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# Information technology – Metamodel framework for interoperability (MFI) – Part 12: Metamodel for information model registration





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# Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 19763-12 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information Technology*, Subcommittee SC 32, *Data management and Interchange*.

ISO/IEC 19763 consists of the following parts, under the general title *Information technology — Metamodel framework for interoperability (MFI)*:

*Part 1: Framework*

*Part 3: Metamodel for ontology registration*

*Part 5: Metamodel for process model registration*

*Part 6: Registry Summary*

*Part 7: Metamodel for service registration*

*Part 8: Metamodel for role and goal registration*

*Part 9: On Demand Model Selection for RGPS [Technical Report]*

*Part 10: Core model and basic mapping*

*Part 12: Metamodel for information model registration*

*Part 13: Metamodel for forms registration*

# Introduction

There is an increasing demand for systems to interoperate by exchanging data. For these data exchanges to be meaningful it is essential that the business information requirements that are met by the data stored in these systems are understood so that suitable data exchange mechanisms can be developed.

Business information requirements, including the semantic meaning of the information, are often represented by information models before the databases that are an integral part of the systems are designed. These models are often called logical models. The subsequent design of the database structure can also be considered to be another form of information model.

Where there is an overlap of the universe of discourse of two systems the information models for these two systems can be registered using the facilities specified by this part of ISO/IEC 19763. The mappings between these two models can then be registered using the facilities specified by Part 10 of ISO/IEC 19763. An interface between the two systems can then be designed, enabling the two systems to interoperate by exchanging information.

# Information technology – Metamodel framework for interoperability (MFI) – Part 12: Metamodel for information model registration

## 1 Scope

The primary purpose of the multipart standard ISO/IEC 19763 is to specify a metamodel framework for interoperability. This part of ISO/IEC 19763 specifies a metamodel for registering information models. This metamodel was developed taking into account two distinct types of information models:

- Those that are used to document the information requirements of a particular area of interest.
- Those that represent the structure of a database. These are often expressed using a Database Definition Language (DDL).

Information models that represent information requirements can be developed using a number of different common diagramming techniques and notations. The metamodel specified in this part of ISO/IEC 19763 was developed to cover the registration of models expressed using the following techniques and notations:

- Express-G, an ISO standard.
- IDEF1X, a US Federal standard (see IEEE Std 1320.2-1998).
- The notation first developed by Harry Ellis and Richard Barker and later adopted by Oracle for its CASE*Method and by the UK's CCTA for SSADM (Structured Systems Analysis and Design Method).
- UML Class Diagrams.
- Entity-Relationship Modelling, as described by Peter Chen.
- Information Engineering, as described by James Martin and Clive Finkelstein.

It is understood that these selected techniques represent all of the essential features of all information modelling techniques used to represent information requirements.

The registration of information models that represent the structure of a database is limited in the metamodel specified in this part of ISO/IEC 19763 to those database structures that conform to the Core SQL specification. Core SQL is the set of features defined in the conformance requirements specified in ISO/IEC 9075-2 and ISO/IEC 9075-11.

The registration of information models that are expressed using notations such as Object Role Modeling (ORM) and "Natural language Information Analysis Method" (NIAM), collectively known as fact based models, is out of scope for this part of ISO/IEC 19763.

# 2 Conformance

## 2.1 General

An implementation claiming conformance with this part of ISO/IEC 19763 shall support the metamodel specified in clause 5, depending on a degree of conformance as described below.

## 2.2 Degree of conformance

### 2.2.1 General

The distinction between “strictly conforming” and “conforming” implementations is necessary to address the simultaneous needs for interoperability and extensions. This part of ISO/IEC 19763 describes specifications that promote interoperability. Extensions are motivated by needs of users, vendors, institutions and industries, but are not specified by this part of ISO/IEC 19763.

A strictly conforming implementation may be limited in usefulness but is maximally interoperable with respect to this part of ISO/IEC 19763. A conforming implementation may be more useful, but may be less interoperable with respect to this part of ISO/IEC 19763.

### 2.2.2 Strictly conforming implementation

A strictly conforming implementation

a) shall support the metamodel specified in clause 5;

b) shall not use, test, access, or probe for any extension features nor extensions to the metamodel specified in clause 5.

### 2.2.3 Conforming implementation

A conforming implementation

a) shall support the metamodel specified in clause 5;

b) as permitted by the implementation, may use, test, access, or probe for any extension features or extensions to the metamodel specified in clause 5.

NOTE 1 All strictly conforming implementations are also conforming implementations.

NOTE 2 The use of extensions to the metamodel might cause undefined behaviour.

## 2.3 Implementation Conformance Statement (ICS)

An implementation claiming conformance with this part of ISO/IEC 19763 shall include an Implementation Conformance Statement stating

a) whether it is a strictly conforming implementation (2.2.2) or a conforming implementation (2.2.3);

b) what extensions, if any, are supported or used if it is a conforming implementation.

# 3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 19763-1, Information technology – Metamodel framework for interoperability (MFI) – Part 1: Reference model

ISO/IEC 19763-3, Information technology – Metamodel framework for interoperability (MFI) – Part 3: Metamodel for ontology registration

ISO/IEC 19763-10, Information technology – Metamodel framework for interoperability (MFI) – Part 10: Core model and basic mapping

ISO/IEC 11179-3, Information technology – Metadata registries (MDR) – Part 3: Registry metamodel and basic attributes

ISO/IEC 9075-1:2011, Information technology – Database languages – SQL – Part 1: Framework

ISO/IEC 9075-2:2011, Information technology – Database languages – SQL – Part 2: Foundation

ISO/IEC 9075-11:2011, Information technology – Database languages – SQL – Part 11: Information and Definition Schemas

# 4 Terms, definitions and abbreviated terms

## 4.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

## 4.2 Terms for concepts used in this part of 19763

**4.2.1**
**aggregation**
special form of **relationship** (4.2.37) that specifies a whole-part **relationship** (4.2.37) between the aggregate (whole) and a component part

NOTE Adapted from ISO/TS 19103:2005, 4.2.2

**4.2.2**
**association**
semantic **relationship** (4.2.37) between two **object classes** (4.2.35)

NOTE Adapted from ISO/IEC 11179-3:2013

**4.2.3**
**associative entity type**
**information model element** (4.2.25) that has both **relationship** (4.2.37) and **entity type** (4.2.21) properties.

NOTE 1 May also be known as an *association class*

NOTE 2 An associative entity type can be seen as a relationship that also has entity type properties, or as an entity type that also has relationship properties.

NOTE 3 Adapted from ISO/IEC 19501:2005, 0000_135

**4.2.4**
**attribute**
named characteristic of an **entity type** (4.2.21) whose values serve to qualify, identify, classify, quantify or express the state of an instance of an **entity type** (4.2.21)

**4.2.5**
**attribute unique identifier element**
**unique identifier element** (4.2.45) that is a statement that a particular **attribute** (4.2.4) is part of a particular **unique identifier** (4.2.44)

**4.2.6**
**cardinality**
number of elements in a **collection** (4.2.8)

NOTE Adapted from ISO/IEC 9075-2:2011

**4.2.7**
**catalog**
named **collection** (4.2.8) of **schemas** (4.2.42) in a database environment

NOTE 1 Within this part this definition applies only to the registration of database structures that conform to the SQL Core specification as described in ISO/IEC 9075-2:2011

NOTE 2 Adapted from ISO/IEC 9075-1:2011

**4.2.8**
**collection**
aggregation of similar objects

EXAMPLES set, bag (or multiset), list, array

NOTE Adapted from ISO/HL7 21731:2006

**4.2.9**
**column**
component of a **table** (4.2.43) that is a collection of values all of the same defined **data type** (4.2.11)

NOTE Within this part this definition applies only to the registration of database structures that conform to the SQL Core specification as described in ISO/IEC 9075-2:2011

**4.2.10**
**composition**
form of **aggregation** (4.2.1) which requires that a part instance be included in at most one composite at a time, and that the composite object is responsible for the creation and destruction of the parts. Composition may be recursive.

[ISO/IEC 19501:2005, 0000_209]

**4.2.11**
**data type**
set of representable values

[ISO/IEC 9075-1:2011, 3.1.1.4]

**4.2.12**
**described domain**
**domain** (4.2.15) that is specified by a description or specification, such as a rule, a procedure, or a range (i.e. interval)

NOTE 1 May also be known as a *non-enumerated domain* or a *continuous domain*

NOTE 2 Adapted from ISO/IEC 11179-3:2013

**4.2.13**
**description**
property of an **information model element** (4.2.25) that is a statement explaining the significance of this **information model element** (4.2.25) to the business and or organisation that is the subject of this **information model** (4.2.24)

NOTE May also be known as a *significance statement*

**4.2.14**
**diagram**
technical document showing part of an **information model** (4.2.24) using graphical symbols

NOTE 1 A model can consist of one or more diagrams

NOTE 2 Adapted from ISO 29845:2011

**4.2.15**
**domain**
**collection** (4.2.8) of values from which an instance of an **attribute** (4.2.4) must take its value

NOTE 1 A domain provides a set of business validation rules, format constraints and other properties for one or more attributes

NOTE 2 The term domain is used in this part of ISO/IEC 19763 purely in the sense that the term is used in modelling information requirements using techniques such as entity-relationship modelling and object oriented modelling; the term should not be confused with its use in contexts such as “business domain” and “domain of discourse”

**4.2.16**
**entity**
concrete or abstract thing that exists, did exist, or might exist, about which information may need to be held in support of business operations

NOTE 1 Some information modelling methods use *entity* for their main information modelling construct whilst others use *entity type*; in this part of ISO/IEC 19763 the term *entity type* is used in preference to *entity*

NOTE 2 May also be known as an *entity instance* (in those information modelling methods that use *entity* for their main information modelling construct) or an *object* (in those information modelling methods that use *object class* for their main information modelling construct)

NOTE 3 Adapted from ISO/IEC 11179-3:2013

**4.2.17**
**entity relationship model**
**information model** (4.2.24) based on **entity types** (4.2.21) and their **attributes** (4.2.4) and **relationships** (4.2.37)

**4.2.18**
**entity role**
role that an **entity type** (4.2.21) is playing in a **relationship** (4.2.37)

**4.2.19**
**entity specialisation hierarchy**
means by which instances of an **entity type** (4.2.21) may be classified or specialised.

NOTE May also be known as an *entity generalisation hierarchy*, an *entity subtype hierarchy*, an *entity type classification* or an *entity classification*

**4.2.20**
**entity subtype**
subset of the instances of an **entity type** (4.2.21), known as the supertype, that share common **attributes** (4.2.4) and/or **relationships** (4.2.37) distinct from other subsets.

NOTE May also be known as a *subtype*, an *object subclass* or a *subclass*

**4.2.21**
**entity type**
set of characteristics common to a **collection** (4.2.8) of **entities** (4.2.16) that are instances of the type

NOTE 1 Some information modelling methods use *entity type* for their main information modelling construct whilst others use *entity*; in this part of ISO/IEC 19763 the term *entity type* is used in preference to *entity*

NOTE 2 May also be known as an *entity* (in those information modelling methods that use *entity* for their main information modelling construct) or an *object class* (in those information modelling methods that use *object class* for their main information modelling construct)

**4.2.22**
**enumerated domain**
**domain** (4.2.15) that is specified by a list of all its **valid values** (4.2.46)

NOTE 1 May also be known as an *discrete domain*

NOTE 2 Adapted from ISO/IEC 11179-3:2013

**4.2.23**
**foreign key attribute**
**key attribute** (4.2.28) whose value contributes in some way to the identification of the one related instance of that **entity type** (4.2.21) involved in the associated **relationship end** (4.2.37)

NOTE A foreign key attribute provides or contributes to an alternative representation of the relationship concerned. Its value must be drawn from the domain of the corresponding key attribute of the related entity type

**4.2.24**
**information model**
graphical and textual representation of **entities** (4.2.16) and the **relationships** (4.2.37) between them

NOTE May also be known as a *data model*, a *conceptual data model*, a *logical data model*, an *entity relationship model***,** an *object class diagram* or a *database definition*

**4.2.25**
**information model element**
element of an **information model** (4.2.24) that may be represented graphically and/or textually

NOTE Typical information model elements are entity types, relationship ends and unique identifiers.

