IG) is used for a technical framework describing an EDIFACT message used in several business processes. E.g. UTILTS and UTILMD. In other organisations the term IG may be used slightly differently, e.g. within ETSO the term IG is used for documents describing a complete description of a business process, including the business collaboration model and translation guides.
Scenario:	A formal specification of a class of business activities having the same business goal.
Template:	A pattern, such as a part of a model, from which copies (reuse) can be made. A template may typically consist of parts of UML artefacts (e.g. activity and class diagrams). Examples of templates are the message header of a business document, the time series part of a business document containing metered data or a generic acknowledgment process.
Translation guide:	Document describing a business document, translated from a syntax

neutral class diagram into a specific syntax, such as XML or EDIFACT.

Appendix D Introduction to UN/CEFACT Modelling Methodology (UMM)

This appendix is an extract of the UMM documentation, which can be found at [1], UN/CEFACT Unified Modelling Methodology (UMM), version 2.0, see http://www.untmg.org/

D.1 Introduction to UMM

The basis for the ebIX Methodology is the UN/CEFCAT modelling Methodology. UN/CEFACT's Modelling Methodology (UMM) is a UML modelling approach to design the business services that each partner must provide in order to collaborate. It provides the business justification for the services to be implemented in a service oriented collaboration architecture. UMM focuses on developing a global choreography of inter organizational business processes and their information exchanges. UMM models are notated in UML syntax and are platform independent models. The platform independent UMM models identify which services need to be realized in a service oriented architecture, implementing the business collaboration. This approach provides insurance against technical obsolescence.

UMM consists of three views each covering a set of well defined artifacts:

- Business Requirements View (bRequirementsV)
- Business Choreography View (bChoreographyV)
- Business Interaction View (bInteractionV)

Constraints:

- A *Business Collaboration Model* MUST contain one *Business Choreography View* and one *Business Information View*
- A *Business Collaboration Model* CAN contain more than one *Business Requirements View*
- A *Business Collaboration Model* CAN contain more than one *Business Choreography View*
- A *Business Collaboration Model* CAN contain more than one *Business Information View*
- A *Business Requirements View*, a *Business Choreography View* and a *Business Information View* MUST be directly located under the root of the *Business Collaboration Model*

A UMM business collaboration model is a special kind of an UML model, based on the UML meta model. It provides a UML Profile consisting of stereotypes, tagged definitions and constraints. Stereotypes are used as a description of the type of UMM elements used and works as a placeholder for tagged values. The stereotypes are also used to show the organisation of the model and for transformation to syntax specific information exchanges.

D.2 Business Requirements View

The Business Requirements View is used to gather existing knowledge. It identifies the business processes in the domain and the business problems that are important to stakeholders. It is important at this stage that business processes are not constructed, but discovered. Stakeholders might describe intra organizational as well as organizational business processes. All of this takes place in the language of the business experts and stakeholders. The business requirements view results in a categorization of the business domain (manifested as a hierarchical structure of packages) and a set of relevant business processes (manifested as UseCase s). The result may be depicted in UseCase diagrams. In order to model the dynamics of each business process, one may use a Business Process Activity Model, or a Sequence Diagram, which would be placed beneath the Business Process UseCase . As a practical note, the Business Process Activity Model may depict a process or processes which involve one or more Business Partners. A Sequence Diagram will depict information exchanges between two or more Business Partners. The Business Partners are described within their own package (Business Partner View). A Business Process Activity Model may show state changes to Business Entities. Business Entities are "real world things" having business significance and are shared among the business partners involved in the collaboration. The Business Entities and their lifecycles of state changes are modelled in the Business Entity View. Furthermore, the Business Entity View also contains one or more packages which represent the conceptual data structures of the Business Entities.

Constraints

- A *Business Requirements View* MAY contain zero or one *Business Domain View* packages.
- A *Business Choreography View* MAY contain zero or one *Business Partner View* packages.
- A *Business Choreography View* MAY contain *Business Entity View* packages.

D.3 Business Partner View

A business partner is an organization type, an organizational unit type or a person type that participates in a business process. A *Business Partner View* must contain at least two *Business Partners*. A stakeholder is a person or representative of an organization who has a stake – a vested interest – in a certain business category or in the outcome of a business process. By definition, a business partner always has a vested interest in the business processes which they are participating in. Therefore, a *Business Partner* is a special type of a *Stakeholder*. In UML, specific relationships between Actors MAY be defined. The business partner view does not restrict the definition of those relationships between business partners and/or stakeholders. For example, generalizations between business partners MAY be defined.

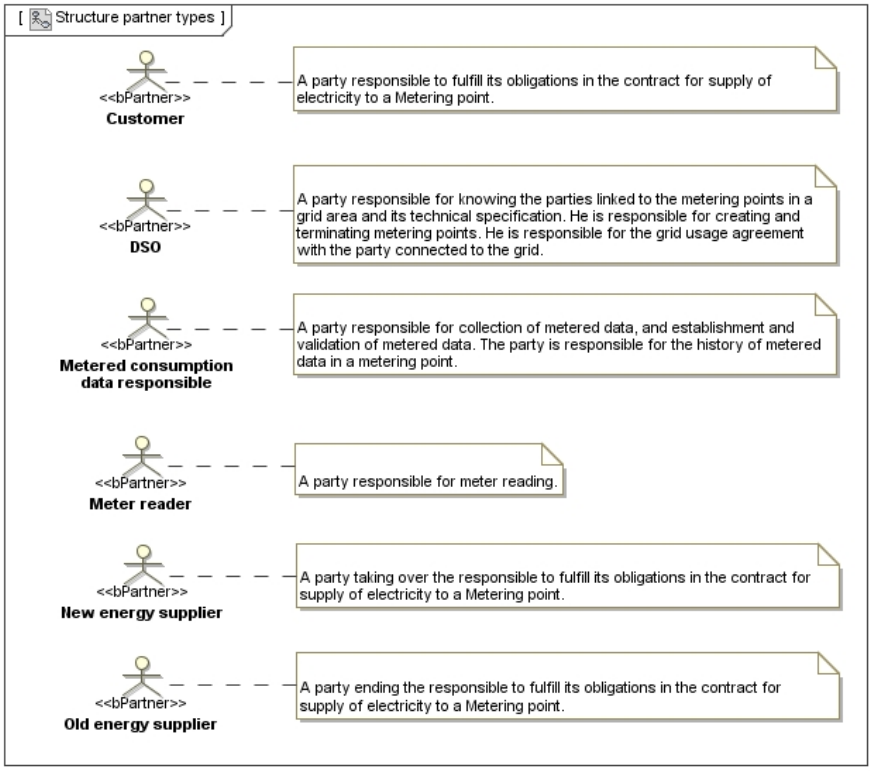


Figure 17 *Business Partners (example)*

Field Code Changed

Constraints:

- A *Business Partner View* SHOULD only contain *Business Partners* and *Stakeholders* and the relationships between them
- A *Business Partner View* MUST contain at least two *Business Partners*

D.4 Business Entity View

A business entity is a real-world thing having business significance that is shared between two or more business partners in a collaborative business process (e.g. “order”, “account”, etc.). Within the business entity view at least one, but possibly more business entities are described. Thus, the *Business Entity View* is composed of one to many *Business Entities*.

Constraints:

- The *Business Entity View* MUST contain only *Business Entities*
- A *Business Entity* has zero or one UML State Diagram that expresses its behavior
- A UML State Diagram describing the lifecycle of a *Business Entity* SHOULD only contain *Business Entity States*, *Pseudo States*, *Final States* or *Transitions*
- A Business Entity has zero or one Business Data View that describes its conceptual design
- Within a Business Data View UML Class Diagrams SHOULD be used

D.4.1 Business entity states

The lifecycle of a business entity MAY be described as a flow of business entity states. Depending on the importance of the business entity lifecycle, the lifecycle may or may not be included. A lifecycle is described using a UML State Diagram. The lifecycle represents the different business entity states a business entity can exist in. The lifecycle of a business entity consists of at least one business entity state. Therefore, the lifecycle of a business entity is composed of one or more *Business Entity States*.

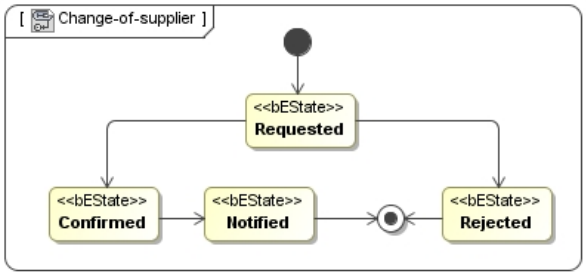


Figure 18 *Business Entity State Diagram (example)*

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D.4.2 Business Data Views

A business entity is a potential candidate for becoming a business document in later steps of the UMM. A business data view MAY be used to elaborate a first conceptual design of a business entity. Hence, a *Business Entity* is composed of zero to one *Business Data Views*. Within a business data view, A UML class diagram is used to describe the assembly of a business entity. Thus, a *Business Data View* contains one-to-many UML Class Diagrams.

D.5 Business Domain View

The business domain view is used to discover business processes UseCases that are of relevance in a project. A business process UseCase is executed by at least one (but possibly more) business partners. A business partner might execute multiple business process UseCase s.

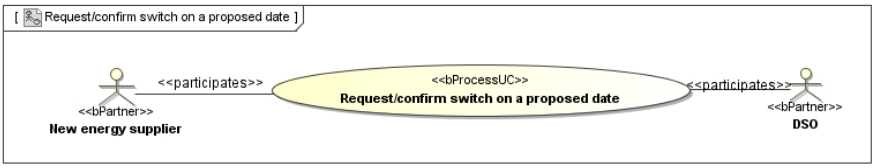

Figure 19 *Business Process UseCase (example)*

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A stakeholder might have interest in multiple business process UseCase s and a business process UseCase might be of interest to multiple stakeholders, but the stakeholder does not need to participate in the business process UseCase itself.

A business process can be decomposed into sub-processes using the «include» and «extends» association stereotypes.

