

<b>1</b>	<b>INTRODUCTION.....</b>	<b>1</b>
1.1	WHY UN/CEFACT MODELING METHODOLOGY? .....	1
1.1.1	Scope.....	2
1.1.2	Vision.....	3
1.2	AUDIENCE.....	3
1.3	THE RELATIONSHIP OF PROJECTS: OPEN-EDI, UML, UNIFIED PROCESS, BUSINESS COLLABORATION FRAMEWORK, AND UMM .....	3
1.4	UN/CEFACT MODELLING METHODOLOGY PHASES AND PROJECT WORKFLOWS .....	4
1.5	UN/CEFACT MODELING METHODOLOGY (UMM) .....	8
1.6	UN/CEFACT MODELLING METHODOLOGY METAMODEL .....	9
1.7	UMM META-MODEL ARCHITECTURE.....	12
1.8	UN/CEFACT MODELLING METHODOLOGY PATTERNS .....	14
1.9	REQUIREMENTS, GLOSSARY AND TRACEABILITY.....	15
1.10	DOCUMENT STRUCTURE.....	16

## 1 Introduction

### 1.1 Why UN/CEFACT Modeling Methodology?

Historically, the definition of information constructs to support information exchange between business and individuals has been tightly tied to the business process they support and the technology syntax used to describe them. This has hampered the migration of existing, working inter-organization information exchanges to new technologies. In the historic methodologies the syntax is so tightly intertwined with the business semantics that it is not easy to retain the semantics (and business knowledge from which they derived) as one attempts to move to new syntaxes such as XML or Objects. To this end, this document describes a method and supporting components to capture business process knowledge, independent of the underlying implemented technology so that the business acumen is retained and usable over generations of implemented technology. Additionally, the UN/CEFACT Modelling Methodology implements processes that help insure predictable results from a software project.

This document describes the UN/CEFACT Modelling Methodology (UMM) that should be adopted by UN/CEFACT to model Business Processes and support the development of existing and "Next Generation" EDI for electronic business. The UMM business process and information modeling technique is based on the Unified Modelling Language (UML) from the Open Management Group (OMG). The UMM methodology is based on configuring the Unified Process methodology developed by the [Rational Corporation](#) to meet UN/CEFACT needs for modelling business processes in addition to objects. This requires extensions of the UML *MetaModel* through business domain specific *stereotyping* to support a complete business process and information definition, resulting objects and interface-specific object behavior descriptions. Focusing on technology and protocol independent steps of the normal software engineering process, the UMM metamodel facilitates the specification of reusable, reproducible process models that are technology and protocol insensitive.

While the UMM is used by business domain experts and business process analysts to describe individual business processes, the UMM *Metamodel*, i.e., UML profile, is used

to describe the UMM components the domain experts and analysts have at their disposal as they describe and analyse individual processes. Additionally, a set of reusable process and information descriptions, *patterns*, help the business domain experts and analysts be more effective and help enforce consistent, reproducible results from the UMM across business domains.

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### 1.1.1 Scope

The UMM, as described in this document is the formal description technique for describing any *Open-edi scenario* as defined in ISO/IEC 14662, Open-edi reference model, and depicted in Figure 1-1. An *Open-edi scenario* is a formal means to specify a class of business transactions having the same business goal, such as, purchasing or inventory management. The primary scope of UMM is the *Business Operations View* (BOV) and not the *Functional Service View* (FSV) as defined in ISO/IEC IS 14662. The BOV is defined as “a perspective of business transactions limited to those aspects regarding the making of business decisions and commitments among organizations”, while the FSV is focused on implementation specific, technological aspects of *Open-edi*. As such, UMM provides a procedure for specifying (modeling), in a technology-neutral, implementation-independent manner business processes involving information exchange.

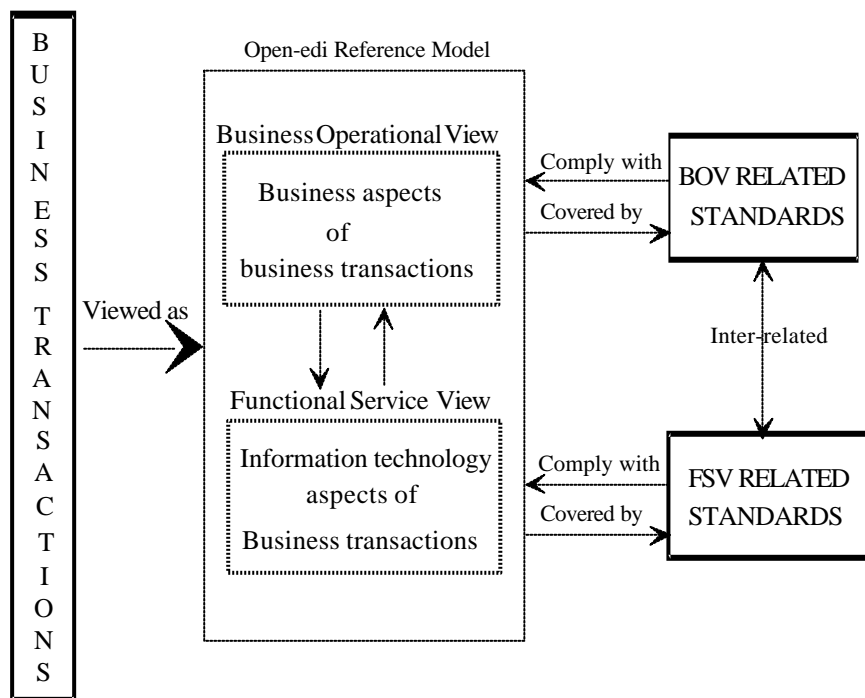


Figure 1-1 Open-edi reference model

With the exception of detailed message design, specifications related to the *Functional Service View* are outside the scope of this methodology. Hence, the BOV of a process

defines the requirements placed on the information technology products and services chosen to implement the process described by the *Open-edi scenario*. The BOV-related methodology provides business process and information exchange specifications that are sufficient for any FSV implementation, whether the implementation uses distributed object technology, XML, UN/EDIFACT or any other protocol.

### **1.1.2 Vision**

A primary vision of UN/CEFACT is to capture the business knowledge that enables the development of low cost software components by software vendors to help the small and medium size companies, and emerging economies engage in e-Business practices. By focusing on developing business process and information models in a protocol neutral manner, these UMM provides insurance against obsolescence by allowing recasting of the *Open-edi scenarios* into new technologies such as eXtensible Markup Language (XML), or other technologies that may emerge ten to fifteen years from now. Hence UMM “future-proofs” *Open-edi scenarios* against obsolescence by new protocol standards and technologies.