**4.2.26**
**information modelling language**
language or notation that is used to model information requirements in an **information model** (4.2.24)

**4.2.27**
**information modelling method**
approach to developing an **information model** (4.2.24) using a particular **information modelling language** (4.2.26)

**4.2.28**
**key attribute**
**attribute** (4.2.4) whose value contributes in some way to the identification of individual instances of the host **entity type** (4.2.21) or of some related **entity type** (4.2.21)

**4.2.29**
**link phrase**
statement that explains the nature, expressed in business terms, of a **relationship** (4.2.37) from the perspective of one of the associated **entity types** (4.2.21)

**4.2.30**
**maximum cardinality**
statement of the maximum number of elements that may exist in a **collection** (4.2.8)

**4.2.31**
**minimum cardinality**
statement of the minimum number of elements that may exist in a **collection** (4.2.8)

**4.2.32**
**native key attribute**
**key attribute** (4.2.28) whose value contributes in some way to the identification of individual instances of the host **entity type** (4.2.21)

**4.2.33**
**non key attribute**
**attribute** (4.2.4) that is not the unique identifier or an element of a composite **unique identifier** (4.2.44) of an **entity type** (4.2.21) or whose value is fully independent of all **relationships** (4.2.37) or other **attributes** (4.2.4)

**4.2.34**
**object**
anything perceivable or conceivable

NOTE Adapted from ISO 1087-1:2000, 3.1.1

**4.2.35**
**object class**
description of a set of **objects** (4.2.34) that share the same **attributes** (4.2.4), operations, methods, **associations** (4.2.2) and semantics]

NOTE Adapted from ISO/IEC 11179-3:2013, 3.1.5

**4.2.36**
**object class model**
**information model** (4.2.24) based on **object classes** (4.2.35) and their **attributes** (4.2.4) and **associations** (4.2.2)

**4.2.37**
**relationship**
set of characteristics common to a collection of connections between instances of two or more **entity types** (4.2.21), or between instances of one **entity type** (4.2.21) and other instances of the same **entity type** (4.2.21)

NOTE May also be known as an *association* when the information model is based upon object classes

**4.2.38**
**relationship end**
part of the definition of a **relationship** (4.2.37) as seen from a given **entity type** (4.2.21), which is known as the host

NOTE May also be known as an *association end* when the information model is based upon object classes

**4.2.39**
**relationship end group**
statement that links one or more **relationship ends** (4.2.37) to their host **entity type** (4.2.21) such that they are mutually exclusive

NOTE The most common case is where the 'group' comprises just one relationship end

**4.2.40**
**relationship end unique identifier element**
**unique identifier element** (4.2.45) that is a statement that a particular **relationship end** (4.2.38) is a part of a particular **unique identifier** (4.2.44)

**4.2.41**
**row**
sequence of values in a **table** (4.2.43), one for each **column** (4.2.9) of the **table** (4.2.43)

NOTE Within this part this definition applies only to the registration of database structures that conform to the SQL Core specification as described in ISO/IEC 9075-2:2011

**4.2.42**
**schema**
persistent, named collection of descriptors for objects in a database

NOTE 1 Within this part this definition applies only to the registration of database structures that conform to the SQL Core specification as described in ISO/IEC 9075-2:2011

NOTE 2 Adapted from ISO/IEC 9075-1:2011

**4.2.43**
**table**
basic construct used to represent data in the SQL database language

NOTE Within this part this definition applies only to the registration of database structures that conform to the SQL Core specification as described in ISO/IEC 9075-2:2011

**4.2.44**
**unique identifier**
statement that the values of a specified set of **attributes** (4.2.4) and/or **relationship ends** (4.2.38) are sufficient to uniquely identify an instance of an **entity type** (4.2.21)

NOTE May also be known as a *key* or a *unique key*

**4.2.45**
**unique identifier element**
statement that a particular **attribute** (4.2.4) or a particular **relationship end** (4.2.38) is a part of a particular **unique identifier** (4.2.44)

**4.2.46**
**valid value**
one of the explicit set of permitted values that comprise an **enumerated domain** (4.2.22)

**4.2.47**
**validation rule**
statement of the validation that may be applied to a **described domain** (4.2.12)

NOTE This may be a reference to a data type to be applied to attributes, a range of values, or a 'format mask', or any other expression that constrains the domain

## 4.3 Abbreviated terms

**IRI**
Internationalized Resource Identifier

**MFI Core and mapping**
ISO/IEC 19763-10, Information technology – Metamodel Framework for Interoperability – Part-10: Core model and basic mapping

**MFI Information model registration**
ISO/IEC 19763-12, Information technology – Metamodel Framework for Interoperability – Part-12: Metamodel for information model registration

**MDR Metamodel**
ISO/IEC 11179-3:2013, Information technology – Metadata registries (MDR) – Part 3: Registry metamodel and basic attributes

# 5 Structure of MFI Information model registration

## 5.1 Overview of MFI Information model registration

Figure 1 shows the metamodel for the registration of information models developed using the common diagramming techniques and notations listed in Clause 1 above. This metamodel can also be used for registering database structure specifications that conform to the SQL Core specification.

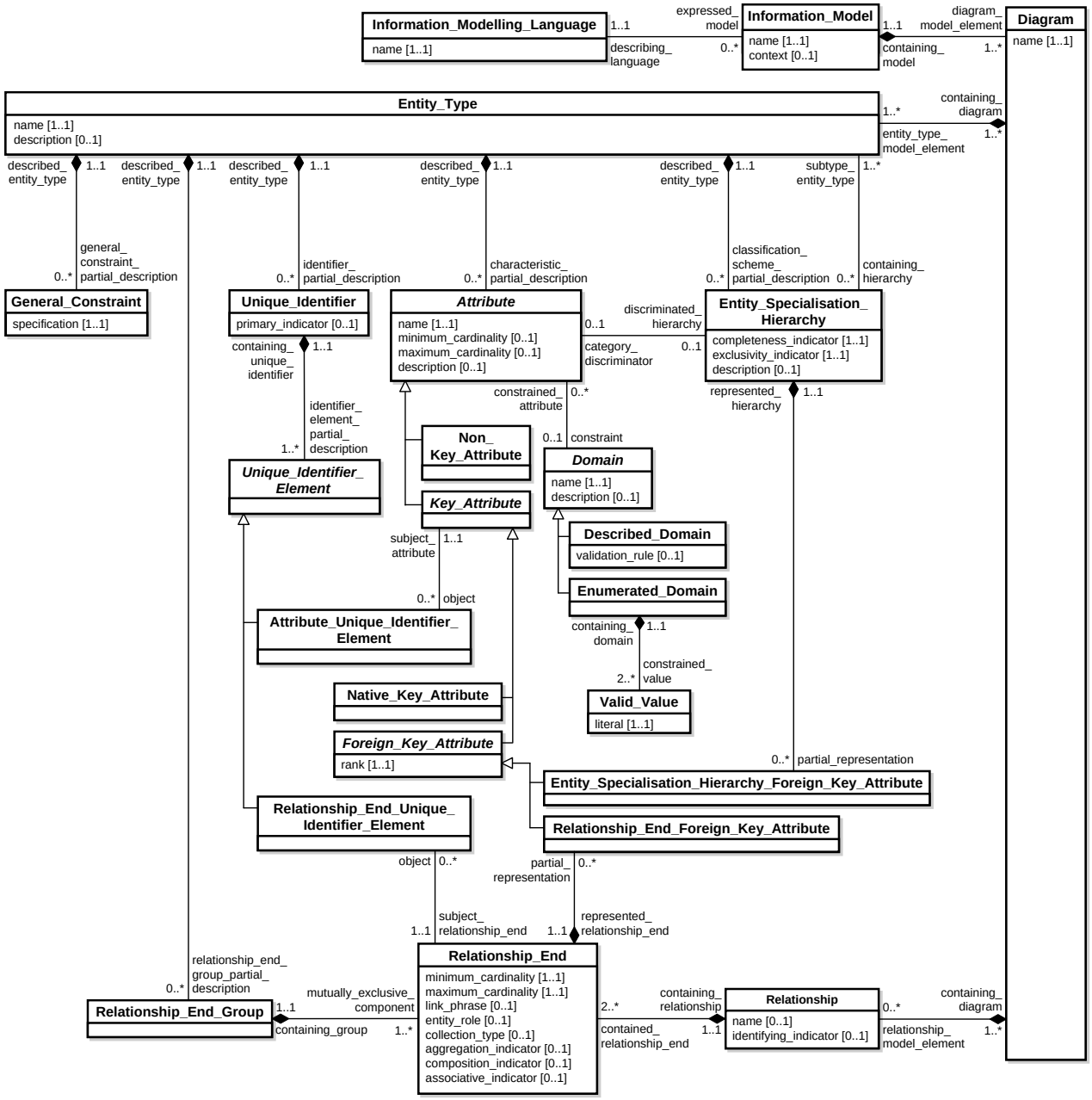


**Figure 1 – Metamodel of MFI Information model registration**

The metamodel for information model registration comprises the following metaclasses:

- **Attribute**
- **Attribute_Unique_Identifier_Element**, a subclass of **Unique_Identifier_Element**
- **Described_Domain**, a subclass of **Domain**
- **Diagram**
- **Domain**
- **Entity_Specialisation_Hierarchy**
- **Entity_Specialisation_Hierarchy_Foreign_Key_Attribute**, a subclass of **Foreign_Key_Attribute**
- **Entity_Type**
- **Enumerated_Domain**, a subclass of **Domain**
- **Foreign_Key_Attribute**, a subclass of **Key_Attribute**
- **General_Constraint**
- **Information_Model**
- **Information_Modelling_Language**
- **Key_Attribute**, a subclass of **Attribute**
- **Native_Key_Attribute**, a subclass of **Key_Attribute**
- **Non_Key_Attribute**, a subclass of **Attribute**
- **Relationship**
- **Relationship_End**
- **Relationship_End_Foreign_Key_Attribute**, a subclass of **Foreign_Key_Attribute**
- **Relationship_End_Group**
- **Relationship_End_Unique_Identifier_Element**, a subclass of **Unique_Identifier_Element**
- **Unique_Identifier**
- **Unique_Identifier_Element**
- **Valid_Value**

The metamodel is described in detail in Annex A (informative). Detailed specifications of the metaclasses are provided in Clause 5.3 below.

## 5.2 Association between MFI Information model registration and MFI Core and mapping

The associations between the metaclasses in MFI Information model registration and the metaclasses in MFI Core and mapping are shown in Figure 2.