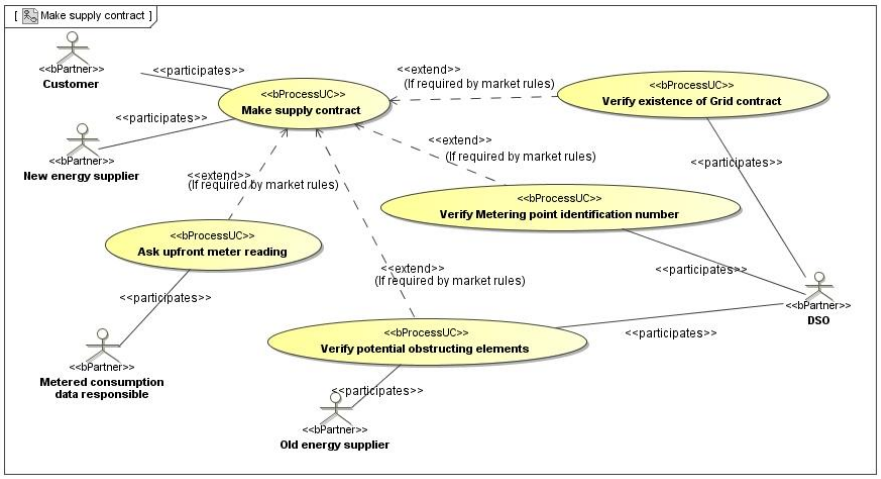

Figure 20 *Business Process UseCase with sub-processes (example)*

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To enable users to readily identify business process UseCase s, they should be classified into business categories. A business category is an abstract concept, which has two concrete specializations – business area and process area. A business area corresponds to a division of an organization and a process area corresponds to a set of common operations within the business area. A business area might be composed of other business areas.

A business process may also denote important states of business entities that are manipulated during the execution of a business process. A business entity state is the output from one business action and input to another business action. There is a transition from a business process action to a business entity state signalling an output as well as a transition from a business entity state to a business process action signalling an input. Some business entity states are meaningful to one business partner only. These are internal business entity states. Business entity states that must be communicated to a business partner are shared business entity states.

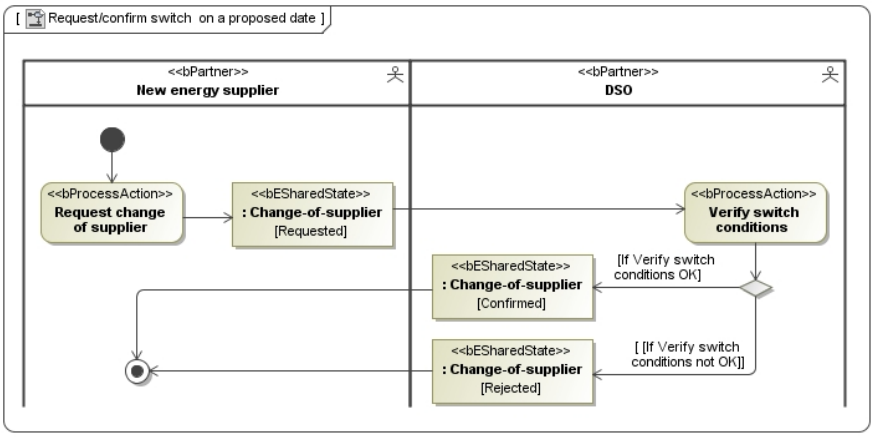

Figure 21 *Business Process Activity (example)*

Field Code Changed

Constraints:

- The *Business Domain View* package MUST include at least one *Business Area*.
- A *Business Area* package MUST include one or more *Business Area* packages or one or more *Process Area* packages or one or more *Business Process UseCases*.
- A *Process Area* MUST contain one or more other *Process Areas* or at least one *Business Process*
- *Business Partners* MUST be connected with *Business Process UseCases* using the *participates* relationship
- *Stakeholders* MUST be connected with *Business Process UseCases* using the *isOfInterestTo* relationship
- A *Business Process UseCase* SHOULD be refined by a *Business Process*
- A *Business Process*, which has no *Activity Partitions*, MUST contain one or more *Business Process Actions* and MAY contain *Internal Business Entity States or Shared Business Entity States*.
- An *Activity Partition* being part of a *Business Process* MUST contain one or more *Business Process Actions* and MAY contain *Internal Business Entity States.*

D.6 Business Choreography View,

The *Business Choreography View* is the second out of the 3 views of a UMM compliant business collaboration model. The business choreography view describes the view how the business analyst sees the process to be modelled. The requirements captured in the business requirements view serve as a basis for the definition of a choreography of information exchanges. The business choreography view is a container for three different artefacts that together describe the overall choreography of information exchanges.

Constraints:

- A *Business Choreography View* MUST contain at least one Business *Collaboration View* package.
- A *Business Choreography View* MUST contain at least one *Business Transaction View* package.
- A *Business Choreography View* MAY contain *Business Realization View* packages.

D.7 Business Transaction View

A *Business Transaction View* is a container for artefacts that define a choreography leading to synchronized states of business entities at both sides of the interaction. In fact, a business transaction view captures two

different artefacts that define the business transaction. First, the business analyst defines concrete requirements specifying the business transaction on a more general level by using business transaction UseCases.

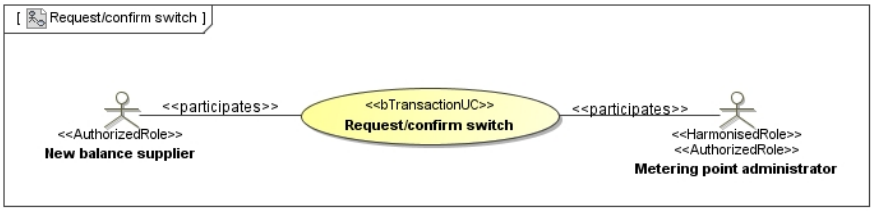

Figure 22 *Business Transaction UseCase (example)*

Second, he defines the flow of information exchanges in accordance to the requirements specified in this container.

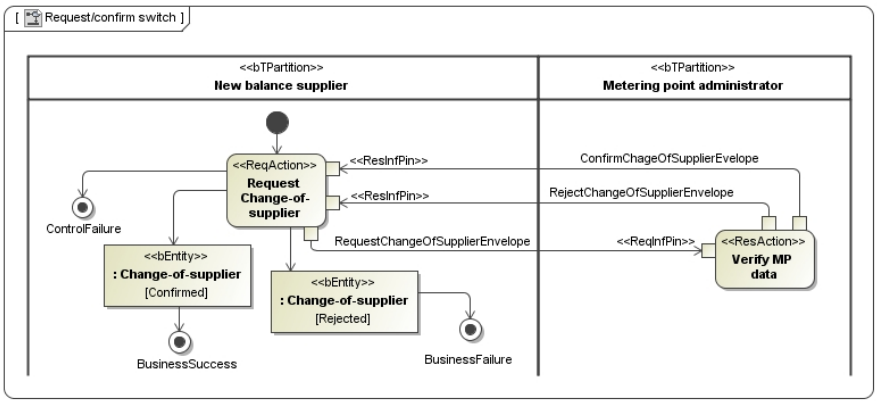

Figure 23 *Business Transaction Activity (example)*

Constraints:

- The *Business Transaction View* MUST contain exactly one *Business Transaction UseCase*, exactly two *Authorized Roles*, and exactly two *participates* associations.
- A *Business Transaction UseCase* MUST be associated with exactly two *Authorized Roles* via stereotyped binary *participate* associations.
- A *Business Transaction UseCase* MUST not include further *UseCases.*
- A *Business Transaction UseCase* MUST be included in at least one *Business Collaboration UseCase.*
- A *Business Transaction UseCase* MUST not be source or target of an extend association.
- *Authorized Roles* in a *Business Transaction View* must have a unique name within the scope of the package, they are located in.
- A *Business Transaction UseCase* MUST be described by exactly one *Business Transaction* defined as a child element of the *Business Transaction UseCase.*
- A *Business Transaction* MUST have exactly two partitions. Each of them MUST be stereotyped as *Business Transaction Partition*. One partition MUST contain the *Requesting Business Action* and one MUST contain the *Responding Business Action.*

- A *Business Transaction Partition* MUST have a classifier, which MUST be one of the associated *Authorized Roles* of the corresponding *Business Transaction UseCase.*
- The *Business Transaction Partition* of the requesting authorized role must contain exactly one *Requesting Business Action*, one *Requesting Information Pin* and one *Initial State*. Furthermore there MUST be at least two *Final States* in this *Business Transaction Swim lane*. Each of the *Final States* MAY have a *Business Entity Shared State* as predecessor. One of the *Final States* SHOULD reflect a *Control Failure* – this *Final State* SHOULD not have a predecessing *Business Entity Shared State*.
- If the transaction is a two-way business transaction, then the partition of the requesting authorized role MUST contain one-to-many *Responding Information Pins*.
- The *Business Transaction Partition* of the responding authorized role MUST contain exactly one *Responding Business Action* and one *Requesting Information Pin*. If the transaction is a two-way business transaction, then the partition must contain one-to-many *Responding Information Pins* as well. Otherwise, it is a one-way business transaction and the responder partition must not contain a *Responding Information Pin*.
- A *Requesting Business Action* MUST embed exactly one *Requesting Information Pin* and zero-to-many *Responding Information Pins.*
- A *Responding Business Action* MUST embed exactly one *Requesting Information Pin* and zero-to-many *Responding Information Pins.*
- Exactly one *Transition* MUST lead from the *Requesting Information Pin* embedded in the *Requesting Business Action* to the *Requesting Information Pin* embedded in the *Responding Business Action.*
- Exactly one *Transition* MUST lead from each *Responding Information Pin* embedded in the *Responding Business Action* to exactly one *Responding Information Pin* embedded in the *Requesting Business Action* (only two way business transactions).
- Each *Requesting Information Pin* and each *Responding Information Pin* MUST either be source or target of exactly one *Transition*.
- One *Transition* MUST lead from the *Requesting Business Action* to each *Business Entity Shared State* and one T*ransition* MUST lead from each *Business Entity Shared State* to a *Final State.* If no *Business Entity Shared States* are used, one *Transition* MUST lead from the *Requesting Business Action* to each *Final State*.
- Each *Requesting Information Pin* and each *Responding Information Pin* MUST have a classifier, which MUST itself be a class and stereotyped as *Business Information* or as a child thereof.