## **1.2 Audience**

This document is targeted to a diverse audience; business domain experts, business process and information modeling analysts, and software application developers. It is recommended that business domain experts focus on Section 1 to get an overview of the UMM. Sections 2 and 3 provide details of the UMM that directly involve business domain experts, and thus lends to their understanding of how business requirements are captured and formally represented.

The primary thrust of this document is for personnel knowledgeable in modelling methodology who facilitate business domain analysis sessions and provide modelling support. Additionally, it serves as a checklist for standardized models when a previously specified business process is contributed to UN/CEFACT for inclusion and incorporation as a standard business process model. Based on Figure 1-4, Sections 2 – 4 are targeted to business process and information modelling analysts, and Sections 3 – 6 provide guidance for technical modelers.

Finally, validation of the UMM vision of producing protocol neutral business process and information models requires the participation of software application developers, i.e., independent software vendors (ISV). Protocol specific standards produced according to Section 6 must unambiguously and completely reflect protocol neutral business process and information models designed according to Section 6. Central to this, Chapter 6 will provide the specification of “production rules” from the UML-based models to the protocol specific standards. (Note: Chapter 6 remains to be completed.)

## **1.3 The Relationship of Projects: Open-edi, UML, Unified Process, Business Collaboration Framework, and UMM**

Many projects have contributed to the UMM.

- Open-edi reference model provides ISO/IEC 14662, a recognized international standard for the specification of a class of business transactions, (i.e., business collaboration) having the same business goal. The Business Operational View of

such business collaboration specifications is technology-neutral, or independent of implementation technologies.

- Unified Modeling Language provides a formal descriptive technique, as required by Open-edi, for a syntactic representation of a business process and information model, and also the underlying semantic understanding of the model via the UML metamodel upon which the model is based, i.e., model of a model. UML is internationally recognized as the modelling technique of choice, and submitted by the OMG to be an ISO standard.
- Unified Process provides a top-down business analysis approach that utilizes the basic workflows that are recognized in the IT industry for application software development: business modelling, requirements, analysis and design.
- Business collaboration framework provides an eBusiness industry recognized methodology and UML profile for specifying an incremental construction of a business process and information model. It provides levels of specification granularity that are suitable for communicating the model to business domain experts, business application integrators and network application solution providers.

#### 1.4 UN/CEFACT Modelling Methodology Phases and Project Workflows

The Unified Process (UP) methodology used in UMM recognises that all software development projects pass through a series of general *phases* over the course of time. The phases are:

- *Inception*
- *Elaboration*
- *Construction*
- *Transition*

The historic view of software engineering projects is a series of sequential steps, or *workflows*, moving from technology independent business process modelling to technology dependent deployment. The Unified Process methodology used by UMM is tied to these historic project steps as indicated in Figure 1-2.

REF

One important *workflow* or project step that is not listed below in Figure 1-2, but is supported by the UP methodology is the *Project Management workflow*. Project management involves assignment of resources to fulfil modelling roles, as well as development of an iteration plan.

The focus of the UMM developed by UN/CEFACT is predominately the technology neutral intersection of the UP *phases* of Inception and Elaboration and the Software Engineering project *workflows* of *Business Modelling*, *Requirements*, *Analysis* and *Design*. This intersection coincided well with the UN/CEFACT TMWG (Techniques and Methodologies Work Group) charter to define a methodology to support the BOV of ISO/IEC IS 14662 standard for the technology neutral definition of *Open-edi scenarios*.

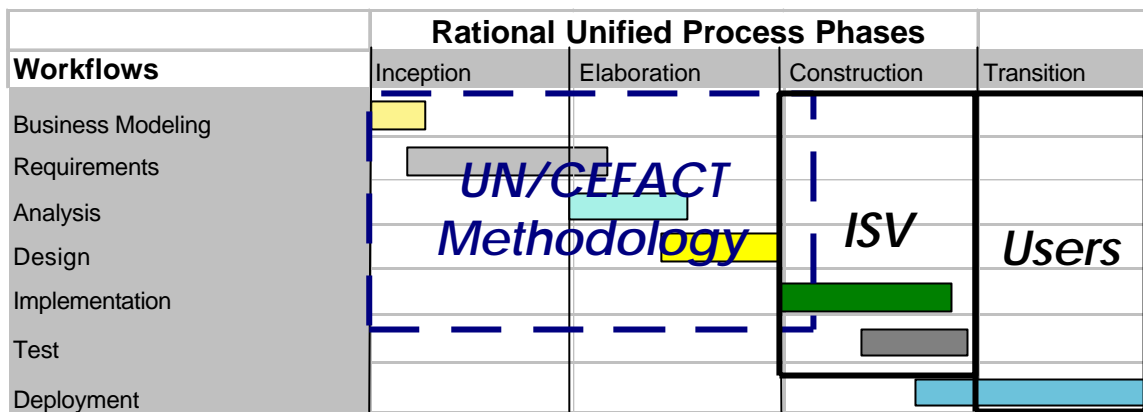


Figure 1-2 Phases and Workflows

Figure 1-3 shows the high-level software engineering project activities associated with each UP phase.

UP Phase	High level activities of a Software Engineering Project
Inception	<ul style="list-style-type: none"> <li>Idea is conceived, and initially documented using the UMM.</li> <li>Applicable workflow is: 1) <i>Business Modelling</i> 2) <i>Requirements</i>.</li> </ul>
Elaboration	<ul style="list-style-type: none"> <li>Idea is further refined and expanded</li> <li>Applicable workflows are 1) <i>Analysis</i>, and 2) <i>Design</i></li> <li>The deliverables are compared with the existing repository contents.</li> <li>New models or enhancements to existing models are incorporated into the repository</li> </ul>
Construction	<ul style="list-style-type: none"> <li>EDIFACT messages/OO-EDI messages are designed and developed</li> <li>XML DTDs/schemas development</li> <li>Software development is performed by ISV</li> <li>Applicable workflows are 1) <i>Implementation</i>, and 2) <i>Testing</i></li> </ul>
Transition	<ul style="list-style-type: none"> <li>Testing is completed by ISV</li> <li>Applicable workflow is <i>Deployment</i></li> </ul>