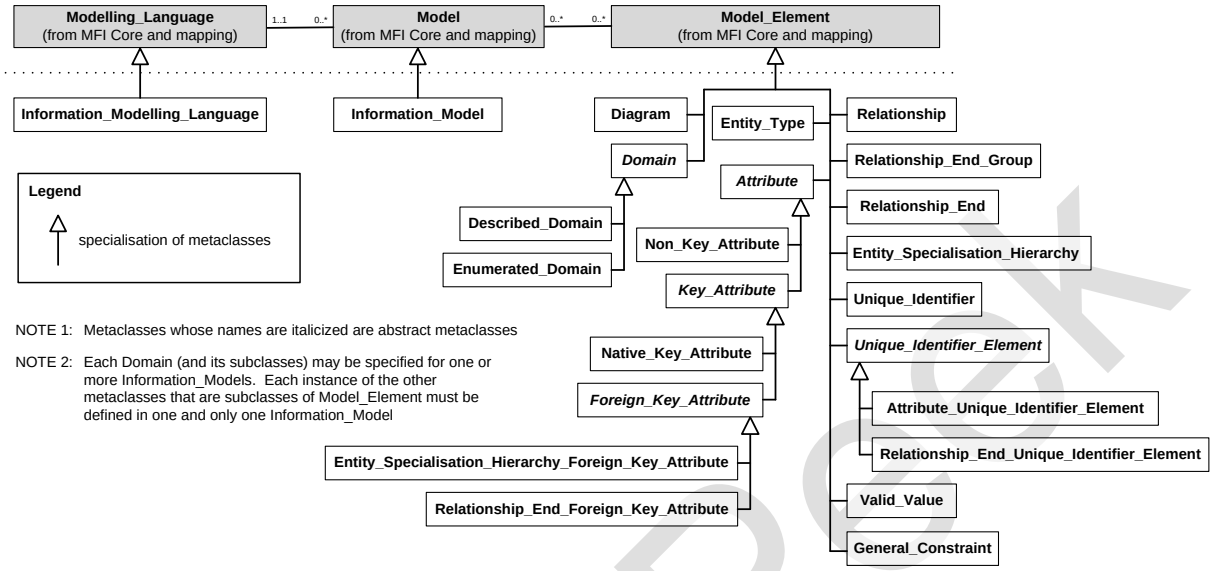


**Figure 2 – The associations between MFI Information model registration and MFI Core and mapping**

Information_Modelling_Language in MFI Information model registration is a specialisation of (or subclass of) Modelling_Language in MFI Core and mapping.

Information_Model in MFI Information model registration is a specialisation of Model in MFI Core and mapping.

All the remaining metaclasses are specialisations of Model_Element in MFI Core and mapping.

The association between Information_Model and Information_Modelling_ Language in MFI Information model registration is a specialisation of the association between Model and Modelling_Language in MFI Core and mapping.

The association between Information_Model and Diagram in MFI Information model registration is a specialization of the association between Model and Model_Element in MFI Core and mapping.

## 5.3 Metaclasses in MFI Information Model Registration

### 5.3.1 Attribute

Attribute is an abstract metaclass each instance of which represents a representation of a particular attribute. The Attribute metaclass may be used to register information about a column in a database structure that conforms to the SQL Core specification as described in ISO/IEC 9075-2:2011

**Superclass**

Model_Element (from MFI Core and mapping)

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| name | String | 1..1 | A name for this attribute. |
| minimum_ cardinality | String | 1..1 | A statement of the minimum number of occurrences of values of this attribute for any particular instance of the associated entity type. In most circumstances this will be '0' (indicating that the attribute is optional) or '1' (indicating that the attribute is mandatory). |
| maximum_ cardinality | String | 0..1 | A statement of the maximum number of occurrences of values of this attribute for any particular instance of the associated entity type. In most information modelling methods this is not specified. |
| description | String | 0..1 | A statement that explains the significance of this attribute to the business and or organisation that is the subject of this information model. |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| described_ entity_type | Entity_Type | 1..1 | The entity type instances which are qualified, identified, classified, quantified or whose state is otherwise expressed by this attribute. | characteristic_ partial_ description | No |
| constraint | Domain | 0..1 | The domain which acts as a constraint on the values taken by this attribute. | constrained_ attribute | No |
| discriminated_ hierarchy | Entity_ Specialisation_ Hierarchy | 0..1 | The entity specialisation hierarchy for which this attribute is the category discriminator. | category_ discriminator | No |

### 5.3.2 Attribute_Unique_Identifier_Element

Attribute_Unique_Identifier_Element is a metaclass each instance of which represents a particular attribute unique identifier element.

**Superclass**

Unique_Identifier_Element

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| [None] | | | |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| subject_ attribute | Key_Attribute | 1..1 | The native key attribute that is used as this unique identifier element. | object | No |

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### 539 5.3.3 Described_Domain

Described_Domain is a metaclass each instance of which represents a representation of a particular described domain.

**Superclass**

Domain

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| validation_rule | String | 0..1 | A statement of the validation that may be applied to this domain. At its simplest it may just be a statement of the data type that may be applied to attributes. It might show upper and lower bounds of a range of values. It might be a 'format mask'. Or, it may be any combination of these. |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|

[None]

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### 541 5.3.4 Diagram

Diagram is a metaclass each instance of which represents a representation of a particular diagram. The Diagram metaclass may be used to register information about a schema in a database structure that conforms to the SQL Core specification as described in ISO/IEC 9075-2:2011

**Superclass**

Model_Element (from MFI Core and mapping)

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| name | String | 1..1 | A name by which this diagram is known. |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| containing_ model | Information_ Model | 1..1 | The information model of which this diagram is a part | diagram_ model_ element | No |
| entity_type_ model_element | Entity_Type | 1..* | The set of entity types which comprise this information model. | containing_ model | Yes |
| relationship_ model_element | Relationship | 0..* | The set of relationships which comprise this information model. | containing_ model | Yes |

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### 5.3.5 Domain

Domain is an abstract metaclass each instance of which represents a representation of a particular domain. The Domain metaclass may be used to register information about a data type in a database structure that conforms to the SQL Core specification as described in ISO/IEC 9075-2:2011

**Superclass**

Model_Element (from MFI Core and mapping)

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| name | String | 1..1 | A name by which this domain is known. |
| description | String | 0..1 | A statement that explains the significance of this domain to the business and or organisation that is the subject of this information model. |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| constrained_ attribute | Attribute | 0..* | The set of attributes whose values are constrained by this domain. | constraint | Yes |

### 5.3.6 Entity_Specialisation_Hierarchy

Entity_Specialisation_Hierarchy is a metaclass each instance of which represents a representation of a particular entity specialisation hierarchy.

**Superclass**

Model_Element (from MFI Core and mapping)

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| completeness_ indicator | Boolean | 1..1 | An indicator that specifies whether the instances of the associated entity subtypes that form this particular entity specialisation hierarchy are the complete set of the instances of the entity type that is the supertype or not. |
| exclusivity_ indicator | Boolean | 1..1 | An indicator that specifies whether the instances of the associated entity subtypes that form this particular entity specialisation hierarchy are mutually exclusive or not. |
| description | String | 0..1 | A statement that describes the purpose or the classification of this particular entity specialisation hierarchy. |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| described_ entity_type | Entity_Type | 1..1 | The entity type whose instances are classified or specialised by this entity specialisation hierarchy. | classification_ scheme_ partial_ description | No |
| subtype_ entity_type | Entity_Type | 1..* | The set of entity types that are the entity subtypes that comprise this entity specialisation hierarchy. | containing_ hierarchy | Yes |
| category_ discriminator | Attribute | 0..1 | The attribute that is the category discriminator for this entity specialisation hierarchy. | discriminated_ hierarchy | Yes |

| | | | | | |
|---|---|---|---|---|---|
| partial_ representation | Entity_Specialisation_ Hierarchy_Foreign_ Key_Attribute | 0..* | The set of foreign key attributes that in sequence represent this entity specialisation hierarchy. | represented_ hierarchy | Yes |

546

547 **5.3.7 Entity_Specialisation_Hierarchy_Foreign_Key_Attribute**

Entity_Specialisation_Hierarchy_Foreign_Key_Attribute is a metaclass each instance of which represents a particular entity specialisation hierarchy foreign key attribute.

**Superclass**

Foreign_Key_Attribute

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| [None] | | | |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| represented_ hierarchy | Entity_ Specialisation_ Hierarchy | 1..1 | The entity specialisation hierarchy which has the entity supertype which is represented by this foreign key attribute along with others in sequence. | partial_ representation | No |

548

549 **5.3.8 Entity_Type**

Entity_Type is a metaclass each instance of which represents a representation of a particular entity type. The Entity_Type metaclass may be used to register information about a table in a database structure that conforms to the SQL Core specification as described in ISO/IEC 9075-2:2011

**Superclass**

Model_Element (from MFI Core and mapping)

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| name | String | 1..1 | A name by which this entity type is known. |
| *description* | String | 0..1 | A statement that explains the significance of this entity type to the business and or organisation that is the subject of this Information Model. |
| annotation | String | 0..1 | A statement that globally identifies a concept in a domain ontology that expresses the meaning or scope of this entity type. It is recommended that this statement should be expressed as an IRI. |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| containing_ diagram | Diagram | 1..1 | The diagram which includes this entity type. | entity_type_ model_ element | No |
| classification_ scheme_partial_ description | Entity_ Specialisation_ Hierarchy | 0..* | The set of entity specialisation hierarchies that are used to classify instances of this entity type. | described_ entity_type | Yes |
| containing_ hierarchy | Entity_ Specialisation_ Hierarchy | 0..* | The set of entity specialisation hierarchies which include this entity type as a subtype. | subtype_ entity_type | No |

| | | | | | |
|---|---|---|---|---|---|
| characteristic_ partial_description | Attribute | 0..* | The set of attributes that are used to qualify, identify, classify, quantify or express the state of any instance of this entity type. | described_ entity_type | Yes |
| relationship_ end_group_ partial_description | Relationship_ End_Group | 0..* | The set of relationship end groups each of which has this entity type as their host entity type. | described_ entity_type | Yes |
| identifier_ partial_description | Unique_ Identifier | 0..* | The set of unique identifiers that uniquely identify an instance of this entity type | described_ entity_type | Yes |
| general_ constraint_ partial_description | General_ Constraint | 0..* | The set of general constraints that apply to instances of this entity type. | described_ entity_type | Yes |

550

551 ### 5.3.9 Enumerated_Domain

Enumerated_Domain is a metaclass each instance of which represents a representation of a particular enumerated domain.

**Superclass**

Domain

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| [None] | | | |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| constrained_ value | Valid_Value | 2..* | The set of valid values that comprise this discrete domain. | containing_ domain | Yes |

552

553

554 ### 5.3.10 Foreign_Key_Attribute

Foreign_Key_Attribute is an abstract metaclass each instance of which represents a representation of a particular foreign key attribute.

**Superclass**

Key_Attribute

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| Rank | Integer | 1..1 | A statement of the position of this foreign key attribute in the foreign key of which it is a part. |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| [None] | | | | | |

555

### 5.3.11 General_Constraint

General_Constraint is a metaclass each instance of which represents a representation of a particular general constraint.

**Superclass**

Model_Element (from MFI Core and mapping)

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| specification | String | 1..1 | A statement of that formally specifies this constraint. |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| described_entity_type | Entity_Type | 1..1 | The entity type that is constrained by this constraint. | general_constraint_partial_description | No |

### 5.3.12 Information_Model

Information_Model is a metaclass each instance of which represents a representation of a particular information model. The Information_Model metaclass may be used to register information about a catalog in a database structure that conforms to the SQL Core specification as described in ISO/IEC 9075-2:2011

**Superclass**

Model (from MFI Core and mapping)

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| name | String | 1..1 | A name by which this information model is known. |
| context | String | 0..1 | A description of the universe of discourse covered by this information model. |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| describing_language | Information_Modelling_Language | 1..1 | The information modelling language in which this model is expressed. | expressed_model | No |
| diagram_model_element | Diagram | 1..* | The set of diagrams which comprise this information model. | containing_model | Yes |

### 5.3.13 Information_Modelling_Language

Information_Modelling_Language is a metaclass each instance of which represents a representation of a particular information modelling language.