D.7.1 States

A business transaction is the basic building block to define a choreography of a business collaboration between collaborating business partners. Communication in a business collaboration is about aligning the information systems of the business partners. Aligning the information systems means that all relevant business objects are in the same state in each information system. If a business partner recognizes an event that changes the state of a business object, it initiates a business transaction to synchronize with the collaborating business partner. It follows that a business transaction is an atomic unit that leads to a synchronized state in both information systems.

A UMM business transaction takes place between two authorized roles. Each role must implement its own business partner interface. It follows, that a UMM business transaction results in two state machines each describing a business partner interface.

The UMM is used to specify a contractual flow of business document exchanges that business partners will agree on. However, the flow as specified by UMM 1.0 requires human interpretation. This is due to the fact that there exist ambiguous interdependencies between the business documents, the business transactions and the business collaboration protocol. Business documents are exchanged leading to a business success or a business failure of a business transaction. However, the same business document type is used to signal a positive and a negative response. It is up to human interpretation how the business document content looks like for a positive response and how it looks like for a negative response. Furthermore, the flow among business transactions - which is specified by a business collaboration protocol - depends on the result of these

business transactions. Unfortunately, the transition guards between the business transactions do not require any formalism allowing traceability to the transaction results.

In order to overcome these limitations UMM 2.0 is extended by three concepts. Firstly, OCL invariants for a positive response as well as for a negative response are introduced. An incoming response document is checked against the OCL invariants to determine whether a business transaction succeeds or fails. Secondly, the concept of business entity states into business transactions is incorporate. This means if the positive invariant applies for a response document, the business entity manipulated by the business transaction is set to an explicitly named business entity state before reaching the successful end state. Similarly, accordance with the negative invariant results in another explicitly named business entity state before ending with a failure. Thirdly, these business entity states are checked in the guard conditions of the control flow of a business collaboration protocol by using the corresponding OCL function.

These UMM extensions lead to an unambiguous choreography that is understood by humans, but is also automatically processable by machines. This is a prerequisite to derive unambiguous platform specific protocols, such as a local choreography for each business partner in BPEL. The transformation of our UMM extension to BPEL is part of future work.

D.8 Business Collaboration View

The business collaboration view is a container for artefacts describing the flow of a complex business collaboration between business partner types that may involve many steps. Similar to the business transaction view, the *Business Collaboration View* captures two different artefacts as well. Once the business analyst has specified the concrete requirements for a business collaboration by using business collaboration UseCases, he is able to define the flow in accordance to the requirements defined in this container.

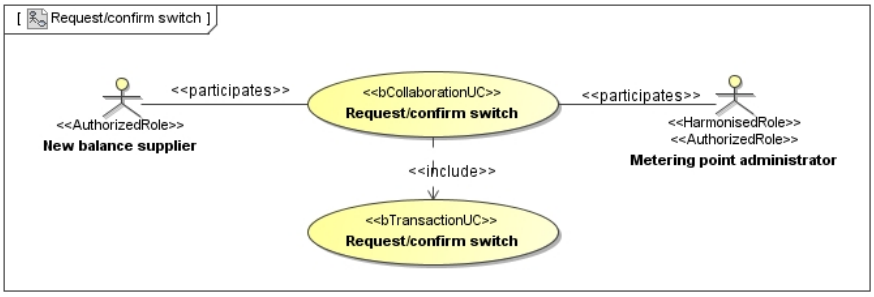

Figure 24 *Business Collaboration UseCase (example)*

Constraints:

- A *Business Collaboration View* MUST contain exactly one *Business Collaboration UseCase*.
- A *Business Collaboration View* MUST contain at least two *Authorized Roles*.
- A *Business Collaboration UseCase* MUST have at least two *participates* associations to *Authorized Roles* contained in the same *Business Collaboration View*.
- Each *Authorized Role* contained in the *Business Collaboration View* MUST have exactly one *participates* association to the *Business Collaboration UseCase* included in the same *Business Collaboration View*.
- An *Authorized Role* MUST not have more than one *participates* association leading to a *Business Collaboration UseCase*. (Note, different *Authorized Roles* with the same name may participate in different *Business Collaboration UseCases*).
- A *Business Collaboration UseCase* MUST have at least one include relationship to either another *Business Collaboration UseCase* or to a *Business Transaction UseCase*.

A B*usiness Collaboration View* is used to define the business choreography of exactly one business collaboration. This business choreography is specified by the concept of a *Business Collaboration Protocol*. The requirements of a *Business Collaboration Protocol* are captured by a *Business Collaboration UseCase*. Each *Business Collaboration UseCase* and its corresponding *Business Collaboration Protocol* are defined in their own business collaboration view package. Accordingly, the *Business Collaboration View* is composed of exactly one *Business Collaboration UseCase* and one *Business Collaboration Protocol*.

In UMM 2.0, role mapping between business collaboration authorized roles and either called business transaction authorized roles or business collaboration protocol authorized roles is defined in the business collaboration protocol. This role mapping is accomplished by information flows and specializations of information flows, i.e. *Initiating Flow* and *Responding Flow*, between either business collaboration partitions or nested collaborations and either business collaboration actions or business transaction actions. Using the approach also enhances the business collaboration protocol by graphically illustrating the relationships between authorized roles and the choreography of actions within a business collaboration protocol.

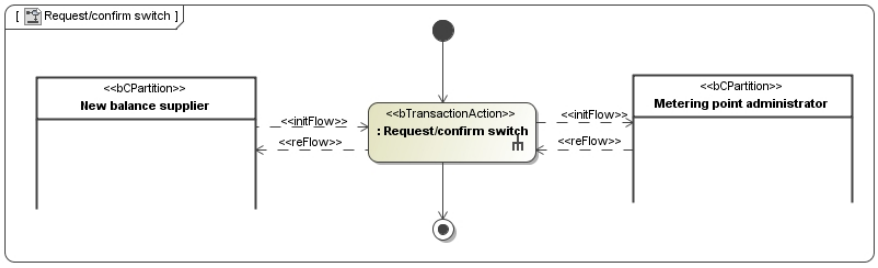

Figure 25 *Business Collaboration Protocol (example)*

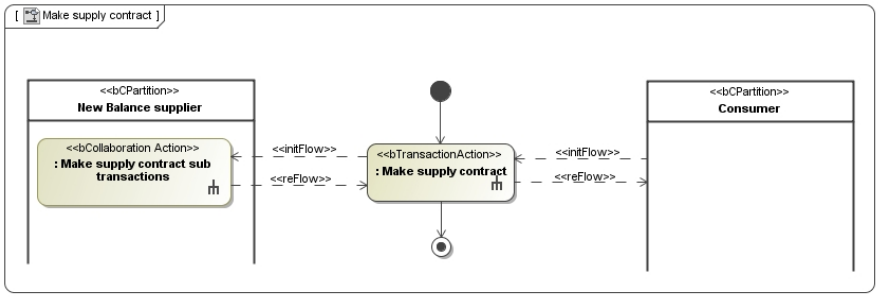

Figure 26 *Nested Business Collaboration Protocol (example)*

Constraints:

- Exactly one *Business Collaboration Protocol* MUST be placed beneath each *Business Collaboration UseCase*.
- A *Business Collaboration Protocol* MUST contain at least one *Business Transaction Action* or one *Business Collaboration Action*.
- Each *Business Transaction Action* MUST call exactly one Business Transaction
- Each *Business Transaction* called by a *Business Transaction Action* MUST be placed beneath a *Business Transaction UseCase* which is included in the *Business Collaboration UseCase* that covers the corresponding *Business Collaboration Protocol*.

- Each *Business Collaboration Protocol* called by a *Business Collaboration Action* MUST be placed beneath a *Business Collaboration Protocol UseCase* which is included in the *Business Collaboration UseCase* that covers the corresponding *Business Collaboration Protocol*.
- A *Business Collaboration Protocol* MUST contain at least two *Business Collaboration Partitions*.
- The number of *Authorized Roles* in the *Business Collaboration View* MUST match the number of *Business Collaboration Partitions* in the *Business Collaboration Protocol* which is placed beneath the *Business Collaboration UseCase* of the same *Business Collaboration View*.
- Each *Authorized Role* in the *Business Collaboration View* MUST be assigned to a *Business Collaboration Partition* in the *Business Collaboration Protocol* which is placed beneath the *Business Collaboration UseCase* of the same *Business Collaboration View*.
- Each *Business Collaboration Partition* MUST be classified by exactly one Authorized Role included in the same *Business Collaboration View* as the *Business Collaboration UseCase* covering the *Business Collaboration Protocol* containing this *Business Collaboration Partition*.
- A *Business Collaboration Partition* MUST be either empty or contain one or more *Nested Business Collaborations*.
- Each *Business Transaction Action* MUST be the target of exactly one *Initial Flow* which source MUST be a *Business Collaboration Partition*.
- Each *Business Transaction Action* MUST be the source of exactly one *Initial Flow* which target MUST be either a *Business Collaboration Partition* or a *Nested Business Collaboration*.
- The *Initial Flow* sourcing from a *Business Transaction Action* and the *Initial Flow* targeting a *Business Transaction Action* MUST NOT be targeting to, or sourcing from, the same *Business Collaboration Partition*, nor targeting to a *Nested Business Collaboration* within the *Business Collaboration Partition*.
- If a *Business Transaction Action* calls a two-way *Business Transaction*, this *Business Transaction Action* MUST be the source of exactly one *Responding Flow* which target MUST be a *Business Collaboration Partition*.
- If a *Business Transaction Action* calls a two-way *Business Transaction*, this *Business Transaction Action* MUST be the target of exactly one *Responding Flow* which source MUST be either a *Business Collaboration Partition* or a *Nested Business Collaboration*.
- The *Responding Flow* sourcing from a *Business Transaction Action* and the *Responding Flow* targeting a *Business Transaction Action* MUST NOT be targeting to /sourcing from the same *Business Collaboration Partition*, nor targeting to a *Nested Business Collaboration* within this*Business Collaboration Partition*.
- If a *Business Transaction Action* calls a one-way *Business Transacti*on, this *Business Transaction Action* MUST NOT be the source of a *Responding Flow* and MUST NOT be the target of a *Responding Flow*.
- The *Responding Flow* targeting a *Business Transaction Action* must start from the *Business Collaboration Partition* / *Nested Business Collaboration* which is the target of the *Initial Flow* starting from the same *Business Transaction Action*.
- The *Responding Flow* starting from a *Business Transaction Action* must target the *Business Collaboration Partition* which is the source of the *Initial Flow* targeting to the same *Business Transaction Action*.
- A *Nested Business Collaboration* MUST be the target of exactly one *Initial Flow*.
- A *Nested Business Collaboration* MAY be the source of a *Responding Flow*, but MUST NOT be the source of more than one *Responding Flow*.
- A *Business Collaboration Action* MUST be the target of two or more *Information Flows* UML standard: <<flow>>).
- A *Business Collaboration Action* MUST not be the source of an *Information Flow*.
- A *Business Collaboration Action* MUST not be the source and MUST not be the target of an *Initial Flow*.
- A *Business Collaboration Action* MUST not be the source and MUST not be the target of a *Responding Flow*.