Figure 1-3 Activities in UP Phases

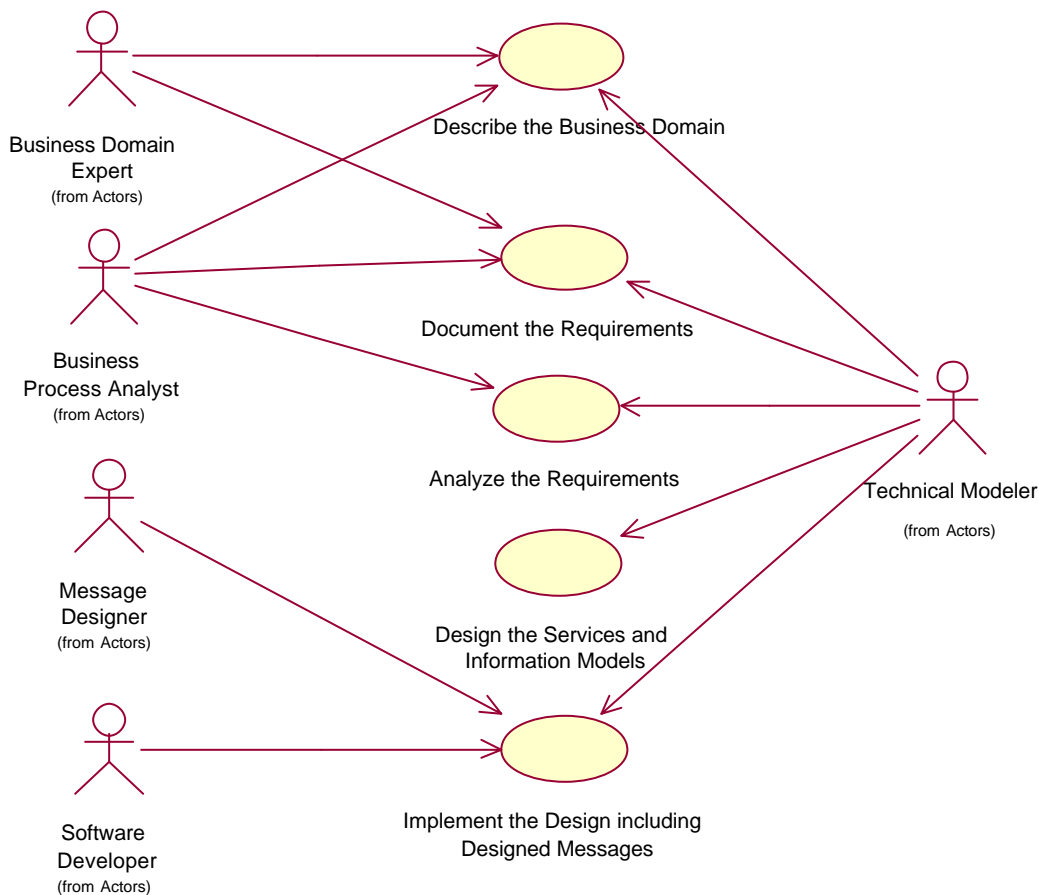
In the *Inception* and *Elaboration* phases the UMM concentrates on *workflow* prerequisites for understanding the business needs and producing business scenarios, business objects and business collaborations. As the software engineering project progresses through sequential *workflows* the UMM produces artifacts in two of the UP phases. They are:

- i. The *Business Modelling* workflow elicits and organizes business processes and information in the business-to-business domain. This includes the creation of packages to categorize key concepts and business models.

- ii. The *Requirements workflow* uses business models as input to understand the requirements of the resulting business-to-business solution. This includes the creation of detailed requirements, UMM *use case diagrams*.
- iii. The *Analysis workflow* further elaborates the Requirement *use cases* by detailing the activities that occur, collaborations between partners, and initial UMM *class diagrams*.
- iv. The *Design workflow* precisely defines the dynamics of the collaboration, along with the structure of data exchanged between business partners.

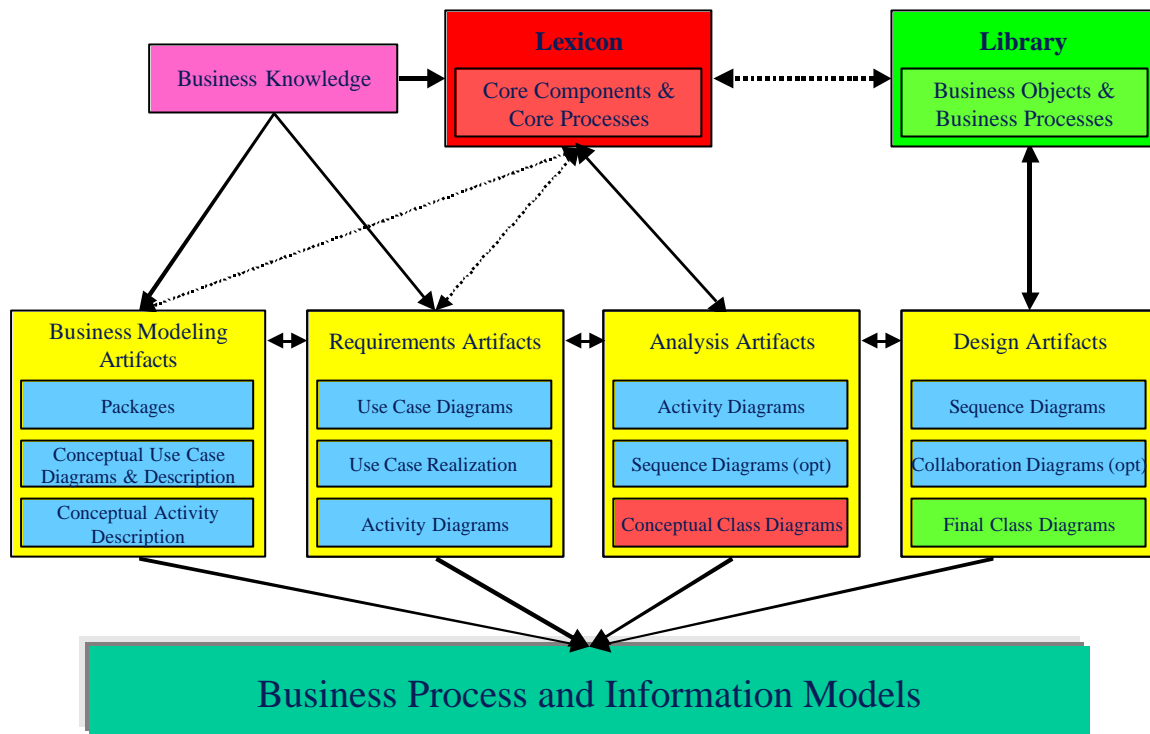
Each *workflow* produces a set of artifacts/ deliverables that are used as input to subsequent *workflows*. This document contains templates to facilitate creation of these and their ongoing maintenance as is expected of any software engineering methodology.