**Superclass**

Modelling_Language (from MFI Core and mapping)

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| name | String | 1..1 | A name by which this information modelling language is known. |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| expressed_model | Information_Model | 0..* | The set of information models that are expressed in this language. | describing_language | Yes |

562 **5.3.14 Key_Attribute**

Key_Attribute is an abstract metaclass each instance of which represents a representation of a particular key attribute.

**Superclass**

Attribute

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| [None] | | | |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| object | Attribute_Unique_ Identifier_Element | 0..* | The set of attribute unique identifier elements for which this key attribute acts as such a unique identifier element. | subject_ attribute | Yes |

563

564 **5.3.15 Native_Key_Attribute**

Native_Key_Attribute is a metaclass each instance of which represents a representation of a particular native key attribute.

**Superclass**

Key_Attribute

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| [None] | | | |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| [None] | | | | | |

565

566 **5.3.16 Non_Key_Attribute**

Non_Key_Attribute is a metaclass each instance of which represents a representation of a particular non key attribute.

**Superclass**

Attribute

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| [None] | | | |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| [None] | | | | | |

567

### 5.3.17 Relationship

Relationship is a metaclass each instance of which represents a representation of a particular relationship.

**Superclass**

Model_Element (from MFI Core and mapping)

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| name | String | 0..1 | A name by which this relationship is known. Some information modelling methods do not provide such a name. |
| identifying_ indicator | Boolean | 0..1 | If this relationship is a binary 'one-to-many' relationship, an indicator that specifies whether this relationship provides part (or all) of the primary unique identifier for the entity type that is at the 'many' end of the relationship or not. Not all information modelling methods recognise this concept. |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| containing_ diagram | Diagram | 1..1 | The diagram which includes this relationship. | relationship_ model_ element | No |
| contained_ relationship_ end | Relationship_End | 2..* | The set of relationship ends that comprise this relationship. | containing_ relationship | Yes |

### 5.3.18 Relationship_End

Relationship_End is a metaclass each instance of which represents a particular relationship end.

**Superclass**

Model_Element (from MFI Core and mapping)

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| minimum_ cardinality | String | 1..1 | A statement of the minimum number of instances of the associated entity type (through the associated relationship end group) that must participate in the relationship of which this relationship end is a part. In most circumstances this will be '0' (indicating that the entity type has optional participation) or '1' (indicating that the entity type has mandatory participation). |
| maximum_ cardinality | String | 1..1 | A statement of the maximum number of instances of the associated entity type (through the associated relationship end group) that may participate in the relationship of which this relationship end is a part. In most circumstances this will be '1' (indicating that one and only one entity type may participate) or '*' (indicating that an unspecified number of entity types may participate). |
| link_phrase | String | 0..1 | A statement that explains the nature of the relationship of which this relationship end is a part from the perspective of the associated entity type (through the associated relationship end group). This is normally expressed in business terms. Not all information modelling methods recognise this concept. |
| entity_role | String | 0..1 | A statement that explains the role that the associated entity type (through the associated relationship end group) is playing in the associated relationship. Not all information modelling methods recognise this concept. |

| | | | |
|---|---|---|---|
| collection_ type | String | 0..1 | A statement as whether the instances of the associated entity type (through the associated relationship end group) are considered to be a 'set', a 'bag' (or 'multiset'), a 'list' or an 'array'. Most information modelling methods do not recognise this concept. |
| aggregation_ indicator | Boolean | 0..1 | An indicator that specifies whether the instance of the associated entity type (through the associated relationship end group) is considered to be an aggregation of the instances of the other entity type participating in the relationship (identified through the associated relationship and relationship end group) or not. Most information modelling methods do not recognise this concept. |
| composition_ indicator | Boolean | 0..1 | An indicator that specifies whether the instance of the associated entity type (through the associated relationship end group) is considered to be a composition of the instances of the other entity type participating in the relationship (identified through the associated relationship and relationship end group) or not. Most information modelling methods do not recognise this concept. |
| associative_ indicator | Boolean | 0..1 | An indicator that specifies whether the instance of the associated entity type (through the associated relationship end group) is an associative entity type or not. Most information modelling methods do not recognise this concept. |

| **Reference** | **Class** | **Multiplicity** | **Description** | **Inverse** | **Precedence** |
|---|---|---|---|---|---|
| containing_ relationship | Relationship | 1..1 | The relationship of which this relationship end is a part. | contained_ relationship_ end | No |
| containing_ group | Relationship_End_ Group | 1..1 | The relationship end group of which this relationship is one of the relationship ends each of which is mutually exclusive with others in the group. | mutually_ exclusive_ component | No |
| partial_ representation | Relationship_End_ Foreign_Key_ Attribute | 0..* | The set of foreign key attributes that in sequence represent this relationship end. | represented_ relationship_ end | Yes |
| object | Relationship_End_ Unique_Identifier_ Element | 0..* | The set of relationship end unique identifier elements for which this relationship end acts as such a unique identifier element. | subject_ relationship_ end | Yes |

571

572 **5.3.19 Relationship_End_Foreign_Key_Attribute**

Relationship_End_Foreign_Key_Attribute is a metaclass each instance of which represents a particular relationship end foreign key attribute.

**Superclass**

Foreign_Key_Attribute

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| [None] | | | |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| represented_ relationship_end | Relationship_End | 1..1 | The relationship end which is, along with others in sequence, represented by this foreign key attribute. | partial_ representation | Yes |

573

574 **5.3.20 Relationship_End_Group**

Relationship_End_Group is a metaclass each instance of which represents a particular relationship end group.

**Superclass**

Model_Element (from MFI Core and mapping)

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| [None] | | | |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| described_ entity_type | Entity_Type | 1..1 | The entity type (the host entity type) that is related to other entity types through this relationship end group. | relationship_ end_group_ partial_description | No |
| mutually_ exclusive_ component | Relationship_End | 1..* | The set of relationship ends that form part of this group and are mutually exclusive with each other. | containing_group | Yes |

575

576 **5.3.21 Relationship_End_Unique_Identifier_Element**

Relationship_End_Unique_Identifier_Element is a metaclass each instance of which represents a particular relationship end unique identifier element.

**Superclass**

Unique_Identifier_Element

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| [None] | | | |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| subject_ relationship_ end | Relationship_End | 1..1 | The relationship end that is used as this unique identifier element. | object | Yes |

577

### 5.3.22 Unique_Identifier

Unique_Identifier is a metaclass each instance of which represents a representation of a particular unique identifier.

**Superclass**

Model_Element (from MFI Core and mapping)

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| primary_indicator | Boolean | 0..1 | An indicator that specifies whether this unique identifier is the primary unique identifier of the associated entity or not. Some information modelling methods do not recognise this concept. |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| described_entity_type | Entity_Type | 1..1 | The entity type whose instances can be uniquely identified by this unique identifier. | identifier_partial_description | No |
| identifier_element_partial_description | Unique_Identifier_Element | 1..* | The set of unique identifier elements that comprise this unique identifier. | containing_unique_identifier | Yes |

### 5.3.23 Unique_Identifier_Element

Unique_Identifier_Element is an abstract metaclass each instance of which represents a representation of a particular unique identifier element.

**Superclass**

Model_Element (from MFI Core and mapping)

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| [None] | | | |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| containing_unique_identifier | Unique_Identifier | 1..1 | The unique identifier of which this unique identifier element is a part. | identifier_element_partial_description | No |

### 5.3.24 Valid_Value

Valid_Value is a metaclass each instance of which represents a representation of a particular valid value.

**Superclass**

Model_Element (from MFI Core and mapping)

| Attribute | DataType | Multiplicity | Description |
|---|---|---|---|
| literal | String | 1..1 | The actual permitted value. In a platform independent model it will probably be the concept, for example, 'Male'. In a platform specific model it will probably be the code, for example, 'M' or '0'. |

| Reference | Class | Multiplicity | Description | Inverse | Precedence |
|---|---|---|---|---|---|
| containing_domain | Enumerated_Domain | 1..1 | The enumerated domain of which this valid value is one of the permitted values. | constrained_value | No |

# Annex A
(informative)
# Description of the metamodel

Figure A.1 repeats the metamodel for the registration of information models, which is then described in detail.

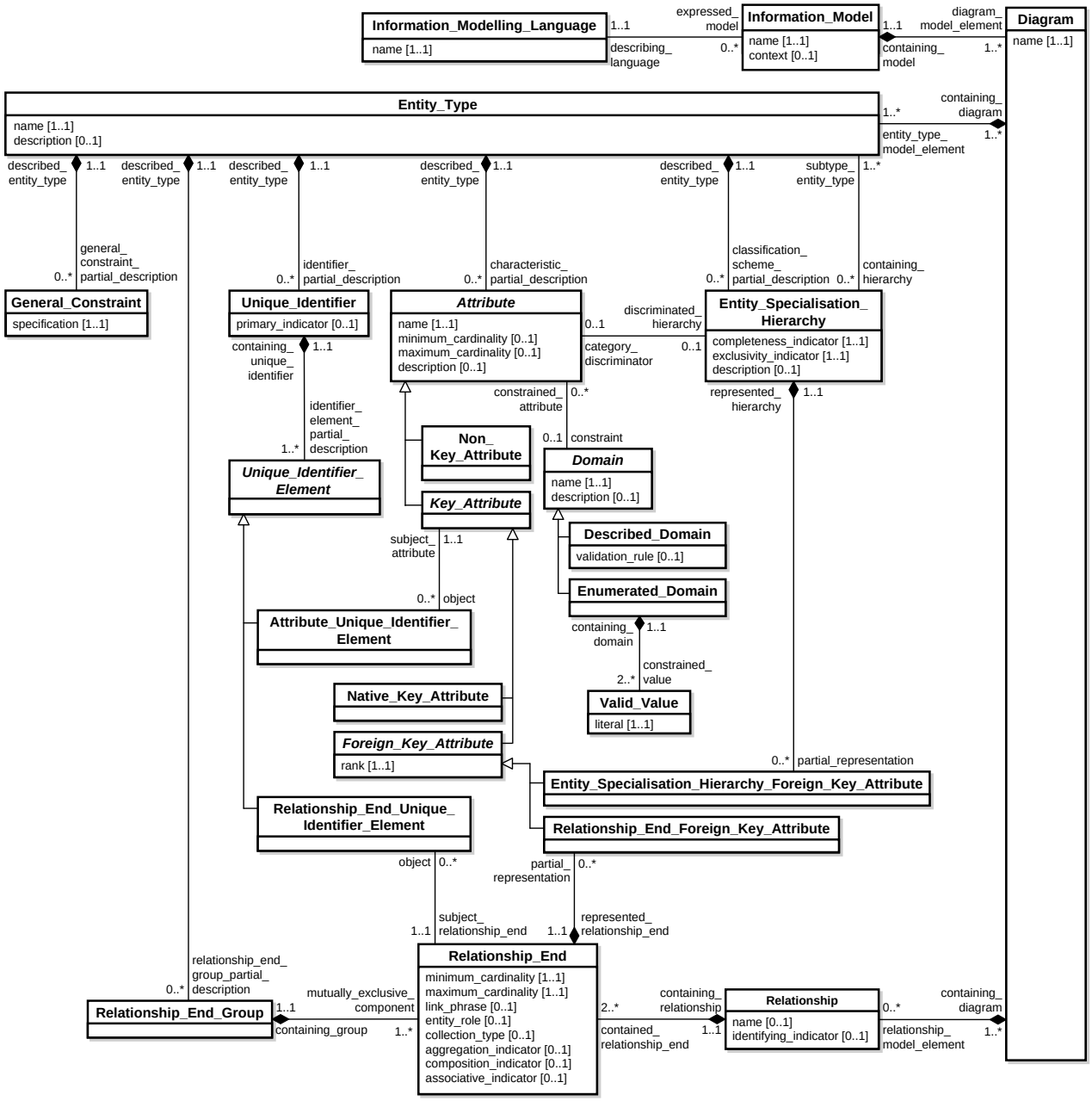



**Figure A.1 – Metamodel of MFI Information model registration (repeated)**

Each information modelling language is a language or notation that is used to model information requirements in an information model. In addition, each information modelling language:

- may be the language used to express zero, one or more information models (each of which are expressed models); not every information modelling language has to be used to express an information model.
- must have a name, which is a unique name by which this information modelling language is known.