- A *Business Transaction Action* MUST not be the source and MUST not be the target of an *Information Flow* (<<flow>>) that is neither stereotyped as *Initial Flow* nor as *Responding Flow*.
- A *Nested Business Collaboration* MUST not be the source and MUST not be the target of an *Information Flow* that targets to / sources from a *Business Collaboration Action*.
- The number of *Information Flows* targeting a *Business Collaboration Action* MUST match the number of *Business Collaboration Partitions* contained in the *Business Collaboration Protocol* that is called by this *Business Collaboration Action*.
- Either an *Authorized Role* classifying a *Business Collaboration Partition* that is the source of an *Information Flow* targeting a *Business Collaboration Action* MUST match an *Authorized Role* classifying a *Business Collaboration Partition* in the *Business Collaboration Protocol* that is called by this *Business Collaboration Action* or the *Information Flow* must be classified by an *Authorized Role* classifying a *Business Collaboration Partition* in the *Business Collaboration Protocol* that is called by this *Business Collaboration Action*.

D.9 Business Realization View

The *Collaboration Realization View* describes the realization of a business collaboration UseCase for a specific set of business partner types.

Business partners identified in the previous *Business Requirements View* must not directly be associated with business collaboration UseCase s and business transaction UseCase s. In order to specify that a specific set of business partners collaborate, we use the concept of a business realization. Each business realization is defined in its own business realization view. Accordingly, the *Business Realization View* is composed of exactly one *Business Realization*. A business realization realizes exactly one business collaboration UseCase . Each business collaboration UseCase may be realized by multiple business realizations. Not each business collaboration UseCase d (e.g. one that is nested within another one) needs to have a corresponding business realization.

Two or more authorized roles participate in a business realization. Usually, the names of the authorized roles participating in the business collaboration UseCase will be the names of the authorized roles in the business realization realizing it. However, the authorized roles participating in the business collaboration UseCase and the business realization will be defined in different namespaces. Furthermore, the number of actors participating in a business collaboration UseCase must be the same as the number of actors participating in the business realization realizing it.

In order to bind a business realization to the business partners executing it, business partners are mapped to the authorized roles participating in the business realization. It is required that each authorized role of a business realization (but not an authorized role in general) is target of exactly one *mapsTo* - association from a business partner. A business partner may play multiple authorized roles of a business realization.

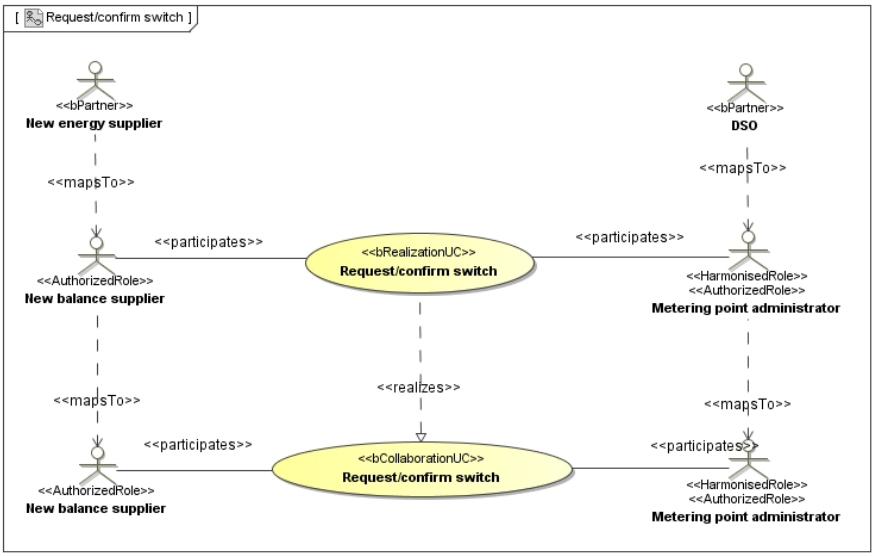

Figure 27 *Business Realization (example)*

Constraints (Business Realization View):

- A *Business Realization View* MUST contain exactly one *Business Realization*, at least two *Authorized Roles*, and at least two *participates* associations.

Constraints (Business Realization):

- *Business Realization* MUST be associated with two or more *Authorized Roles* via stereotyped binary *participates* associations.
- A *Business Realization* MUST be the source of exactly one realization dependency to a *Business Collaboration UseCase.*
- A *Business Realization* MUST NOT be the source or target of an include or extends association.

Constraints (Authorized Roles):

- All dependencies from/to an *Authorized Role* must be *mapsTo* dependencies.
- An *Authorized Role*, which participates in a *Business Realization*, must be the target of exactly one *mapsTo* dependency from a *Business Partner*. Furthermore the *Authorized Role*, which participates in the *Business Realization* must be the source of exactly one *mapsTo* dependency to targeting an *Authorized Role* participating in a *Business Collaboration UseCase*.
- *Authorized Roles* in a *Business Realization View* must have a unique name within the scope of the package, they are located in.

D.10 Business Information View

A *Business Information View* is a container of artefacts that describe the information exchanged in a *Business Transaction*. As previously mentioned; *Requesting Information Pin* and *Responding Information Pin* are classified by an *Information Envelope* which is a subclass of a *Business Information*. A *Business Information* serves as an abstract container for all of the information exchanged between the *Requesting Action* and the *Responding Action* or vice versa, respectively. The stereotypes *Business Information* and *Information Envelope* is part of the UMM base module and imported into the UMM foundation module.

The current UMM foundation module does not mandate a specific business information modelling approach. However, UMM strongly suggests using UN/CEFACT's Core Components and Core Components Message Assembly artefacts to model the business information. Because Core Components are syntax independent and stereotyped, the usage of the UML Profile for Core Components is suggested within the *Business Information View*.

Constraints:

- A *Business Information View* can contain *Information Envelopes* or any other document modelling artefacts.
- Any artefact that is used in order to set the type of a *Requesting Information Pin* or a *Responding Information Pin* in a *Business Transaction* MUST be of type *Information Envelope*.

D.11 PRIMLibrary

The package with the stereotype "PRIMLibrary" contains the fixed set of CEFACT primitive types as defined in the CCTS. The CEFACT primitive types are later on used to provide primitive types for the content components (CON) and supplementary components (SUP) of the core data types (CDT) and qualified data types (QDT) and are represented as UML classes with the stereotype "PRIM".

D.12 ENUMLibrary

The package with the stereotype "ENUMLibrary" contains the enumerations (code lists) that are used within the model. Enumerations may later on used to restrict the content component (CON) of qualified data types (QDT) and are represented as UML enumerations with the stereotype "ENUM".

D.13 CDTLibrary

The package with the stereotype "CDTLibrary" contains the fixed set of core component types as defined in the CCTS. The core component types are later on used to derive qualified data types (QDT) by restriction and are represented as UML classes with the stereotype "CDT" containing exactly one content component as a UML attribute with the stereotype "CON" and one to many supplementary components as UML attributes with the stereotype "SUP".

D.14 QDTLibrary

The package with the stereotype "QDTLibrary" contains the qualified data types (QDT) used within the model. The qualified data types are derived by restriction from CDTs and are represented as UML classes with the stereotype "QDT" containing exactly one content component as a UML attribute with the stereotype "CON" and zero to many supplementary components as UML attributes with the stereotype "SUP".

The fact that a QDT is derived from a CDT is represented as a UML dependency with stereotype *basedOn* between a QDT and a CDT. The name of a QDT contains the name of the CDT it is based on prefixed by zero to many semantic qualifiers separated with underscore as defined in the CCTS.

D.15 CCLibrary

The package with the stereotype "CCLibrary" contains aggregate core components represented as UML classed with stereotype "ACC" consisting of basic core components represented as UML attributes with stereotype "BCC" and association core components represented as UML compositions with stereotype "ASCC". Aggregate core components are generic information objects as defined in the CCTS. The aggregate core components (ACC) are later on used to derive aggregate business information entities (ABIE) by restriction. The name of a class with stereotype "ACC" is the object class term as defined in the CCTS while the names the attributes with stereotype "BCC" are the property terms and the target roles of compositions

with stereotype “ASCC” are the representation terms (not the dictionary entry names respectively). The types of the attributes with stereotype “BCC” are taken from the “CDTLibrary”.

D.16 BIELibrary

The package with the stereotype “BIELibrary” contains aggregate business information entities represented as UML classed with stereotype “ABIE” consisting of basic business information entities represented as UML attributes with stereotype “BBIE” and association business information entities represented as UML compositions with stereotype “ASBIE”. ABIEs are reusable information objects that are derived by restriction from ACCs. The fact that an ABIE is derived from an ACC is represented as a UML dependency with stereotype “basedOn” between an ABIE and an ACC. The names of ABIEs, BBIEs and ASBIEs contain the name of the respective ACC, BCC and ASCC they are based on prefixed by zero to many semantic qualifiers separated with underscore as defined in the CCTS.