A use case of the Business Modelling, Requirements, Analysis and Design workflows, how they interact, and the roles necessary to facilitate each are described using UML in REFFigure 1-4.



**Figure 1-4 Use Case for UN/CEFACT Modelling Methodology (UMM)**

The UMM and deliverables are outlined in the following and presented in detail in the body of this document, illustrated with examples based on the “Order From Catalogue” business area. The deliverables of the above *workflows* are shown as *artifacts* in REFFigure 1-5.



**Figure 1-5 Overview of *Workflows* and *Artifacts***

The UN/CEFACT Modelling Methodology requires the use of a *lexicon*. This *Lexicon* contains information and process definitions including relationships and cross-references as expressed in business terminology and organized by industry domain. This knowledge is captured from business experts across multiple domains, and evolves over time. The *Lexicon* functionally is a bridge between the specific business or industry language and the UML models through the application of the UN/CEFACT UMM. In addition to the *Lexicon*, models can reuse *artifacts* from a library of business information objects and processes.

The UN/CEFACT UMM begins with business modeling and produces the Business Operations Map (BOM) in the form of a model architecture expressed as UML packages and initial business *use cases* with descriptions. A business *use case* typically is expressed as a first cut *business activity diagram*.

The *Requirements Workflow* is the first time that stakeholder needs are elicited. Typically, the first cut activity diagram is reviewed, and more *Use Cases* are discovered. These use cases and the resultant activity diagrams are heavily influenced by the stakeholder needs and business requirements. In addition, there may be an opportunity to define new *Lexicon* entries.

The *Analysis Workflow* fundamentally looks at the collaborations between business roles, assigns business information transaction patterns, and begins to understand the information bundles (business documents) that flow between roles. These information bundles can be expressed as conceptual *class diagrams*. The *artifacts* produced in the *analysis workflow* draw upon information in the *Lexicon*, or may populate the *Lexicon* where relevant information is not available.

The *Design Workflow* primarily involves detailing the information model, applying *business information objects* across all class models, detailing service protocol syntax and semantics [comparable to EDIFACT, XML message design], and applying Business Service Interaction patterns. The content of the *business object library* is created by analyzing existing *business objects* as used by many industries today in conjunction with the *Lexicon* content. The information model should undergo harmonization to integrate it with other models in the same industry and across other industries.

Analysis of business processes can proceed along different paths depending on the focus of the modeling effort. For example, if the goal is to establish a business reference model for an industry, the process will likely proceed as discussed in the UMM, from the beginning to the end. However, if the effort is to model existing EDIFACT documents and their associated business processes, for example, the process will more naturally start with the elaboration of business transaction and roles. In this case, there is usually a strong implicit understanding of the associated business process by business domain experts. Business process analysis can be partitioned into four high-level activities<sup>1</sup> as shown in Figure 1-6.

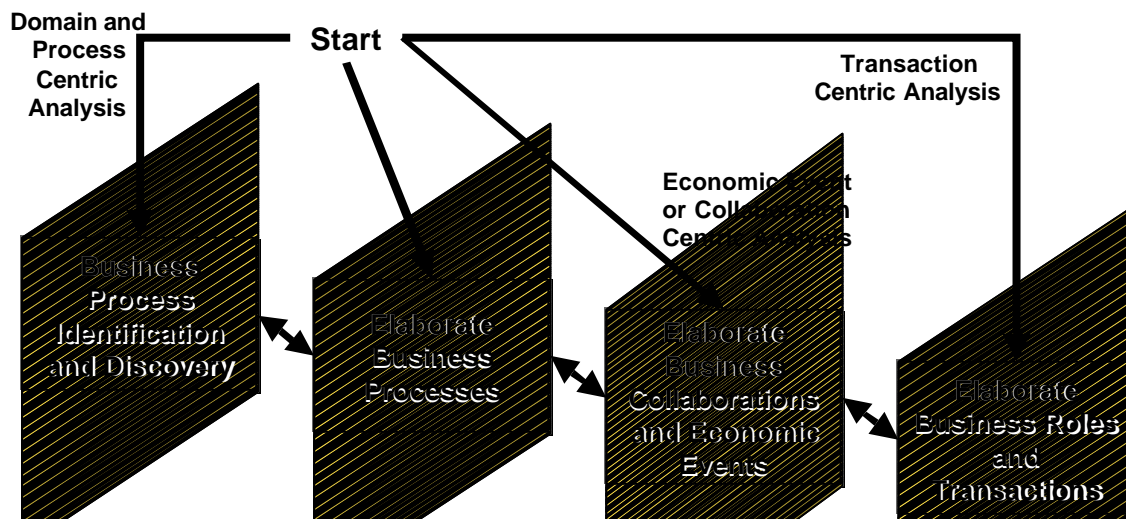


Figure 1-6 Analyze Business Process Activities

## 1.5 UN/CEFACT Modeling Methodology (UMM)

<sup>1</sup> It is recognized that the analyze business process activity MAY be partitioned in different ways to suit the sensibilities of the participants in the analysis process.



The UN/CEFACT Modeling Methodology provides the prescription and precision required for predictive and reproducible results. The UMM defines the use and relationships of the *methods*, *patterns* and *model artifacts* within each *workflow*. For each *workflow* a *method* is applied to a *pattern* using modelling techniques with well-defined semantics.

REFFigure 1-7 shows the relationship between the *methods*, *patterns* and the *artifacts* they produce for each workflow.