Each information model is a graphical and textual representation of entities and the relationships between them. In addition, each information model:

- must be expressed in one and only one information modelling language (the describing language).
- must be comprised of one or more diagrams (each of which are diagram model elements).
- must have a name, which is a unique name by which this information model is known.
- may have a context, which is a description of the universe of discourse covered by the model; not every information model has to have a context.

Each diagram is a technical document showing part of an information model using graphical symbols. In addition, each diagram:

- must be part of one and only one information model (the containing language).
- must be comprised of one or more entity types (each of which are entity type model elements).
- may be comprised of zero, one or more relationships (each of which are relationship model elements); not every diagram has to be comprised of relationships.
- must have a name, which is a unique name by which this diagram is known.

Each entity type is a set of characteristics common to a collection of entities that are instances of the type. In addition, each entity type:

- must be part of one and only one diagram (the containing diagram).
- may be further defined with zero, one or more entity specialisation hierarchies (each of which is a classification scheme partial description); not every entity type has to be further defined with an entity specialisation hierarchy.
- may be used as a subtype in zero, one or more entity specialisation hierarchies; not every entity type has to be used as a subtype in an entity specialisation hierarchy.
- may be with instances described by values assigned to each of zero, one or more attributes (each of which is a characteristic partial description); not every entity type has to be defined with attributes.
- may be related to others through zero, one or more relationship end groups (each of which is a relationship end group partial description); not every entity type has to be related to others through a relationship end group.

- may be with instances identified by zero, one or more unique identifiers (each of which is an identifier partial description); not every entity type has to be defined with a unique identifier.

- may be further constrained by zero, one or more general constraints (each of which is a general constraint partial description); not every entity type has to be further constrained by a general constraint.

- must have a name, which is a unique name by which this entity type is known.

- may have a description, which is a statement that explains the significance of this entity type to the business and or organisation that is the subject of this information model; not every entity type has to have a description.

Each entity specialisation hierarchy is a means by which instances of an entity type may be classified or specialised. In addition, each entity specialisation hierarchy:

- must be a further description of one and only one entity type (the described entity type).

- must be comprised of one or more entity types (each of which is a subtype within the classification scheme).

- may be categorised by zero or one attribute (the category discriminator); most information modelling methods do not recognise the concept of a categorising attribute so not every entity specialisation hierarchy has to be categorised by an attribute.

- may be partially represented by zero, one or more entity specialisation hierarchy foreign key attributes; most information modelling methods do not recognise the concept of a representing entity specialisation hierarchies using foreign keys so not every entity specialisation hierarchy has to be represented by an entity specialisation hierarchy foreign key attribute.

- must have a completeness indicator, which is an indicator that specifies whether the instances of the associated entity subtypes that form this particular entity specialisation hierarchy are the complete set of the instances of the entity type that is the supertype or not.

- must have an exclusivity indicator, which is an indicator that specifies whether the instances of the associated entity subtypes that form this particular entity specialisation hierarchy are mutually exclusive or not.

- may have a description, which is a statement that describes the purpose or the classification of this particular entity specialisation hierarchy; some information modelling methods do not recognise the concept of describing an entity specialisation hierarchy so not every entity specialisation hierarchy has to have a description.

Each relationship is a set of characteristics common to a collection of connections between instances of two or more entity types, or between instances of one entity type and other instances of the same entity type. In addition, each relationship:

- must be part of one and only one diagram (the containing diagram).

- must be comprised of two or more relationship ends (each of which is a contained relationship end).

- may have a name, which is a name, which may not be unique within the information model, by which this relationship is known; some information modelling methods do not provide such a name so not every relationship has to have a name.

- may have an identifying indicator, which, if this relationship is a binary 'one-to-many' relationship, is an indicator that specifies whether this relationship provides part (or all) of the primary unique identifier for the entity type that is at the 'many' end of the relationship or not; not all information modelling methods recognise this concept so not every relationship has to have an identifying indicator.

Each relationship end is the part of the definition of a relationship as seen from a given entity type (the host). In addition, each relationship end:

- must be part of one and only one relationship (the containing relationship).

- must be mutually exclusive with other relationship ends within one and only one relationship end group (the containing group).

- may be represented by a sequence of zero, one or more relationship end foreign key attributes (each of which is a partial representation); some information modelling methods do not represent relationship ends by foreign key attributes so not every relationship end has be represented by a sequence of relationship end foreign key attributes.

- may be used as zero, one or more relationship end unique identifier elements (each of which is an object); some information modelling methods do not use relationship ends as unique identifier elements so not every relationship end has be used as a relationship end unique identifier element.

- must have a minimum cardinality, which is a statement of the minimum number of instances of the associated entity type (through the associated relationship end group) that must participate in the relationship of which this relationship end is a part; in most circumstances this will be '0' (indicating that the entity type has optional participation) or '1' (indicating that the entity type has mandatory participation).

- must have a maximum cardinality, which is a statement of the maximum number of instances of the associated entity type (through the associated relationship end group) that may participate in the relationship of which this relationship end is a part; in most circumstances this will be '1' (indicating that one and only one entity type may participate) or '*' (indicating that an unspecified number of entity types may participate).

- may have a link phrase, which is a statement, normally expressed in business terms, that explains the nature of the relationship of which this relationship end is a part from the perspective of the associated entity type (through the associated relationship end group); some information modelling methods do not use link phrases so not every relationship end has to have a link phrase.

- may have an entity role, which is a statement that explains the role that the associated entity type (through the associated relationship end group) is playing in the associated relationship; some information modelling methods do not use entity role so not every relationship end has to have an entity role.

- may have a collection type, which is a statement as to whether the instances of the associated entity type (through the associated relationship end group) are considered to be a 'set', a 'bag' (or 'multiset'), a 'list' or an 'array'; most information modelling methods do not recognise this concept so not every relationship end has to have a collection type.

- may have an aggregation indicator, which is an indicator that specifies whether the instance of the associated entity type (through the associated relationship end group) is

considered to be an aggregation of the instances of the other entity type participating in the relationship (identified through the associated relationship and relationship end group) or not; most information modelling methods do not recognise this concept so not every relationship end has to have an aggregation indicator.

- may have a composition indicator, which is an indicator that specifies whether the instance of the associated entity type (through the associated relationship end group) is considered to be a composition of the instances of the other entity type participating in the relationship (identified through the associated relationship and relationship end group) or not; most information modelling methods do not recognise this concept so not every relationship end has to have a composition indicator.

- may have an associative indicator, which is an indicator that specifies whether the instance of the associated entity type (through the associated relationship end group) is an associative entity type or not; most information modelling methods do not recognise this concept so not every relationship end has to have an associative indicator.

Each relationship end group is a statement that links one or more relationship ends to their host entity type such that they are mutually exclusive. The most common case is where the 'group' comprises just one relationship end. In addition, each relationship end group:

- must be viewed from one and only one entity type (the described entity type).

- must be defined to include one or more relationship ends (each of which is a mutually exclusive component).

Each attribute is a named characteristic of an entity type whose values serve to qualify, identify, classify, quantify or express the state of an instance of an entity type. In addition, each attribute:

- must be either a key attribute or a non-key attribute, but not both.

- must be defined to be part of the description of one and only one entity type (the described entity type).

- may be assigned with values from zero or one domain (the constraint); some information modelling methods do not recognise the concept of assigning a domain to an attribute so not every attribute has to be assigned with values from a domain.

- may be the category discriminator for zero or one entity specialisation hierarchy (the discriminated hierarchy); most information modelling methods do not recognise the concept of a discriminating or categorising attribute so not every attribute has to be a category discriminator for an entity specialisation hierarchy.

- must have a name, which is a unique name for this attribute; in some information modelling methods this will be unique within the entity type (in which case the entity type name must be concatenated with the attribute name to gain model uniqueness) whilst in other information modelling methods this will be unique within the information model.

- may have a minimum cardinality, which is a statement of the minimum number of occurrences of values of this attribute for any particular instance of the associated entity type; in most circumstances this will be '0' (indicating that the attribute is optional) or '1' (indicating that the attribute is mandatory); some information modelling methods do not recognise the concept of cardinality of attributes so not every attribute has to have a minimum cardinality.

- may have a maximum cardinality, which is a statement of the maximum number of occurrences of values of this attribute for any particular instance of the associated entity

type; in most information modelling methods this is not specified because it is assumed that this the maximum cardinality is '1'; some information modelling methods do not recognise the concept of cardinality of attributes so not every attribute has to have a maximum cardinality.

- may have a description, which is a statement that explains the significance of this attribute to the business and or organisation that is the subject of this information model; some information modelling methods do not recognise the concept of descriptions for attributes so not every attribute has to have a description.

Each non key attribute is an attribute that is not the unique identifier or an element of a composite unique identifier of an entity type or whose value is fully independent of all relationships or other attributes.

Each key attribute is an attribute whose value contributes in some way to the identification of individual instances of the host entity type or of some related entity type. In addition each key attribute:

- must be either a native key attribute or a foreign key attribute, but not both.

- may be used as zero, one or more attribute unique identifier elements; some attributes may not be used as elements of a unique identifier so not every key attribute has to be used as zero, one or more attribute unique identifier elements.

Each native key attribute is a key attribute whose value contributes in some way to the identification of individual instances of the host entity type.

Each foreign key attribute is a key attribute whose value contributes in some way to the identification of the one related instance of that entity type involved in the associated relationship end. In addition, each foreign key attribute:

- must be either a relationship end foreign key attribute or an entity specialisation hierarchy foreign key attribute, but not both.

- must have a rank, which is a statement of the position of this foreign key attribute in the sequence of the foreign key attributes that make up the foreign key of which this foreign key attribute is a part.

Each relationship end foreign key attribute is a foreign key attribute whose referenced attribute is in an entity type that is related to the entity type for which this foreign key attribute is defined through a relationship. In addition, each relationship end foreign key attribute must be part of a sequence forming a representation of one and only one relationship end (the represented relationship end).

Each entity specialisation hierarchy foreign key attribute is a foreign key attribute whose referenced attribute in the entity supertype of the related entity specialisation hierarchy. In addition, each entity specialisation hierarchy foreign key attribute must be part of a sequence forming a representation of one and only one entity specialisation hierarchy (the represented hierarchy).

Each domain is a collection of values from which an instance of an attribute must take its value. A domain provides a set of business validation rules, format constraints and other properties for one or more attributes. In addition, each domain:

- must be either a described domain or an enumerated domain, but not both.

- may be a constraint on zero, one or more attributes (the constrained attribute).

- must have a name, which is a unique name by which this domain is known.

- may have a description, which is a statement that explains the significance of this domain to the business and or organisation that is the subject of this information model; some information modelling methods do not recognise the concept of descriptions for domains so not every domain has to have a significance statement.

Each described domain is a domain whose values are not drawn from an explicit list of valid values. In addition, each described domain may have a validation rule, which is a statement of the validation that may be applied to this domain. At its simplest this validation rule may just be a statement of the data type that may be applied to attributes. It might show upper and lower bounds of a range of values. It might be a 'format mask'. Or, it may be any combination of these. Some information modelling methods do not recognise the concept of validation rules for domains so not every domain has to have a validation rule.