Note that the classes with stereotype “ABIE” can be restricted by means of:

- restricted number of attributes (BBIEs) and compositions (ASBIEs),
- restricted multiplicity of attributes (BBIEs) and compositions (ASBIEs) and
- restricted data types using qualified data types (QDT) as restricted CDTs to type attributes (BBIEs).

D.17 DOCLibrary

The package with the stereotype “DOCLibrary” contains the business information assembled from reusable ABIEs as Root Schema Modules (RSM) to be exchanged in a given business scenario.

Business information from a “DOCLibrary” can be used as part of an UMM collaboration model within the *Business Information View*.

Appendix E Introduction to UML

This appendix is an extract of the OMG Unified Modeling Language (OMG UML), Superstructure, V2.1.2, which can be found at [13]. It gives an overview of the possibilities UML gives when modelling business processes within the energy industry and explains the artefacts used within ebIX models.

E.1 Terms and definitions

Actor:	An actor specifies a role played by a user or any other system that interacts with the subject. An actor is represented by "stick man" icon with the name of the actor in the vicinity (usually above or below) the icon.
Classifier:	A classifier is a classification of instances. It describes a set of instances that have features in common.
Guard:	A condition that must be satisfied in order to enable an associated transition to fire. In a simple transition with a guard, the guard is evaluated before the transition is triggered. In compound transitions involving multiple guards, all guards are evaluated before a transition is triggered, unless there are choice points along one or more of the paths. The order in which the guards are evaluated is not defined. If there are choice points in a compound transition, only guards that precede the choice point are evaluated according to the above rule. Guards downstream of a choice point are evaluated if and when the choice point is reached (using the same rule as above). In other words, for guard evaluation, a choice point has the same effect as a state.
Operation:	A service that can be requested from an object to effect behaviour. An operation has a signature, which may restrict the actual parameters that are possible.
Package:	A package is used to group elements, and provides a namespace for the grouped elements. A package can be contained in other packages.
State	A condition or situation during the life of an object during which it satisfies some condition, performs some activity, or waits for some event.
Transitions:	A relationship between two states indicating that an object in the first state will perform certain specified actions and enter the second state when a specified event occurs and specified conditions are satisfied. On such a change of state, the transition is said to fire.

E.2 UseCases and UseCase diagrams

UseCase Diagrams are a specialization of Class Diagrams such that the classifiers shown are restricted to being either Actors or UseCase s.

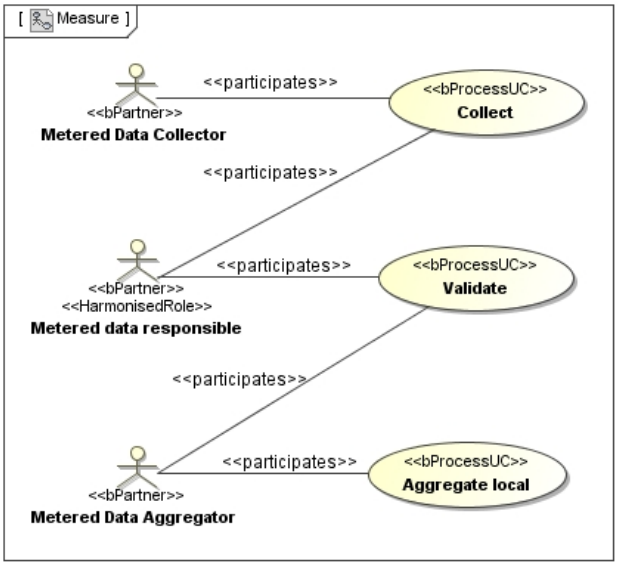

Figure 28 UseCase diagram

E.2.1 UseCase

UseCases are a means for specifying required usages of a system. Typically, they are used to capture the requirements of a system, that is, what a system is supposed to do. The key concepts associated UseCases are actors, UseCase s, and the subject. The subject is the system under consideration to which the UseCase s apply. The users and any other systems that may interact with the subject are represented as actors. Actors always model entities that are outside the system. The required behaviour of the subject is specified by one or more UseCase s, which are defined according to the needs of actors. Strictly speaking, the term “UseCase ” refers to a UseCase type. An instance of a UseCase refers to an occurrence of the emergent behaviour that conforms to the corresponding UseCase type. Such instances are often described by interaction specifications. UseCase s, actors, and systems are described using UseCase diagrams.

A UseCase is the specification of a set of actions performed by a system, which yields an observable result that is, typically, of value for one or more actors or other stakeholders of the system.

A UseCase is a kind of *behavioured classifier* that represents a declaration of an offered behaviour. Each UseCase specifies some behaviour, possibly including variants, that the subject can perform in collaboration with one or more actors. UseCase s define the offered behaviour of the subject without reference to its internal structure. These behaviours, involving interactions between the actor and the subject, may result in changes to the state of the subject and communications with its environment. A UseCase can include possible variations of its basic behaviour, including exceptional behaviour and error handling.

The subject of a UseCase could be a physical system or any other element that may have behaviour, such as a component, subsystem, or class. Each UseCase specifies a unit of useful functionality that the subject provides to its users (i.e., a specific way of interacting with the subject). This functionality, which is initiated by an

actor, must always be completed for the UseCase to complete. It is deemed complete if, after its execution, the subject will be in a state in which no further inputs or actions are expected and the UseCase can be initiated again or in an error state.

UseCase s can be used both for specification of the (external) requirements on a subject and for the specification of the functionality offered by a subject. Moreover, the UseCase s also state the requirements the specified subject poses on its environment by defining how they should interact with the subject so that it will be able to perform its services.

The behaviour of a UseCase can be described by a specification that is some kind of Behaviour (through its *owned Behaviour relationship*), such as interactions, activities, and state machines, or by pre-conditions and post-conditions as well as by natural language text where appropriate. It may also be described indirectly through a Collaboration that uses the UseCase and its actors as the classifiers that type its parts. Which of these techniques to use depends on the nature of the UseCase behaviour as well as on the intended reader. These descriptions can be combined.

E.2.2 Actor

An Actor models a type of role played by an entity that interacts with the subject (e.g., by exchanging signals and data), but which is *external* to the subject (i.e., in the sense that an instance of an actor is not a part of the instance of its corresponding subject). Actors may represent roles played by human users, external hardware, or other subjects. Note that an actor does not necessarily represent a specific physical entity but merely a particular facet (i.e., "role") of some entity that is relevant to the specification of its associated UseCase s. Thus, a single physical instance may play the role of several different actors and, conversely, a given actor may be played by multiple different instances. Since an actor is external to the subject, it is typically defined in the same classifier or package that incorporates the subject classifier.

Style Guidelines Actor names should follow the capitalization and punctuation guidelines used for classes in the model. The names of abstract actors should be shown in italics.

E.2.3 Extend relationship

There are four basic relationships that can be used within UseCase diagrams:

- Relationship between *Actors* and *UseCases*:
  - Association
- Relationship between *Actors*:
  - Generalisation
- Relationship between *UseCases*:
  - Include
  - Extend

E.2.3.1 Association

An association describes a set of tuples whose values refer to typed instances. An instance of an association is called a link.

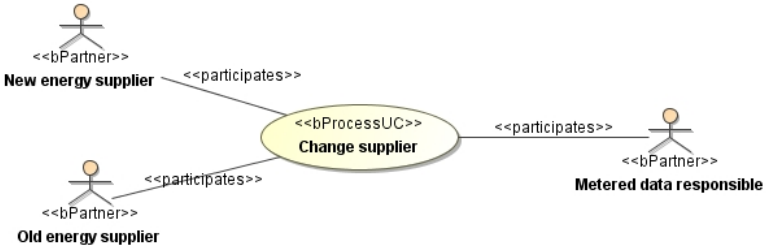

Figure 29 association

E.2.3.2 Generalisation

A generalization is a taxonomic relationship between a more general *classifier* (e.g. an *Actor*) and a more specific *classifier*. Each instance of the specific classifier is also an indirect instance of the general classifier. Thus, the specific classifier inherits the features of the more general classifier.

A generalization relates a specific classifier to a more general classifier, and is owned by the specific classifier.

A Generalization is shown as a line with a hollow triangle as an arrowhead between the symbols representing the involved classifiers. The arrowhead points to the symbol representing the general classifier.

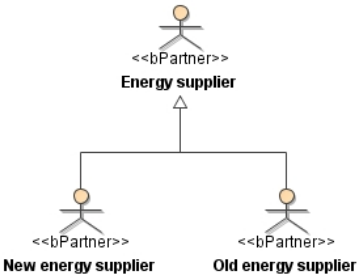

Figure 30 Generalisation

E.2.3.3 Extend relationship

A relationship from an *extending* UseCase to an *extended* UseCase that specifies how and when the behaviour defined in the extending UseCase can be inserted into the behaviour defined in the extended UseCase.

This relationship specifies that the behaviour of a UseCase may be extended by the behaviour of another (usually supplementary) UseCase. The extension takes place at one or more specific extension points defined in the extended UseCase. Note, however, that the extended UseCase is defined independently of the extending UseCase and is meaningful independently of the extending UseCase. On the other hand, the extending UseCase typically defines behaviour that may not necessarily be meaningful by itself. Instead, the extending UseCase defines a set of modular behaviour increments that augment an execution of the extended UseCase under specific conditions. Note that the same extending UseCase can extend more than one UseCase. Furthermore, an extending UseCase may itself be extended. It is a kind of *Directed Relationship*, such that the source is the extending UseCase and the destination is the extended UseCase. It is also a kind of *Named*

Element so that it can have a name in the context of its owning UseCase. The extend relationship itself is owned by the extending UseCase.

An extend relationship between UseCase s is shown by a dashed arrow with an open arrowhead from the UseCase providing the extension to the base UseCase . The arrow is labelled with the keyword «extend». The condition of the relationship as well as the references to the extension points are optionally shown in a Note attached to the corresponding extend relationship.

E.2.3.4 Include relationship

An include relationship defines that a UseCase contains the behaviour defined in another UseCase .