Workflow	Methodology	Pattern	Model Artifacts [UML Nomenclature]
<b>Business Modelling</b>	<ul style="list-style-type: none"> <li>Domain Analysis</li> <li>Use Case Analysis</li> <li>Process Discovery</li> <li>Activity Modeling</li> </ul>	<ul style="list-style-type: none"> <li>Business Patterns (The definition of Business Patterns is a future activity.)</li> </ul>	<ul style="list-style-type: none"> <li>Business Area [Package]</li> <li>Process Area [Package]</li> <li>Process(es) [Use Cases][Activity Diagrams]</li> <li>Business Entity [Class]</li> </ul>
<b>Requirements</b>	<ul style="list-style-type: none"> <li>Requirements Gathering</li> <li>Use Case Analysis</li> <li>Process Analysis</li> <li>Activity Modeling</li> </ul>	<ul style="list-style-type: none"> <li>Business Collaboration (The definition of Business Collaboration Patterns is a future activity.)</li> </ul>	<ul style="list-style-type: none"> <li>Business Process(es) [Use Case]</li> <li>Business Collaboration Use Case</li> <li>Business Collaboration [Collaboration-Use Case Realization]</li> </ul>
<b>Analysis</b>	<ul style="list-style-type: none"> <li>Process Analysis</li> <li>Activity Modelling</li> <li>Conceptual Class Modeling</li> </ul>	<ul style="list-style-type: none"> <li>Business Information Flow Patterns</li> </ul>	<ul style="list-style-type: none"> <li>Business Collaboration Protocol [Activity Diagram]</li> <li>Business Transactions [Activity Diagram]</li> <li>Business Documents (conceptual) [Class Diagram]</li> </ul>
<b>Design</b>	<ul style="list-style-type: none"> <li>Process Analysis</li> <li>Collaboration Modelling</li> <li>Message Sequencing</li> <li>Information Modelling</li> <li>Message Modelling (protocol neutral)</li> </ul>	<ul style="list-style-type: none"> <li>Business Service Interaction Patterns</li> <li>Information Modelling Patterns</li> </ul>	<ul style="list-style-type: none"> <li>Service Collaboration [Object Collaboration]</li> <li>Network Component [Class Diagram]</li> <li>Business Service [Class Diagram]</li> <li>Service Transactions [Sequence Diagram]</li> <li>Business Documents (detail) [Class Diagram]</li> </ul>
<b>Implementation</b>	<ul style="list-style-type: none"> <li>Message Translation</li> <li>Software Development</li> </ul>	<ul style="list-style-type: none"> <li>Message Design Rules</li> <li>UML to XML Mapping</li> </ul>	<ul style="list-style-type: none"> <li>Not applicable</li> <li>Component Diagrams</li> <li>Message Specifications</li> <li>Software Components</li> </ul>

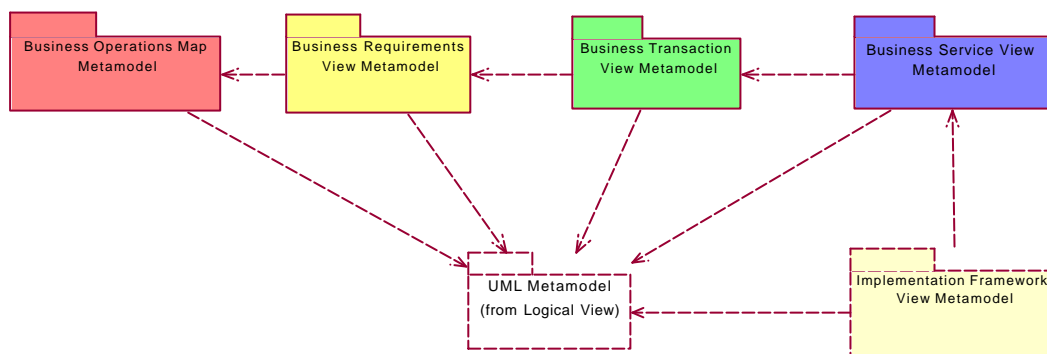
**Figure 1-7 UMM Methods, Patterns and Artifacts**

## 1.6 UN/CEFACT Modelling Methodology MetaModel

Business process and information models are expressed using the Unified Modeling Language (UML) and the Object Constraint Language (OCL) both of which are standards maintained by the [Object Management Group](#). The UML is a language expressive enough to specify the structure and behavior of objects that interact in any conceptual domain of discourse. A business process and information model, however, is a specification of the structure and behavior of objects interacting through business partner interfaces, a specialized domain of discourse. The UML metamodel (the model

that defines the UML modeling language) is extended to include domain specific syntax and semantics using extension mechanisms known as *stereotyping*. The UMM metamodel is thus defined as a UML profile by extending the UML syntax and semantics with stereotype syntax and semantics of the business process domain. Business process and information models are then constructed using the syntax of the UMM metamodel. Tools and applications that support the syntax and semantics of the UMM metamodel will be able to support the construction and execution of business processes.

The UMM metamodel is based on a precise definition of the UML metamodel extension that facilitates the expression of a business processes as an object-oriented model. This extended metamodel is termed the UMM Metamodel, shown at a high level in REFFigure 1-8.



**Figure 1-8 UMM Metamodel**

The UMM Metamodel is organized into the following views so that each business process and information model can be viewed from a number of perspectives.

- The *Business Operations Map (BOM) metamodel* – the partitioning of business processes into business areas and business categories (See REFFigure 1-9).