Each enumerated domain is a domain whose permitted values consist of an explicit list of valid values. In addition, each enumerated domain must be constrained to two or more valid values (each of which is a constrained value).

Each valid value is one of the explicit set of permitted values that comprise an enumerated domain. In addition, each valid value:

- must be for one and only one enumerated domain (the constraining domain).

- must have a literal, which is the actual permitted value; in a platform independent model it will probably be the concept, for example, 'Male' whilst in a platform specific model it will probably be the code, for example, 'M' or '0'.

Each unique identifier is a statement that the values of a specified set of attributes and/or relationship ends are sufficient to uniquely identify an instance of an entity type. In addition, each unique identifier:

- must be defined for one and only one entity type (the described entity type).

- must be comprised of one or more unique identifier elements (each of which is an identifier element partial description).

- may have a primary indicator, which is an indicator that specifies whether this unique identifier instance is the primary unique identifier of the associated entity or not; some information modelling methods do not recognise this concept so not every unique identifier has to have a primary indicator.

Each unique identifier element is a statement that a particular attribute or a particular relationship end is a part of a particular unique identifier. In addition, each unique identifier element:

- must be either an attribute unique identifier element or a relationship end unique identifier element, but not both.

- must be part of one and only one unique identifier (the containing unique identifier).

Each attribute unique identifier element is a unique identifier element that is a statement that a particular attribute is a part of a particular unique identifier. In addition, each attribute unique identifier element must be a role played by one and only one key attribute (the subject attribute).

Each relationship end unique identifier element is a unique identifier element that is a statement that a particular relationship end is a part of a particular unique identifier. In addition, each relationship end unique identifier element must be a role played by one and only one relationship end (the subject relationship end).

Each general constraint is a constraint on the instances of an entity type that cannot be expressed using any other constructs in the metamodel. In addition, each general constraint:

- must be defined to be part of the description of one and only one entity type (the described entity type).
- must have a specification, which is a statement that formally specifies this constraint.

# Annex B
(informative)
# Relationship of metaclasses to the MDR Metamodel

As explained in ISO/IEC 19763 Part 10, instances of the metaclasses defined in this part of ISO/IEC 19763 can be extended by types such as defined in the MDR Metamodel as follows:

- Instances of **Information_Modelling_Language** may be extended as an **Identified_Item** and as a **Designatable_Item**.
- Instances of **Information_Model** may be extended as an **Administered_Item** and as a **Designatable_Item**.
- Instances of **Entity_Type** may be extended as an **Attached_Item** and as a **Designatable_Item**.
- Instances of **Entity_Specialisation_Hierarchy** may be extended as an **Attached_Item** and as a **Designatable_Item**.
- Instances of **Relationship** may be extended as an **Attached_Item** and as a **Designatable_Item**.
- Instances of **Relationship_End** may be extended as an **Attached_Item** and as a **Designatable_Item**.
- Instances of **Relationship_End_Group** may be extended as an **Attached_Item**.
- Instances of **Attribute** (and its subclasses) may be extended as an **Attached_Item** and as a **Designatable_Item**.
- Instances of **Domain** (and its subclasses) may be extended as an **Attached_Item** and as a **Designatable_Item**.
- Instances of **Valid_Value** may be extended as an **Attached_Item** and as a **Designatable_Item**.
- Instances of **Unique_Identifier** may be extended as an **Attached_Item**.
- Instances of **Unique_Identifier_Element** (and its subclasses) may be extended as an **Attached_Item**.
- Instances of **General Constraint** may be extended as an **Attached_Item**.

# Annex C
(informative)
# Applicability of information modelling concepts to techniques

Table 1 shows the applicability of major information modelling concepts to the techniques and notations used in the development of this part of ISO/IEC 19763.

**Table C.1 – Use of concepts within techniques**

| Concept | Applicability | | | | | | |
|---|---|---|---|---|---|---|---|
| | Ellis-Barker | IDEF1X | Information Engineering | Chen | Express-G | UML Class Diagrams | SQL DDL |
| Entity types are named | Yes | Yes | Yes | Yes | Yes | Yes | Yes (as Tables) |
| Entity types have descriptions | Optional | Optional | Optional | Optional | Optional | Optional | No |
| Entity specialization hierarchies allowed | Yes | Yes | Yes | No | Yes | Yes | No |
| Only one entity specialization hierarchy allowed | Yes | Yes | Yes | NA | No | No | NA |
| Entity specialization hierarchies must be complete | Yes | No | Yes | NA | No | No | NA |
| Entity subtypes in an entity specialization hierarchy must be mutually exclusive | Yes | Yes | Yes | NA | No | No | NA |
| Relationships have one name | No | Yes | Yes | Yes | Yes | Optional | NA |
| Relationships have two names (link phrases), one for each relationship end | Yes | No | No | No | No | No | NA |
| Relationships are recognised as identifying or non-identifying relationships | Optional | Yes | No | No | No | No | NA |
| Entity types are given role names to signify their role in a relationship | No | No | No | No | No | Optional | NA |
| Entity types at a relationship end can be recognised as being in a collection | No | No | No | No | Yes | No | NA |
| Relationships can be annotated to recognise that the entity types at the other end of the relationship form an ‘aggregation’ | No | No | No | No | No | Yes | NA |
| Relationships can be annotated to recognise that the entity types at the other end of the relationship form an ‘composition’ | No | No | No | No | No | Yes | NA |
| All relationships are binary relationships | Yes | Yes | Yes | No | Yes | Yes | NA |
| *n*-ary relationships allowed | No | No | No | Yes | No | No | NA |
| Attributes are named | Yes | Yes | Yes | Yes | Yes | Yes | Yes (as Columns) |
| Attributes have descriptions | Optional | Optional | Optional | Optional | Optional | Optional | No |
| Domains are named | Yes | Yes (as Data Types) | No | No | Yes (as Data Types) | Yes (as Data Types) | Yes (as Data Types) |
| Domains have descriptions | Optional | Optional | No | No | No | No | No |
| Foreign keys are documented | No | Yes | Optional | No | No | No | Yes |
| Unique identifiers using native key attributes and foreign key attributes are documented | No | Yes | Optional | No | No | No | Yes (as Primary Keys) |
| Unique identifiers using native key attributes and relationships are documented | Optional | No | No | No | No | No | No |

# Annex D
(informative)
# Examples of information model registration

## D.1 Introduction

This annex illustrates the registration of information models using the metamodel specified in MFI Information model registration. The examples are not exhaustive.

The examples all follow the same format. First the example models are presented and this is then followed by a set of illustrative instances. Each instance is identified with the name of the metaclass in angle brackets.

Object identifiers, of the form "ObjectXXX" are introduced to help with the description of the examples. The detailed specification of these identifiers is beyond the scope of this part of the standard.

## D.2 EXPRESS-G example

This example is based on a car sales scenario which is drawn in EXPRESS-G notation (see Figure D.1). Figure D.2 provides the object instances to illustrate the registration of this model.

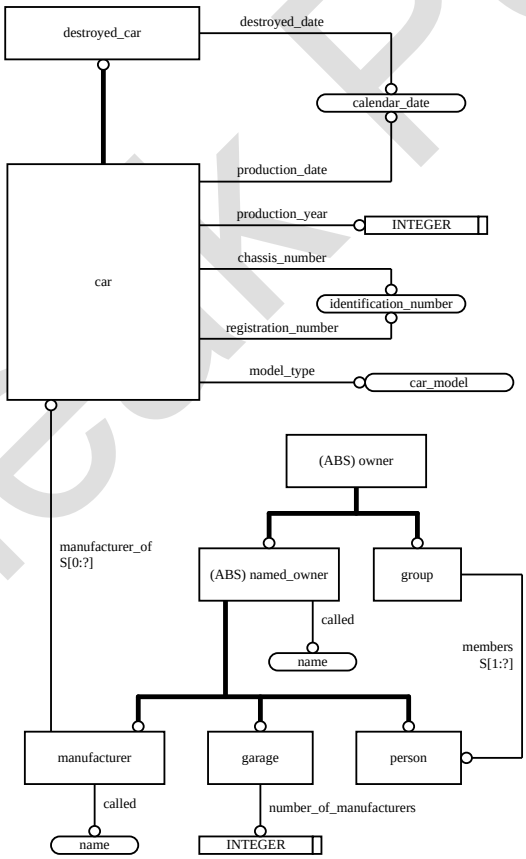



**Figure D.1 – Example information model drawn in EXPRESS-G**

**<Information_Modelling_Language>**
Object101

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "EXPRESS-G" |
| expressed_model | Object102 |

**<Information_Model>**
Object102

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "Car Sales Version 2.7" |
| describing_language | Object101 |
| diagram_model_element | Object103 |

**<Diagram>**
Object103

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "Car Sales Version 2.7 Diagram 1" |
| containing_model | Object102 |
| entity_type_model_element | Object104, Object105, Object106, Object107, Object108, Object109, Object110, Object111 |
| relationship_model_element | Object129, Object130 |

**<Entity_Type>**
Object104

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "car" |
| containing_diagram | Object103 |
| classification_scheme_partial_description | Object112 |
| characteristic_partial_description | Object115, Object116, Object117, Object118, Object119 |
| relationship_end_group_partial_description | Object136 |

**<Entity_Type>**
Object105

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "destroyed_car" |
| containing_diagram | Object103 |
| containing_hierarchy | Object112 |
| characteristic_partial_description | Object120 |

**<Entity_Type>**
Object106

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "owner" |
| containing_diagram | Object103 |
| classification_scheme_partial_description | Object113 |

**<Entity_Type>**
Object107

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "named_owner" |
| containing_diagram | Object103 |
| classification_scheme_partial_description | Object114 |
| containing_hierarchy | Object113 |
| characteristic_partial_description | Object121 |

**<Entity_Type>**
Object108

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "group" |
| containing_diagram | Object103 |
| containing_hierarchy | Object113 |
| relationship_end_group_partial_description | Object137 |

**<Entity_Type>**
Object109

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "manufacturer" |
| containing_diagram | Object103 |
| containing_hierarchy | Object114 |
| characteristic_partial_description | Object122 |
| relationship_end_group_partial_description | Object135 |

**<Entity_Type>**
Object110

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "garage" |
| containing_diagram | Object103 |
| containing_hierarchy | Object114 |
| characteristic_partial_description | Object123 |

**<Entity_Type>**
Object111

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "person" |
| containing_diagram | Object103 |
| containing_hierarchy | Object114 |
| relationship_end_group_partial_description | Object138 |

**<Entity_Specialisation_Hierarchy>**
Object112

| Attribute/Reference | Literal/Instance |
|---|---|
| completeness_indicator | False |
| exclusivity_indicator | True |
| described_entity_type | Object104 |
| subtype_entity_type | Object105 |

**<Entity_Specialisation_Hierarchy>**
Object113

| Attribute/Reference | Literal/Instance |
|---|---|
| completeness_indicator | True |
| exclusivity_indicator | True |
| described_entity_type | Object106 |
| subtype_entity_type | Object107, Object108 |

**<Entity_Specialisation_Hierarchy>**
Object114

| Attribute/Reference | Literal/Instance |
|---|---|
| completeness_indicator | True |
| exclusivity_indicator | True |
| described_entity_type | Object107 |
| subtype_entity_type | Object109, Object110, Object111 |

**<Non_Key_Attribute>**
Object115

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "production_date" |
| described_entity_type | Object104 |
| constraint | Object125 |

**<Non_Key_Attribute>**
Object116

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "production_year" |
| described_entity_type | Object104 |
| constraint | Object124 |