Include is a *Directed Relationship* between two UseCase s, implying that the behaviour of the included UseCase is inserted into the behaviour of the including UseCase . It is also a kind of *Named Element* so that it can have a name in the context of its owning UseCase . The including UseCase may only depend on the result (value) of the included UseCase . This value is obtained as a result of the execution of the included UseCase . Note that the included UseCase is not optional, and is always required for the including UseCase to execute correctly.

An include relationship between two UseCase s means that the behaviour defined in the including UseCase is included in the behaviour of the base UseCase . The include relationship is intended to be used when there are common parts of the behaviour of two or more UseCase s. This common part is then extracted to a separate UseCase , to be included by all the base UseCase s having this part in common. Since the primary use of the include relationship is for reuse of common parts, what is left in a base UseCase is usually not complete in itself but dependent on the included parts to be meaningful. This is reflected in the direction of the relationship, indicating that the base UseCase depends on the addition but not vice versa.

Execution of the included UseCase is analogous to a subroutine call. All of the behaviour of the included UseCase is executed at a single location in the included UseCase before execution of the including UseCase is resumed.

An include relationship between UseCase s is shown by a dashed arrow with an open arrowhead from the base UseCase to the included UseCase . The arrow is labelled with the keyword «include».

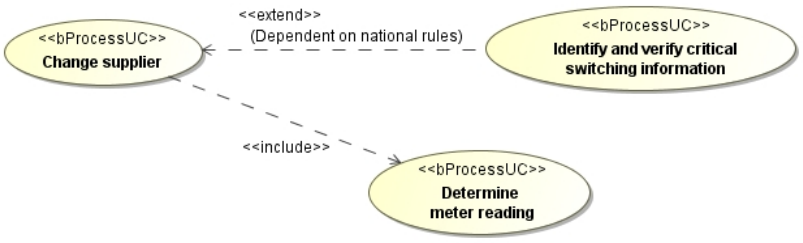

Figure 31 UseCase diagram with include and extend relations

E.3 Actions, Activities and Activity diagrams

The focus of activity modelling is the sequence and conditions for coordinating lower-level behaviours, rather than which classifiers own those behaviours. These are commonly called control flow and object flow models. The behaviours coordinated by these models can be initiated because other behaviours finish executing, because objects and data become available, or because events occur external to the flow

E.3.1 Activities

Activity modelling emphasizes the sequence and conditions for coordinating lower-level behaviours, rather than which classifiers own those behaviours. These are commonly called control flow and object flow models. The actions coordinated by activity models can be initiated because other actions finish executing, because objects and data become available, or because events occur external to the flow.

An *action execution* corresponds to the execution of a particular action. Similarly, an activity *execution* is the execution of an activity, ultimately including the executions of actions within it. Each action in an activity may execute zero, one, or more times for each activity execution. At the minimum, actions need access to data, they need to transform and test data, and actions may require sequencing. The activities specification (at the higher compliance levels) allows for several (logical) threads of control executing at once and synchronization mechanisms to ensure that activities execute in a specified order. Semantics based on concurrent execution can then be mapped easily into a distributed implementation. However, the fact that the UML allows for concurrently executing objects does not necessarily imply a distributed software structure. Some implementations may group together objects into a single task and execute sequentially - so long as the behaviour of the implementation conforms to the sequencing constraints of the specification.

There are potentially many ways of implementing the same specification, and any implementation that preserves the information content and behaviour of the specification is acceptable. Because the implementation can have a different structure from that of the specification, there is a mapping between the specification and its implementation. This mapping need not be one-to-one: an implementation need not even use object-orientation, or it might choose a different set of classes from the original specification.

The mapping may be carried out by hand by overlaying physical models of computers and tasks for implementation purposes, or the mapping could be carried out automatically. This specification neither provides the overlays, nor does it provide for code generation explicitly, but the specification makes both approaches possible.

An action represents a single step within an activity, that is, one that is not further decomposed within the activity. An activity represents a behaviour that is composed of individual elements that are actions. Note, however, that a call behaviour action may reference an activity definition, in which case the execution of the call action involves the execution of the referenced activity and its actions (similarly for all the invocation actions). An action is therefore simple from the point of view of the activity containing it, but may be complex in its effect and not be atomic. As a piece of structure within an activity model, it is a single discrete element; as a specification of behaviour to be performed, it may invoke referenced behaviour that is arbitrarily complex. As a consequence, an activity defines a behaviour that can be reused in many places, whereas an instance of an action is only used once at a particular point in an activity.

An action may have sets of incoming and outgoing activity edges that specify control flow and data flow from and to other nodes. An action will not begin execution until all of its input conditions are satisfied. The completion of the execution of an action may enable the execution of a set of successor nodes and actions that take their inputs from the outputs of the action.

An activity is the specification of parameterized behaviour as the coordinated sequencing of subordinate units whose individual elements are actions. There are actions that invoke activities (directly by "*CallBehaviorAction*" or indirectly as methods by "*CallOperationAction*".

E.3.2 Actions

An action is the fundamental unit of behaviour specification. An action takes a set of inputs and converts them into a set of outputs, though either or both sets may be empty. This clause defines semantics for a number of specialized actions, as described below. Some of the actions modify the state of the system in which the action executes. The values that are the inputs to an action may be described by value specifications, obtained from the output of actions that have one output (in *StructuredActions*), or in ways specific to the behaviours that use them. For example, the activity flow model supports providing inputs to actions from the outputs of other actions.

Actions are contained in behaviours, which provide their context. Behaviours provide constraints among actions to determine when they execute and what inputs they have. The Actions clause is concerned with the semantics of individual, primitive actions.

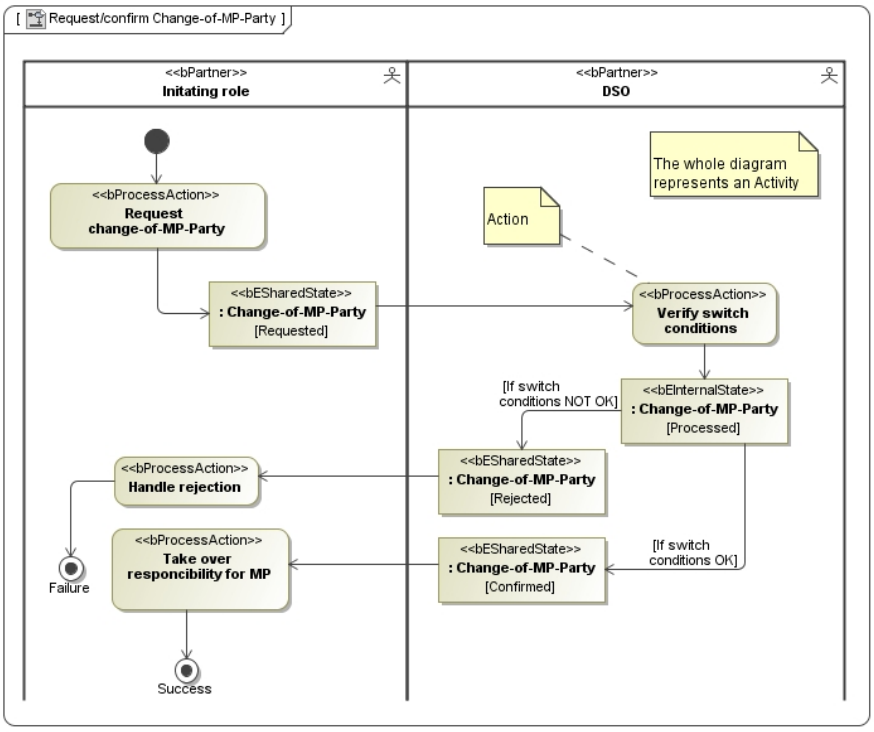

Figure 32 Activity with actions

E.3.3 OutputPin

An *output pin* is a pin that holds output values produced by an action.

E.3.4 ActionInputPin

An *action input pin* is a kind of pin that executes an action to determine the values to input to another.

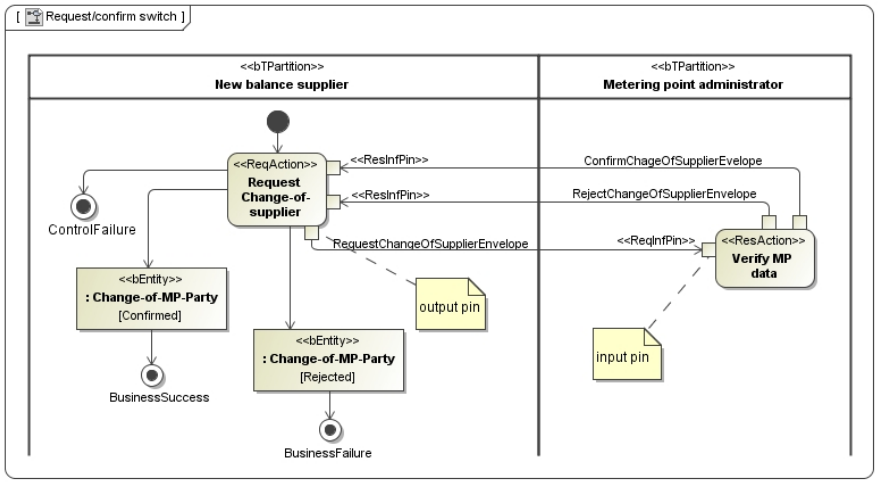

Figure 33 Actions with input pins and output pins

E.3.5 CallBehaviorAction

A *Call Behaviour Action* is a call action that invokes a behaviour directly rather than invoking a behavioural feature that, in turn, results in the invocation of that behaviour. The argument values of the action are available to the execution of the invoked behaviour. For synchronous calls the execution of the call behaviour action waits until the execution of the invoked behaviour completes and a result is returned on its output pin. The action completes immediately without a result, if the call is asynchronous.