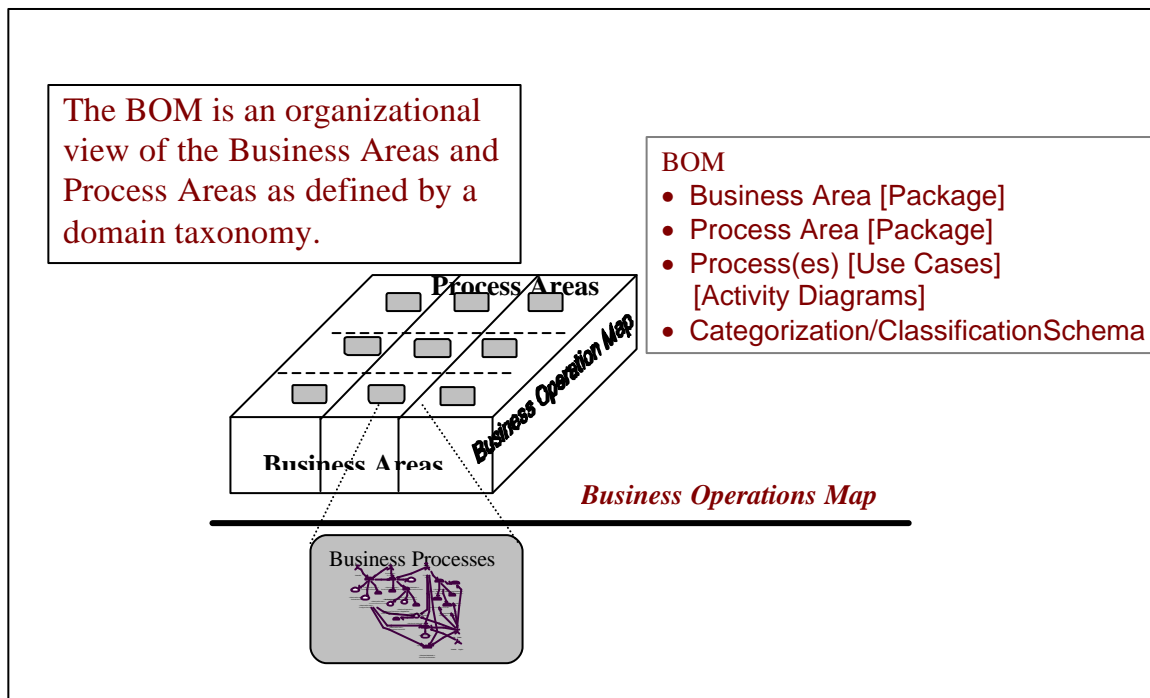


Figure 1-9 Business Operations Map

- The *Business Requirements View (BRV) metamodel* – the view of a business process model that captures the Use Case scenarios, inputs, outputs, constraints and system boundaries for business transactions and their interrelationships (See REFFigure 1-10).

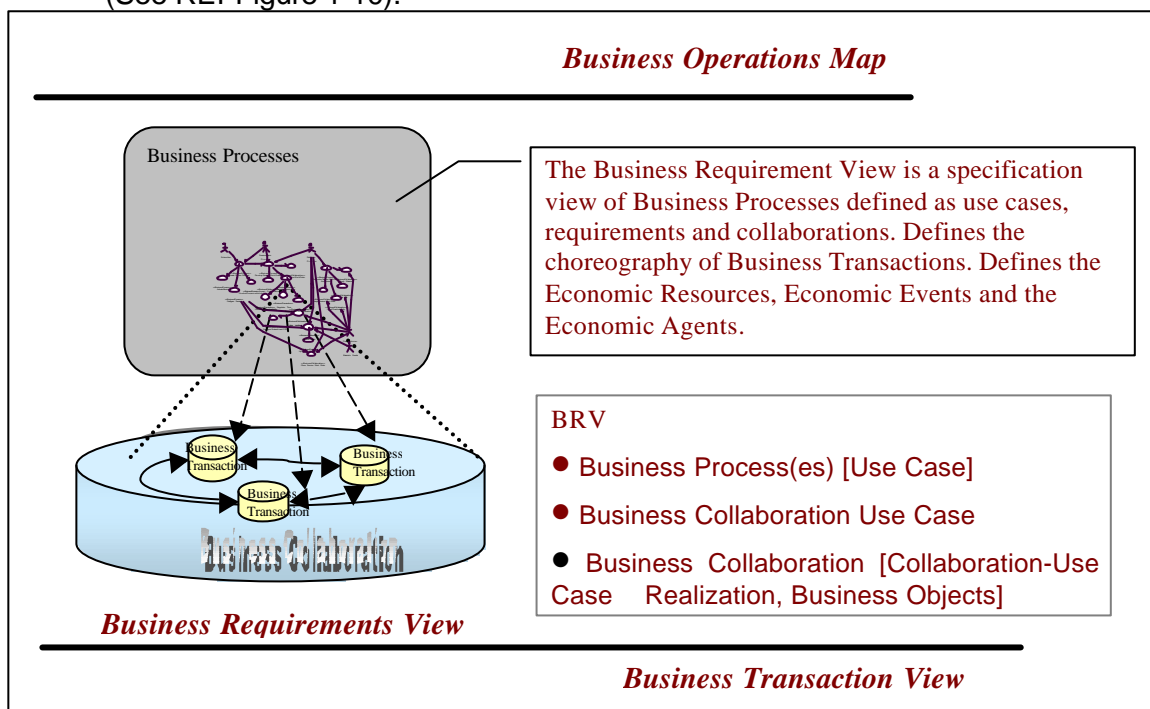


Figure 1-10 Business Requirement View

- The *Business Transaction View (BTV) metamodel* - the view of a business process model that captures the semantics of business information entities and their flow of exchange between roles as they perform business activities (See REFFigure 1-11).
- The *Business Service View (BSV) metamodel* - the view of a business process model that specifies the network component services and agents and their message (information) exchange as interactions necessary to execute and validate a business process (See REFFigure 1-11).