**<Non_Key_Attribute>**
Object117

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "chassis_number" |
| described_entity_type | Object104 |
| constraint | Object126 |

**Figure D.2 – Registration of the EXPRESS-G example (Part 1 of 2)**

**<Non_Key_Attribute>**
Object118

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "registration_number" |
| described_entity_type | Object104 |
| constraint | Object126 |

**<Non_Key_Attribute>**
Object119

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "model_type" |
| described_entity_type | Object104 |
| constraint | Object127 |

**<Non_Key_Attribute>**
Object120

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "destroyed_date" |
| described_entity_type | Object105 |
| constraint | Object125 |

**<Non_Key_Attribute>**
Object121

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "called" |
| described_entity_type | Object107 |
| constraint | Object128 |

**<Non_Key_Attribute>**
Object122

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "called" |
| described_entity_type | Object109 |
| constraint | Object128 |

**<Non_Key_Attribute>**
Object123

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "number_of_manufacturers" |
| described_entity_type | Object110 |
| constraint | Object124 |

**<Described_Domain>**
Object124

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "INTEGER" |
| constrained_attribute | Object116, Object123 |

**<Described_Domain>**
Object125

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "calendar_date" |
| constrained_attribute | Object115, Object120 |

**<Described_Domain>**
Object126

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "identification_number" |
| constrained_attribute | Object117, Object118 |

**<Described_Domain>**
Object127

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "car_model" |
| constrained_attribute | Object119 |

**<Described_Domain>**
Object128

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "name" |
| constrained_attribute | Object121, Object122 |

**<Relationship>**
Object129

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "manufacturer_of" |
| containing_diagram | Object103 |
| contained_relationship_end | Object131, Object132 |

**<Relationship>**
Object130

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "members" |
| containing_diagram | Object103 |
| contained_relationship_end | Object133, Object134 |

**<Relationship_End>**
Object131

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| containing_relationship | Object129 |
| containing_group | Object135 |

**<Relationship_End>**
Object132

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "Many" |
| collection_type | "Set" |
| containing_relationship | Object129 |
| containing_group | Object136 |

**<Relationship_End>**
Object133

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| containing_relationship | Object130 |
| containing_group | Object137 |

**<Relationship_End>**
Object134

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "Many" |
| collection_type | "Set" |
| containing_relationship | Object130 |
| containing_group | Object138 |

**<Relationship_End_Group>**
Object135

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object109 |
| mutually_exclusive_component | Object131 |

**<Relationship_End_Group>**
Object136

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object104 |
| mutually_exclusive_component | Object132 |

**<Relationship_End_Group>**
Object137

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object108 |
| mutually_exclusive_component | Object133 |

**<Relationship_End_Group>**
Object138

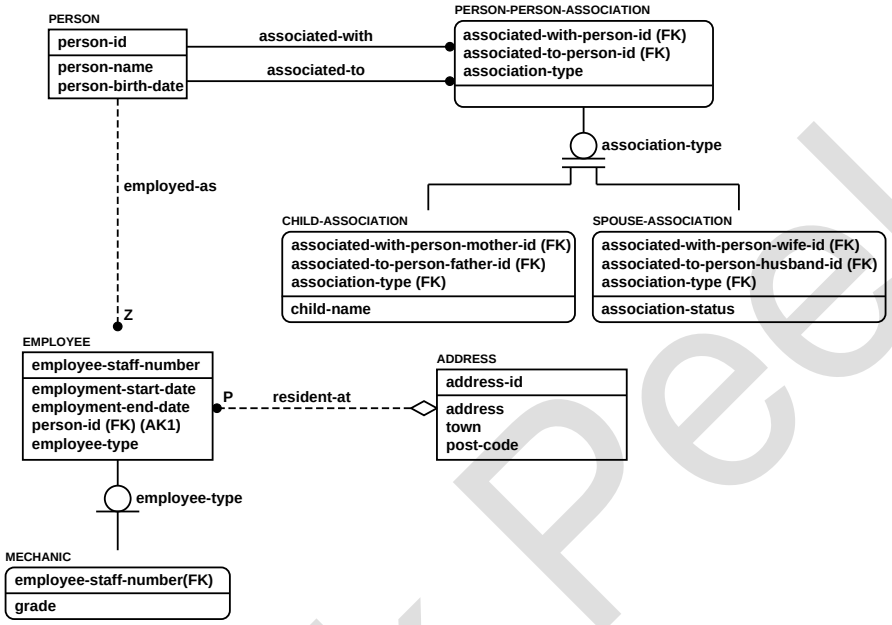
| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object111 |
| mutually_exclusive_component | Object134 |

**Figure D.2 – Registration of the EXPRESS-G example (Part 2 of 2)**

907

## 908 D.3 IDEF1X example

909 This example is based on an employee relationships scenario which is drawn in IDEF1X notation (see
910 Figure D.3). Figure D.4 provides the object instances to illustrate the registration of this model.




911

912 **Figure D.3 – Example information model drawn in IDEF1X**

**<Information_Modelling_Language>**
Object201

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "IDEF1X" |
| expressed_model | Object202 |

**<Information_Model>**
Object202

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "Employee Relationships V0.4" |
| describing_language | Object201 |
| diagram_model_element | Object203 |

**<Diagram>**
Object203

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "Employee Relationships V0.4 Diagram 1" |
| containing_model | Object202 |
| entity_type_model_element | Object204, Object205, Object206, Object207, Object208, Object209, Object210 |
| relationship_model_element | Object213, Object214, Object215, Object216 |

**<Entity_Type>**
Object204

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "PERSON" |
| containing_diagram | Object203 |
| characteristic_partial_description | Object234, Object235, Object236 |
| relationship_end_group_partial_description | Object225, Object227, Object229 |
| identifier_partial_description | Object277 |

**<Entity_Type>**
Object205

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "EMPLOYEE" |
| containing_diagram | Object203 |
| classification_scheme_partial_description | Object211 |
| characteristic_partial_description | Object237, Object238, Object239, Object240, Object241 |
| relationship_end_group_partial_description | Object230, Object231 |
| identifier_partial_description | Object278, Object 279 |

913

914 **Figure D.4 – Registration of the IDEF1X example (Part 1 of 7)**

**<Entity_Type>**
Object206

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "MECHANIC" |
| containing_diagram | Object203 |
| containing_hierarchy | Object211 |
| characteristic_partial_description | Object242, Object243 |
| identifier_partial_description | Object280 |

**<Entity_Type>**
Object207

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "ADDRESS" |
| containing_diagram | Object203 |
| characteristic_partial_description | Object244, Object245, Object246, Object247 |
| relationship_end_group_partial_description | Object232 |
| identifier_partial_description | Object281 |

**<Entity_Type>**
Object208

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "PERSON-PERSON-ASSOCIATION" |
| containing_diagram | Object203 |
| classification_scheme_partial_description | Object212 |
| characteristic_partial_description | Object248, Object249, Object250 |
| relationship_end_group_partial_description | Object226, Object228 |
| identifier_partial_description | Object282 |

**<Entity_Type>**
Object209

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "CHILD-ASSOCIATION" |
| containing_diagram | Object203 |
| containing_hierarchy | Object212 |
| characteristic_partial_description | Object251, Object252, Object253, Object254 |
| identifier_partial_description | Object283 |

**<Entity_Type>**
Object210

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "SPOUSE-ASSOCIATION" |
| containing_diagram | Object203 |
| containing_hierarchy | Object212 |
| characteristic_partial_description | Object255, Object256, Object257, Object 258 |
| identifier_partial_description | Object284 |

**<Entity_Specialisation_Hierarchy>**
Object211

| Attribute/Reference | Literal/Instance |
|---|---|
| completeness_indicator | False |
| exclusivity_indicator | True |
| described_entity_type | Object205 |
| subtype_entity_type | Object206 |
| category_discriminator | Object241 |
| partial_representation | Object242 |

**<Entity_Specialisation_Hierarchy>**
Object212

| Attribute/Reference | Literal/Instance |
|---|---|
| completeness_indicator | True |
| exclusivity_indicator | True |
| described_entity_type | Object208 |
| subtype_entity_type | Object209, Object210 |
| category_discriminator | Object250 |
| partial_representation | Object251, Object252, Object253, Object255, Object256, Object257 |

**<Relationship>**
Object213

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "associated-with" |
| containing_diagram | Object203 |
| identifying_indicator | True |
| contained_relationship_end | Object217, Object218 |

**<Relationship>**
Object214

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "associated-to" |
| containing_diagram | Object203 |
| identifying_indicator | True |
| contained_relationship_end | Object219, Object220 |

**<Relationship>**
Object215

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "employed_as" |
| containing_diagram | Object203 |
| identifying_indicator | False |
| contained_relationship_end | Object221, Object222 |

**<Relationship>**
Object216

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "resident-at" |
| containing_diagram | Object203 |
| identifying_indicator | False |
| contained_relationship_end | Object223, Object224 |

**<Relationship_End>**
Object217

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| containing_relationship | Object213 |
| containing_group | Object225 |

**<Relationship_End>**
Object218

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "Zero" |
| maximum_cardinality | "Many" |
| containing_relationship | Object213 |
| containing_group | Object226 |
| partial_representation | Object248 |

**<Relationship_End>**
Object219

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| containing_relationship | Object214 |
| containing_group | Object227 |

**<Relationship_End>**
Object220

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "Zero" |
| maximum_cardinality | "Many" |
| containing_relationship | Object214 |
| containing_group | Object228 |
| partial_representation | Object249 |

**<Relationship_End>**
Object221

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| containing_relationship | Object215 |
| containing_group | Object229 |



915

916 **Figure D.4 – Registration of the IDEF1X example (Part 2 of 7)**

**<Relationship_End>**
Object222

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "Zero" |
| maximum_cardinality | "Many" |
| containing_relationship | Object215 |
| containing_group | Object230 |
| partial_representation | Object240 |

**<Relationship_End>**
Object223

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "Many" |
| containing_relationship | Object216 |
| containing_group | Object231 |

**<Relationship_End>**
Object224

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "Zero" |
| maximum_cardinality | "One" |
| containing_relationship | Object216 |
| containing_group | Object232 |

**<Relationship_End_Group>**
Object225

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object204 |
| mutually_exclusive_component | Object217 |

**<Relationship_End_Group>**
Object226

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object208 |
| mutually_exclusive_component | Object218 |

**<Relationship_End_Group>**
Object227

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object204 |
| mutually_exclusive_component | Object219 |

**<Relationship_End_Group>**
Object228

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object208 |
| mutually_exclusive_component | Object220 |

**<Relationship_End_Group>**
Object229

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object204 |
| mutually_exclusive_component | Object221 |

**<Relationship_End_Group>**
Object230

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object205 |
| mutually_exclusive_component | Object222 |

**<Relationship_End_Group>**
Object231

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object205 |
| mutually_exclusive_component | Object223 |

**<Relationship_End_Group>**
Object232

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object207 |
| mutually_exclusive_component | Object224 |

**<Native_Key_Attribute>**
Object234

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "person-id" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object204 |
| object | Object285 |

**<Non_Key_Attribute>**
Object235

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "person-name" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object204 |

**<Non_Key_Attribute>**
Object236

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "person-birth-date" |
| minimum_cardinality | "Zero" |
| maximum_cardinality | "One" |
| described_entity_type | Object204 |

**<Native_Key_Attribute>**
Object237

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "employee-staff-number" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object205 |
| object | Object286 |

**<Non_Key_Attribute>**
Object236

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "employment-start-date" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object205 |

**<Non_Key_Attribute>**
Object239

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "employment-end-date" |
| minimum_cardinality | "Zero" |
| maximum_cardinality | "One" |
| described_entity_type | Object205 |