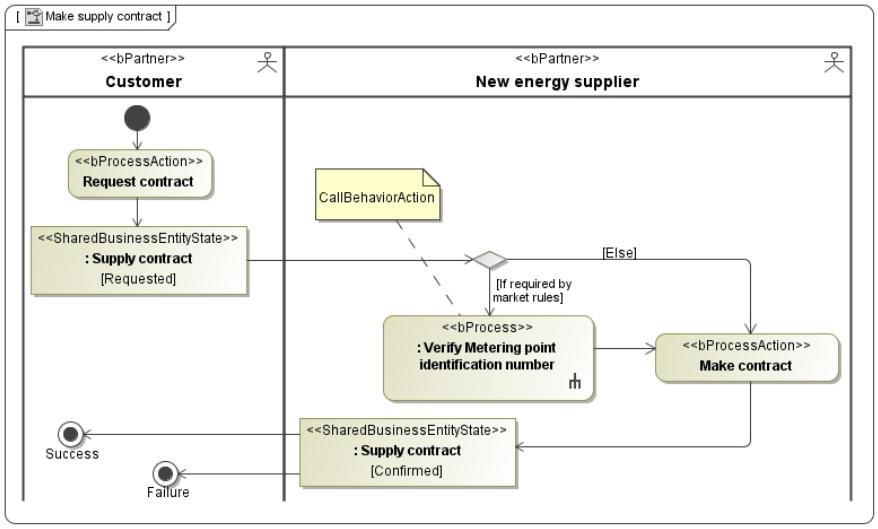

Figure 34 Call Behaviour Action

E.4 Classes and Class diagram

E.4.1 Classes

A class describes a set of objects that share the same specifications of features, constraints, and semantics.

Class is a kind of classifier whose features are attributes and operations. Attributes of a class are represented by instances of Property that are owned by the class. Some of these attributes may represent the navigable ends of binary associations.

The purpose of a class is to specify a classification of objects and to specify the features that characterize the structure and behaviour of those objects. Objects of a class must contain values for each attribute that is a member of that class, in accordance with the characteristics of the attribute, for example its type and multiplicity.

A class is often shown with three compartments. The middle compartment holds a list of attributes while the bottom compartment holds a list of operations. Additional compartments may be supplied to show other details, such as constraints, or to divide features.

Style Guidelines:

- Centre class name in boldface.
- Capitalize the first letter of class names
- Left justify attributes and operations in plain face.
- Begin attribute and operation names with a lowercase letter. Multi-word names are often formed by concatenating the words and using lowercase for all letters except for upcasing the first letter of each word but the first.
- Put the class name in italics if the class is abstract.
- Show full attributes and operations when needed and suppress them in other contexts or when merely referring to a class.

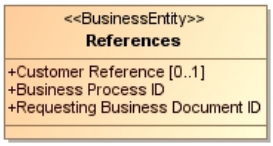

Figure 35 Class

E.4.1.1 Data types

A data type is a type whose instances are identified only by their value. A Data Type may contain attributes to support the modelling of structured data types. A typical use of data types would be to represent programming language primitive types. For example, integer and string types are often treated as data types.

A data type is a special kind of classifier, similar to a class. It differs from a class in that instances of a data type are identified only by their value. All copies of an instance of a data type and any instances of that data type with the same value are considered to be the same instance. Instances of a data type that have attributes (i.e., is a structured data type) are considered to be the same if the structure is the same and the values of the corresponding attributes are the same. If a data type has attributes, then instances of that data type will contain attribute values matching the attributes.

E.4.1.2 Enumeration

An enumeration is a data type whose values are enumerated in the model as enumeration literals. Enumeration is a kind of data type, whose instances may be any of a number of user-defined enumeration literals. It is possible to extend the set of applicable enumeration literals in other packages or profiles.

An enumeration may be shown using the classifier notation (a rectangle) with the keyword «enumeration». The name of the enumeration is placed in the upper compartment. A compartment listing the attributes for the enumeration is placed below the name compartment. A compartment listing the operations for the enumeration is placed below the attribute compartment. A list of enumeration literals may be placed, one to a line, in the bottom compartment. The attributes and operations compartments may be suppressed, and typically are suppressed if they would be empty.

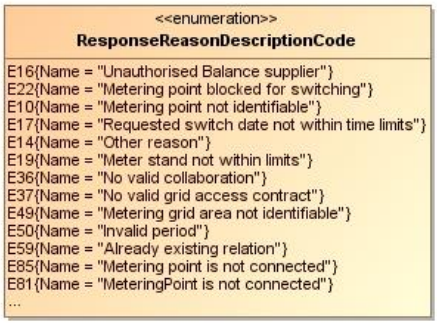

Figure 36 Enumeration

E.4.1.3 EnumerationLiteral

An enumeration literal is a user-defined data value for an enumeration.

An Enumeration Literal defines an element of the run-time extension of an enumeration data type. An Enumeration Literal has a name that can be used to identify it within its enumeration data type. The enumeration literal name is scoped within and must be unique within its enumeration. Enumeration literal names are not global and must be qualified for general use.

An Enumeration Literal is typically shown as a name, one to a line, in the compartment of the enumeration notation.

E.4.1.4 Types

A type constrains the values represented by a typed element. A type serves as a constraint on the range of values represented by a typed element. Type is an abstract metaclass.

E.4.2 Graphic paths

E.4.2.1 Associations

An association specifies a semantic relationship that can occur between typed instances. It has at least two ends represented by properties, each of which is connected to the type of the end. More than one end of the association may have the same type. An end property of an association that is owned by an end class or that is a navigable owned end of the association indicates that the association is navigable from the opposite ends; otherwise, the association is not navigable from the opposite ends.

A binary association is normally drawn as a solid line connecting two classifiers, or a solid line connecting a single classifier to itself (the two ends are distinct). A line may consist of one or more connected segments.

An association declares that there can be links between instances of the associated types. A link is a tuple with one value for each end of the association, where each value is an instance of the type of the end.

When one or more ends of the association are ordered, links carry ordering information in addition to their end values.

Navigability means instances participating in links at runtime (instances of an association) can be accessed efficiently from instances participating in links at the other ends of the association. The precise mechanism by which such access is achieved is implementation specific. If an end is not navigable, access from the other ends may or may not be possible. An open arrowhead on the end of an association indicates the end is navigable.

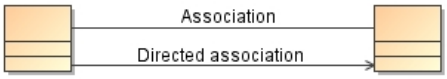

Figure 37 Associations

An association end is the connection between the line depicting an association and the icon (often a box) depicting the connected classifier. A name string may be placed near the end of the line to show the name of the association end. The name is optional and suppressible. Various other notations can be placed near the end of the line as follows:

- A multiplicity
- A property string enclosed in curly braces, e.g. {sequence} to show that the end represents a sequence (an ordered bag).

Note that by default an association end represents a set.

An association may represent a *composite aggregation* (i.e., a whole/part relationship). Only binary associations can be aggregations. *Composite aggregation* is a strong form of aggregation that requires a part instance be included in at most one composite at a time. If a composite is deleted, all of its parts are normally deleted with it.

An association with *aggregationKind = shared* differs in notation from binary associations in adding a hollow diamond as a terminal adornment at the aggregate end of the association line. An association with *aggregationKind = composite* likewise has a diamond at the aggregate end, but differs in having the diamond filled in.

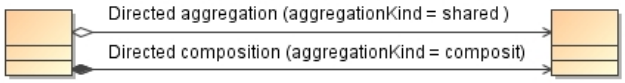

Figure 38 Compositions and Aggregations

E.4.2.2 Association Class

An Association Class is a model element that has both association and class properties. An *Association Class* can be seen as an association that also has class properties, or as a class that also has association

properties. It not only connects a set of classifiers but also defines a set of features that belong to the relationship itself and not to any of the classifiers.

An association may be refined to have its own set of features; that is, features that do not belong to any of the connected classifiers but rather to the association itself. Such an association is called an association class. It will be both an association, connecting a set of classifiers and a class, and as such have features and be included in other associations. The semantics of an association class is a combination of the semantics of an ordinary association and of a class.

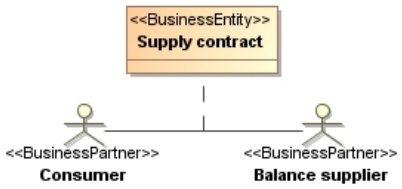

Figure 39 Association class

E.4.2.3 Multiplicity Element

A multiplicity is a definition of an inclusive interval of non-negative integers beginning with a lower bound and ending with a (possibly infinite) upper bound. A multiplicity element embeds this information to specify the allowable cardinalities for an instantiation of this element. A *Multiplicity Element* also includes specifications of whether the values in an instantiation of this element must be unique or ordered.

A multiplicity defines a set of integers that define valid cardinalities. Specifically, cardinality C is valid for multiplicity M if M includes Cardinality(C). A multiplicity is specified as an interval of integers starting with the lower bound and ending with the (possibly infinite) upper bound. If the *Multiplicity Element* is specified as ordered (i.e., isOrdered is true), then the collection of values in an instantiation of this element is ordered. This ordering implies that there is a mapping from positive integers to the elements of the collection of values.

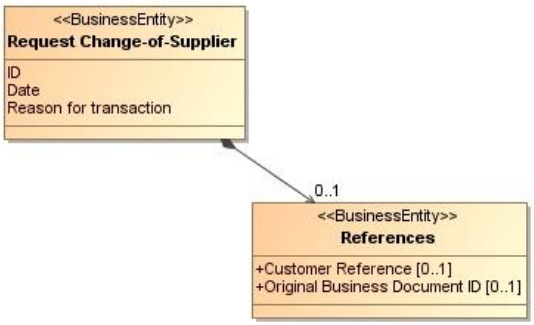

Figure 40 Multiplicity

E.4.2.4 Dependency

A dependency is a relationship that signifies that a single or a set of model elements requires other model elements for their specification or implementation. This means that the complete semantics of the depending elements is either semantically or structurally dependent on the definition of the supplier element(s).

A dependency signifies a supplier/client relationship between model elements where the modification of the supplier may impact the client model elements. A dependency implies the semantics of the client is not complete without the supplier. The presence of dependency relationships in a model does not have any runtime semantics implications, it is all given in terms of the model-elements that participate in the relationship, not in terms of their instances.