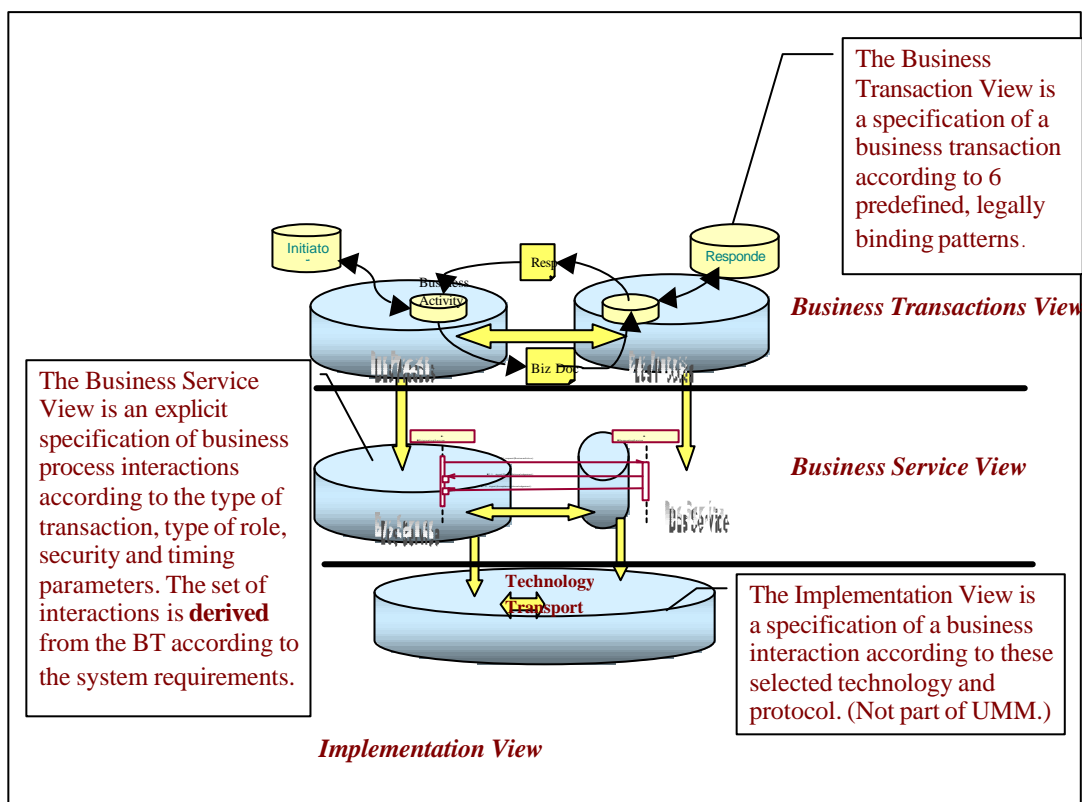


Figure 1-11 Business Transaction View/Business Service View

These perspectives support an incremental model construction methodology and provide levels of specification granularity that are suitable for communicating the model to business domain experts, business application integrators and network application solution providers.

## 1.7 UMM Meta-Model Architecture

The UMM Meta-Model Architecture follows the structure of meta-model definition that the Object Management Group (OMG) uses to define the Unified Modeling Language (UML). The definition is an extension of UML and is known as a profile by OMG. The OMG has four perspectives in referring to this structure; 1) the syntax and structure of the modeling elements, 2) the semantics of the modeling elements, 3) the syntax and structure of the model and 4) the semantics of the model. The four perspectives are shown in Figure 1-12.

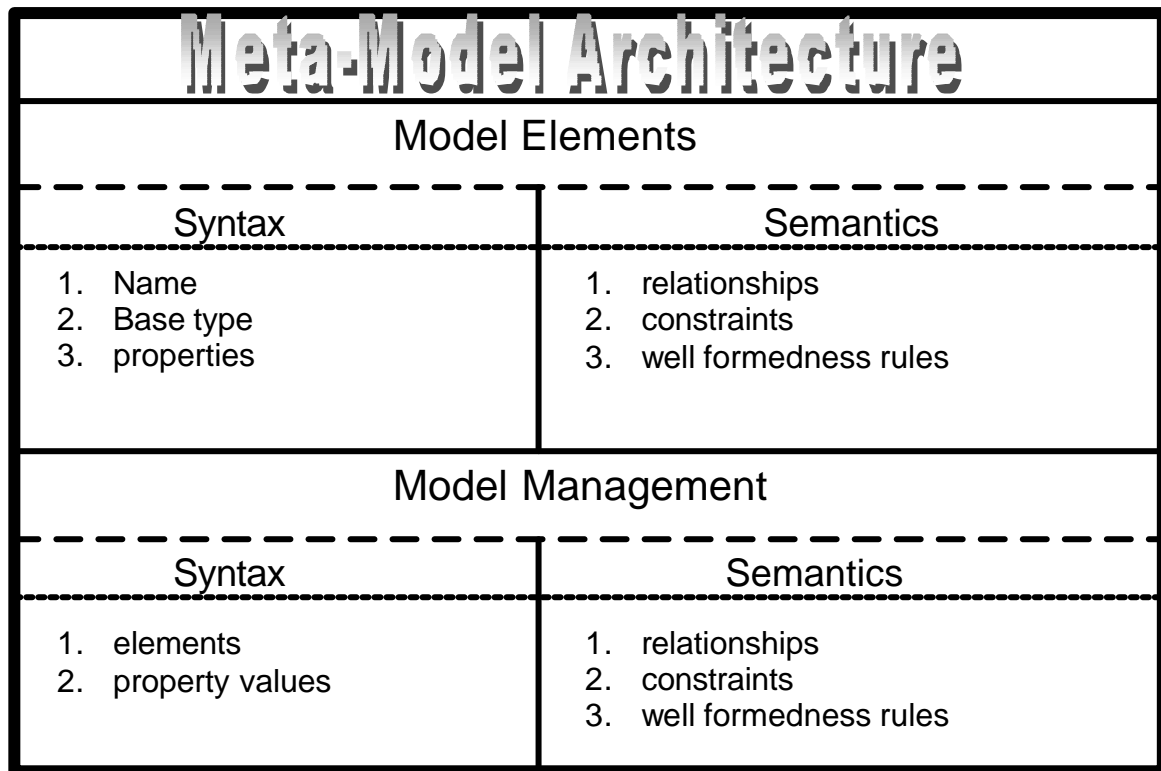


Figure 1-12 Metamodel architecture

#### *Model Elements Abstract Syntax*

Each modeling element is defined by its base type and properties. Each modeling element becomes a UML stereotype that is used during business process modeling. Tag-value pairs are used to record the values of the properties.

#### *Model Elements Semantics*

The second perspective defines the associations and relationships among the elements already defined in (1). These associations or relationships define the semantics of modeling elements.

#### *Model Management Syntax*

The third perspective defines the set of modeling elements that are required or available for use in the business model. This provides for the structure or syntax of the model.

#### *Model Management Semantics*

As the second perspective provides for the semantics of individual modelling elements, the final perspective (4) of the meta-model also defines or constrains the semantics of the modelling elements as they are used within the model. Associations or relationships define the semantics of modelling elements.

## 1.8 UN/CEFACT Modelling Methodology Patterns

Patterns are reusable, generalized business process abstractions that can be applied to many domains. A *metamodel* provides the syntax and grammar for expressing designs. Patterns are subjective constructions that meet the requirements of specific business process scenarios.

Patterns are applications of the *metamodel* to common business process and information representations. Common business process and information representations capture common structure and semantics applicable to specific business process domains.

The key to repeatable business process and information model constructions is the application of patterns to specific business process scenarios. While patterns can be expressed for business processes at various levels, the UMM currently includes patterns for business transaction activities and their associated service collaborations.

Predefined analysis patterns are described in Section 9.3 for the six types of business transaction activities that have been identified to date. The business transaction patterns are:

- Commercial Transaction - used to model the “*offer and acceptance*” business transaction process that results in a residual obligation between both parties to fulfill the terms of the contract
- 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
- 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
- Request/Confirm - used for business contracts where an initiating partner requests confirmation about their status with respect to previously established contracts or with respect to a responding partner's business rules
- Information Distribution - used to model an *informal* information exchange business transaction that therefore has no non-repudiation requirements
- Notification - used to model a *formal* information exchange business transaction that therefore has non-repudiation requirements

These business transaction activity patterns comprehensively cover all the known legally binding collaborations at the lowest level of request/response interaction between two business applications (Decision Making Applications in ISO/IEC 14662). The specific business transaction activity pattern(s) used in a business collaboration is(are) based on extracting information from business domain experts via answers to questions asked according to a standard script in the Business Modelling and Requirements workflows. Figure 1-13 contains a decision tree that can assist a business process and information modelling analyst in determining the appropriate business transaction pattern to use within a business collaboration between two entities.

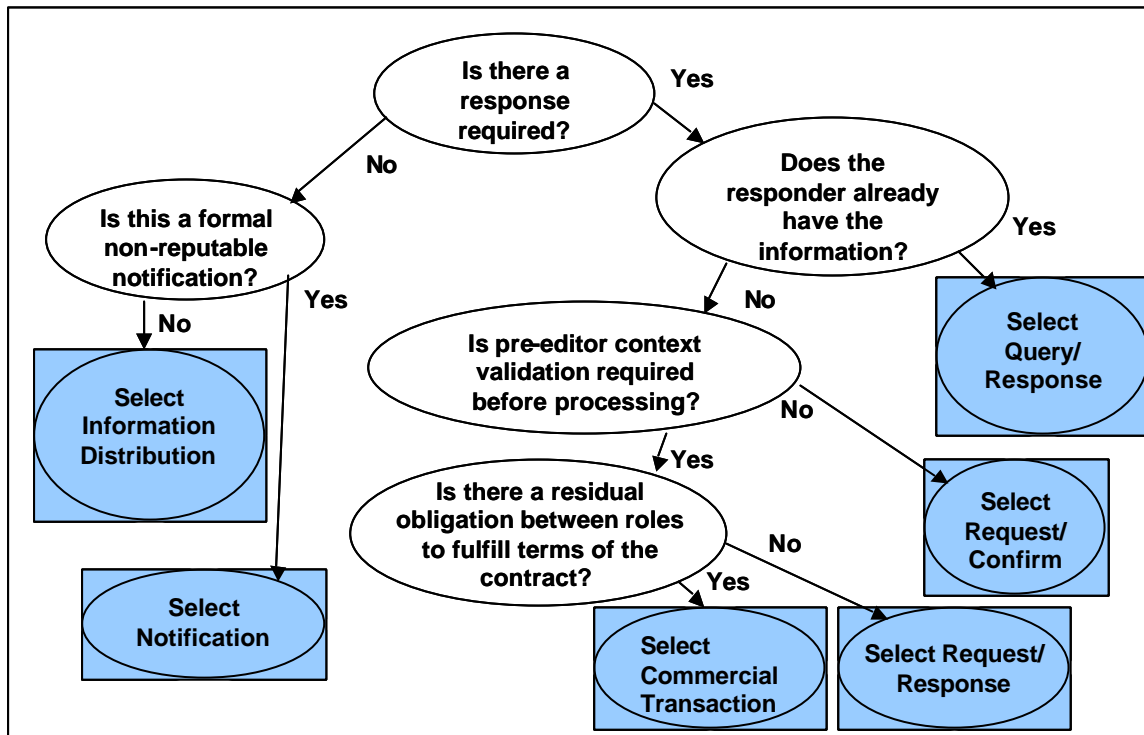


Figure 1-13 Business Transaction Selection Decision Tree

Predefined design patterns in Section 9.4 are described for service collaborations appropriate for each business transaction pattern. These service interaction patterns specify specific interaction sequences between two application systems (referred to as Information Processing Domains in ISO/IEC 14662), i.e., protocols, of message exchanges, according to the type of business transaction, type of role, security and timing parameters. The specific service interaction pattern is derived from information gathered in the Requirements workflow. Unless parameter default values are required to be overridden, the appropriate service collaboration pattern is derived according to the metamodel and instantiated in the business process specification.

## 1.9 Requirements, Glossary and Traceability

The Requirements List and the Glossary are two key cross-reference documents used in UMM by the domain experts and facilitators throughout the *workflows* to ensure that all business requirements, terms, and definitions are recorded. (See Annex 3 for more information.) In order to enable traceability throughout the modelling process, the deliverables developed will be given a *traceability indicator*. (See Annex 2 for more information.) The modelling activity relies heavily on the use of modelling tools and a repository supported by appropriately skilled resources. The repository will hold the deliverables and can be accessed to check on the availability of suitable models created from earlier business requirements analysis to facilitate re-useability and consistency.

## 1.10 Document Structure

The Business Modelling, Requirements, Analysis and Design workflows are described in Sections 2, 3, 4, and 5, respectively. Following the workflow descriptions in each section are descriptions of the deliverables for each workflow, referred to as artifacts.

Methodology procedures, i.e., guidelines, for stepping through the workflows are then provided, followed by an illustrative example.

Section 6 describes the extension of the Design workflow for protocol specific standards, e.g., eXtended Markup Language (XML), stopping short of standards required for the information exchange infrastructure such as for transport, routing and packaging protocols.

Section 7 provides requirements for expertise, resources and training for each of the workflows.

Section 8 describes the UMM metamodel underlying the business modeling, requirements, analysis and design workflows as described in 1.4. Artifacts that represent the Business Operations Map, Business Requirements View and Business Transaction View are produced as a result of transforming business process requirements into an object-oriented business process model. Business service design patterns as described in Section 8.4 are Business Service View modeling artifacts that are, for the most part, predefined according to the Business Service View metamodel. Unless there are parameter overrides, this part of the metamodel is automatically reused as each service collaboration pattern is derived and instantiated.

Section 9 provides a complete description of the modelling patterns used in the UMM. Annexes are provided as follows:

- Annex 1: Modelling Methodology Glossary
- Annex 2: Traceability
- Annex 3: Glossary and Requirements List Template
- Annex 4: Use Case Specification Template
- Annex 5: Use Case Checklist
- Annex 6: Model Notation
- Annex 7: Naming & Style Guide
- Annex 8: Describing Addresses
- Annex 9: References
- Annex 10: Example Business Contract Formations
- Annex 11: Understanding Business Contracts Using X12/EDI