A dependency is shown as a dashed arrow between two model elements. The model element at the tail of the arrow (the client) depends on the model element at the arrowhead (the supplier). The arrow may be labeled with an optional stereotype and an optional name. It is possible to have a set of elements for the client or supplier. In this case, one or more arrows with their tails on the clients are connected to the tails of one or more arrows with their heads on the suppliers.

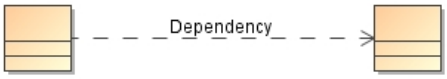

Figure 41 Dependency

E.4.2.5 Generalization

A generalization is a taxonomic relationship between a more general classifier and a more specific classifier. Each instance of the specific classifier is also an indirect instance of the general classifier. Thus, the specific classifier inherits the features of the more general classifier.

Any constraint applying to instances of the general classifier also applies to instances of the specific classifier.

The generalization Set associates those instances of a Generalization with a particular Generalization Set. For example, one Generalization could relate Person as a general Classifier with a Female Person as the specific Classifier. Another Generalization could also relate Person as a general Classifier, but have Male Person as the specific Classifier. These two Generalizations could be associated with the same Generalization Set, because they specify one way of partitioning the Person class.

A Generalization is shown as a line with a hollow triangle as an arrowhead between the symbols representing the involved classifiers. The arrowhead points to the symbol representing the general classifier. When these relationships are named, that name designates the *Generalization Set* to which the Generalization belongs. Each *Generalization Set* has a name (which it inherits since it is a subclass of *Packageable Element*). Therefore, all Generalization relationships with the same *Generalization Set* name are part of the same *Generalization Set*. When two or more lines are drawn to the same arrowhead, the specific Classifiers are part of the same *Generalization Set*. When diagrammed in this way, the lines do not need to be labelled separately; instead the generalization set need only be labelled once. The labels are optional because the *Generalization Set* is clearly designated.

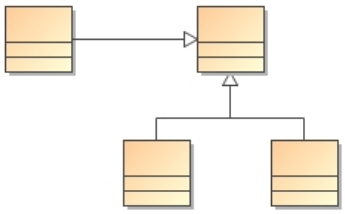

Figure 42 Generalisation

E.4.3 Realization

Realization is a specialized abstraction relationship between two sets of model elements, one representing a specification (the supplier) and the other represents an implementation of the latter (the client). Realization can be used to model stepwise refinement, optimizations, transformations, templates, model synthesis, framework composition, etc.

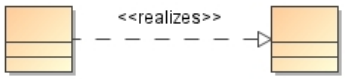

Figure 43 Realisation

E.4.4 UN/CEFACT rules for message diagrams

The following rules apply when making class diagrams for messages (*Canonical model*) based on the UN/CEFACT Requirements Specification Mapping (RSM).

- All classes shall be normalized. That is to say:
  1. An attribute shall represent a single piece of information
  2. An attribute shall appear only once (i.e. it cannot be repeated)
  3. An attribute shall have a distinct name
  4. Each instance of a class must be uniquely identifiable
  5. There is no positional dependence between the attributes
  6. All attributes contribute to the definition of the class
- The only relationship permitted in a UMM compliant class diagram is a composite aggregation. All compositions shall be unidirectional (directed composition).
- Target association end names shall be used.
- The multiplicity of an attribute is only used to indicate a conditional attribute with the convention [0..1] that immediately follows the attribute name.
- The multiplicity of an association shall only appear at the target end of the association.
- An attribute shall use a core components data type
- Only XOR constraints are allowed between associations.
- Enumerations shall be used to identify code lists. In the *canonical model* an enumeration shall be used to identify a restriction on a generic code list.
- No association classes or association names are permitted in the *canonical model*

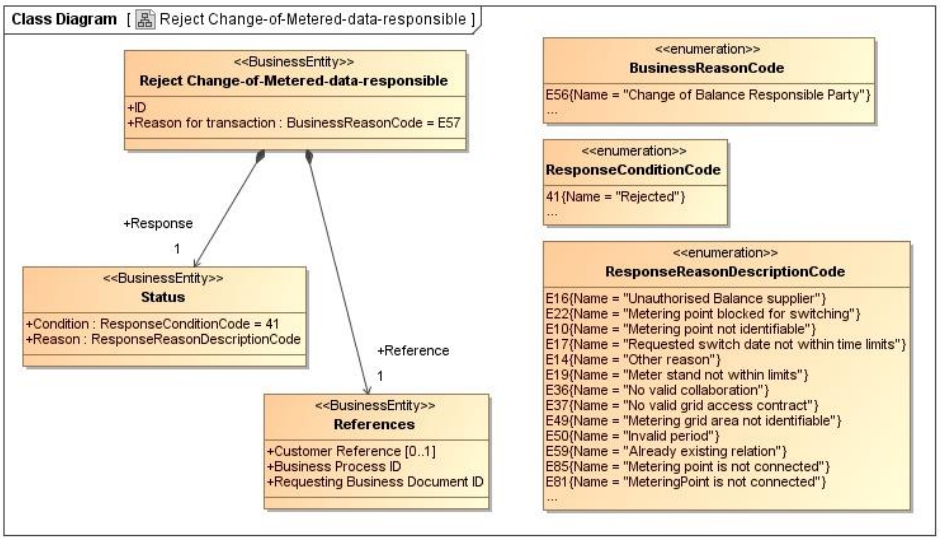

Figure 44 Example of class diagram

E.5 States

The usage of states within ebIX models are under discussion not yet be used.

E.5.1 StateMachine

The StateMachine package defines a set of concepts that can be used for modelling discrete behaviour through finite state-transition systems. In addition to expressing the behaviour of a part of the system, state machines can also be used to express the usage protocol of part of a system. These two kinds of state machines are referred to here as *behavioural state machines* and *protocol state machines*.

Behavioural state machines

State machines can be used to specify behaviour of various model elements. For example, they can be used to model the behaviour of individual entities (e.g., class instances). The state machine formalism described in this sub clause is an object-based variant of Harel statecharts.

Protocol State machines

Protocol state machines are used to express usage protocols. Protocol state machines express the legal transitions that a classifier can trigger. The state machine notation is a convenient way to define a lifecycle for objects, or an order of the invocation of its operation. Because protocol state machines do not preclude any specific behavioural implementation, and enforces legal usage scenarios of classifiers, interfaces, and ports can be associated to this kind of state machines.

E.5.2 Protocol state machine

A *protocol state machine* is always defined in the context of a classifier. It specifies which operations of the classifier can be called in which state and under which condition, thus specifying the allowed call sequences on the classifier's operations. A protocol state machine presents the possible and permitted transitions on the instances of its context classifier, together with the operations that carry the transitions. In this manner, an instance lifecycle can be created for a classifier, by specifying the order in which the operations can be activated and the states through which an instance progresses during its existence.

The states of a protocol state machine (protocol states) present an external view of the class that is exposed to its clients. Depending on the context, protocol states can correspond to the internal states of the instances as expressed by behavioural state machines, or they can be different.

A protocol state machine expresses parts of the constraints that can be formulated for pre- and post-conditions on operations. The translation from protocol state machine to pre- and post-conditions on operations might not be straightforward, because the conditions would need to account for the operation call history on the instance, which may or may not be directly represented by its internal states. A protocol state machine provides a direct model of the state of interaction with the instance, so that constraints on interaction are more easily expressed.

The protocol state machine defines all allowed transitions for each operation. The protocol state machine must represent all operations that can generate a given change of state for a class. Those operations that do not generate a transition are not represented in the protocol state machine.

Protocol state machines constitute a means to formalize the interface of classes, and do not express anything except consistency rules for the implementation or dynamics of classes.

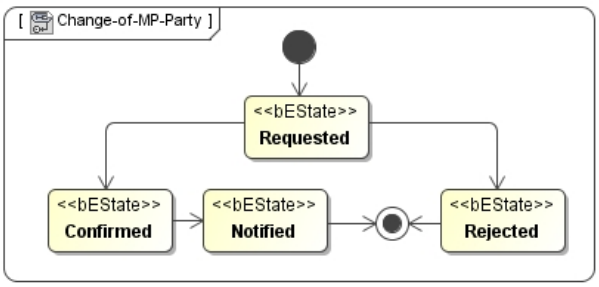

Figure 45 Protocol state machine

E.5.3 ObjectNode

An object node is an abstract activity node that is part of defining object flow in an activity.

An object node is an activity node that indicates an instance of a particular classifier, *possibly in a particular state*, may be available at a particular point in the activity. Object nodes can be used in a variety of ways, depending on where objects are flowing from and to, as described in the semantics sub clause.

Object nodes may only contain values at runtime that conform to the type of the object node, in the state or states specified, if any. If no type is specified, then the values may be of any type. Multiple tokens containing the same value may reside in the object node at the same time. This includes data values. A token in an object node can traverse only one of the outgoing edges.

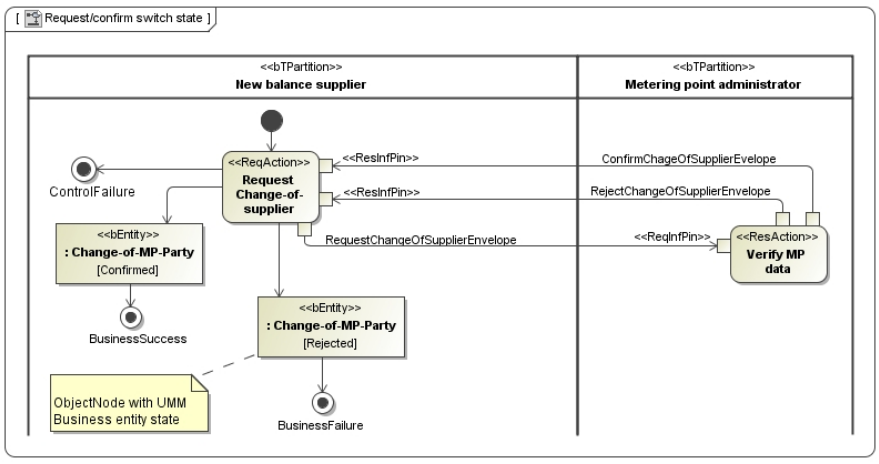

Figure 46 Object nodes with states