**<Relationship_End_Foreign_Key_Attribute>**
Object240

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "person-id" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| rank | 1 |
| described_entity_type | Object205 |
| object | Object287 |
| represented_relationship_end | Object222 |

**Figure D.4 – Registration of the IDEF1X example (Part 3 of 7)**

**<Non_Key_Attribute>**
Object241

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “employee_type” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| described_entity_type | Object205 |
| constraint | Object261 |
| discriminated_hierarchy | Object211 |

**<Entity_Specialisation_Hierarchy_Foreign_Key_Attribute>**
Object242

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “employee-staff-number” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| rank | 1 |
| described_entity_type | Object206 |
| object | Object288 |
| represented_hierarchy | Object211 |

**<Non_Key_Attribute>**
Object243

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “grade” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| described_entity_type | Object206 |
| constraint | Object262 |

**<Native_Key_Attribute>**
Object244

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “address-id” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| described_entity_type | Object207 |
| object | Object289 |

**<Non_Key_Attribute>**
Object245

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “address” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| described_entity_type | Object207 |

**<Non_Key_Attribute>**
Object246

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “town” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| described_entity_type | Object207 |

**<Non_Key_Attribute>**
Object247

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “post-code” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| described_entity_type | Object207 |

**<Relationship_End_Foreign_Key_Attribute>**
Object248

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “associated-with-person-id” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| rank | 1 |
| described_entity_type | Object208 |
| object | Object290 |
| represented_relationship_end | Object218 |

**<Relationship_End_Foreign_Key_Attribute>**
Object249

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “associated-to-person-id” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| rank | 1 |
| described_entity_type | Object208 |
| object | Object291 |
| represented_relationship_end | Object220 |

**<Native_Key_Attribute>**
Object250

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “association-type” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| described_entity_type | Object208 |
| constraint | Object259 |
| object | Object292 |
| discriminated_hierarchy | Object212 |

**<Entity_Specialisation_Hierarchy_Foreign_Key_Attribute>**
Object251

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “associated-with-person-mother-id” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| rank | 1 |
| described_entity_type | Object209 |
| object | Object293 |
| represented_hierarchy | Object212 |

**<Entity_Specialisation_Hierarchy_Foreign_Key_Attribute>**
Object252

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “associated-to-person-father-id” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| rank | 2 |
| described_entity_type | Object209 |
| object | Object294 |
| represented_hierarchy | Object212 |

**<Entity_Specialisation_Hierarchy_Foreign_Key_Attribute>**
Object253

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “association-type” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| rank | 3 |
| described_entity_type | Object209 |
| constraint | Object259 |
| object | Object295 |
| represented_hierarchy | Object212 |

**Figure D.4 – Registration of the IDEF1X example (Part 4 of 7)**

**<Non_Key_Attribute>**
Object254

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "child-name" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object209 |

**<Entity_Specialisation_Hierarchy_Foreign_Key_Attribute>**
Object255

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "associated-with-person-wife-id" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| rank | 1 |
| described_entity_type | Object210 |
| object | Object296 |
| represented_hierarchy | Object212 |

**<Entity_Specialisation_Hierarchy_Foreign_Key_Attribute>**
Object256

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "associated-to-person-husband-id" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| rank | 2 |
| described_entity_type | Object210 |
| object | Object297 |
| represented_hierarchy | Object212 |

**<Entity_Specialisation_Hierarchy_Foreign_Key_Attribute>**
Object257

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "association-type" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| rank | 3 |
| described_entity_type | Object210 |
| constraint | Object259 |
| object | Object298 |
| represented_hierarchy | Object212 |

**<Non_Key_Attribute>**
Object258

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "association-status" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object210 |
| constraint | Object260 |

**<Enumerated_Domain>**
Object259

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "association-type" |
| constrained_attribute | Object250, Object253, Object257 |
| constrained_value | Object263, Object264 |

**<Enumerated_Domain>**
Object260

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "association-status" |
| constrained_attribute | Object258 |
| constrained_value | Object265, Object266, Object267 Object268, Object269, Object270 Object271 |

**<Enumerated_Domain>**
Object261

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "employee-type" |
| constrained_attribute | Object241 |
| constrained_value | Object272, Object273 |

**<Enumerated_Domain>**
Object262

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "grade" |
| constrained_attribute | Object243 |
| constrained_value | Object274, Object275, Object276 |

**<Valid_Value>**
Object263

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "child-association" |
| containing_domain | Object259 |

**<Valid_Value>**
Object264

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "spouse-association" |
| containing_domain | Object259 |

**<Valid_Value>**
Object265

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "current-marriage" |
| containing_domain | Object260 |

**<Valid_Value>**
Object266

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "current-civil-partnership" |
| containing_domain | Object260 |

**<Valid_Value>**
Object267

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "current-cohabitation" |
| containing_domain | Object260 |

**<Valid_Value>**
Object268

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "separated" |
| containing_domain | Object260 |

**<Valid_Value>**
Object269

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "divorced" |
| containing_domain | Object260 |

**<Valid_Value>**
Object270

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "wife-deceased" |
| containing_domain | Object260 |

**<Valid_Value>**
Object271

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "husband-deceased" |
| containing_domain | Object260 |

**Figure D.4 – Registration of the IDEF1X example (Part 5 of 7)**

**<Valid_Value>**
Object272

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "mechanic" |
| containing_domain | Object261 |

**<Valid_Value>**
Object273

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "other-employee" |
| containing_domain | Object261 |

**<Valid_Value>**
Object274

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "trainee-mechanic" |
| containing_domain | Object262 |

**<Valid_Value>**
Object275

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "trained-mechanic" |
| containing_domain | Object262 |

**<Valid_Value>**
Object276

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "lead-mechanic" |
| containing_domain | Object262 |

**<Unique_ Identifier>**
Object277

| Attribute/Reference | Literal/Instance |
|---|---|
| primary_indicator | True |
| described_entity_type | Object204 |
| identifier_element_partial_ description | Object285 |

**<Unique_ Identifier>**
Object278

| Attribute/Reference | Literal/Instance |
|---|---|
| primary_indicator | True |
| described_entity_type | Object205 |
| identifier_element_partial_ description | Object286 |

**<Unique_ Identifier>**
Object279

| Attribute/Reference | Literal/Instance |
|---|---|
| primary_indicator | False |
| described_entity_type | Object205 |
| identifier_element_partial_ description | Object287 |

**<Unique_ Identifier>**
Object280

| Attribute/Reference | Literal/Instance |
|---|---|
| primary_indicator | True |
| described_entity_type | Object206 |
| identifier_element_partial_ description | Object288 |

**<Unique_ Identifier>**
Object281

| Attribute/Reference | Literal/Instance |
|---|---|
| primary_indicator | True |
| described_entity_type | Object207 |
| identifier_element_partial_ description | Object289 |

**<Unique_ Identifier>**
Object282

| Attribute/Reference | Literal/Instance |
|---|---|
| primary_indicator | True |
| described_entity_type | Object208 |
| identifier_element_partial_ description | Object290, Object291, Object292 |

**<Unique_ Identifier>**
Object283

| Attribute/Reference | Literal/Instance |
|---|---|
| primary_indicator | True |
| described_entity_type | Object209 |
| identifier_element_partial_ description | Object293, Object294, Object295 |

**<Unique_ Identifier>**
Object284

| Attribute/Reference | Literal/Instance |
|---|---|
| primary_indicator | True |
| described_entity_type | Object210 |
| identifier_element_partial_ description | Object296, Object297, Object298 |

**<Attribute_Unique_ Identifier_Element>**
Object285

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object277 |
| subject_attribute | Object234 |

**<Attribute_Unique_ Identifier_Element>**
Object286

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object278 |
| subject_attribute | Object237 |

**<Attribute_Unique_ Identifier_Element>**
Object287

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object279 |
| subject_attribute | Object240 |

**<Attribute_Unique_ Identifier_Element>**
Object288

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object280 |
| subject_attribute | Object242 |

**<Attribute_Unique_ Identifier_Element>**
Object289

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object281 |
| subject_attribute | Object244 |

**Figure D.4 – Registration of the IDEF1X example (Part 6 of 7)**

<Attribute_Unique_ Identifier_Element>
Object290

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object282 |
| subject_attribute | Object248 |

<Attribute_Unique_ Identifier_Element>
Object295

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object283 |
| subject_attribute | Object253 |

<Attribute_Unique_ Identifier_Element>
Object291

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object282 |
| subject_attribute | Object249 |

<Attribute_Unique_ Identifier_Element>
Object296

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object284 |
| subject_attribute | Object255 |

<Attribute_Unique_ Identifier_Element>
Object292

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object282 |
| subject_attribute | Object250 |

<Attribute_Unique_ Identifier_Element>
Object297

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object284 |
| subject_attribute | Object256 |

<Attribute_Unique_ Identifier_Element>
Object293

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object283 |
| subject_attribute | Object251 |

<Attribute_Unique_ Identifier_Element>
Object298

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object284 |
| subject_attribute | Object257 |

<Attribute_Unique_ Identifier_Element>
Object294

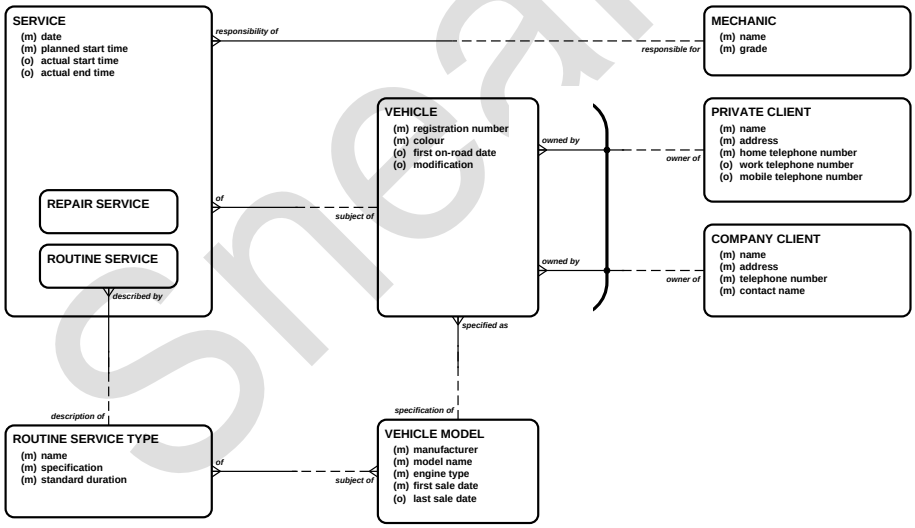
| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object283 |
| subject_attribute | Object252 |

925

926 **Figure D.4 – Registration of the IDEF1X example (Part 7 of 7)**

## 927 D.4 Ellis-Barker example

928 This example is based on a vehicle servicing scenario which is drawn in Ellis-Barker notation (see Figure
929 D.5). Figure D.6 provides the object instances to illustrate the registration of this model.




930

931 **Figure D.5 – Example information model drawn in 'Ellis-Barker' notation**

**<Information_Modelling_Language>**
Object301

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "E-R (Ellis-Barker)" |
| expressed_model | Object302 |

**<Information_Model>**
Object302

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "Robinson Motors Vehicle Service Recording Ver 1.0" |
| describing_language | Object301 |
| diagram_model_element | Object303 |

**<Diagram>**
Object303

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "Robinson Motors Vehicle Service Recording Ver 1.0 Diagram 1" |
| containing_model | Object302 |
| entity_type_model_element | Object304, Object310, Object315, Object318, Object324, Object329, Object333, Object339, Object341 |
| relationship_model_element | Object365, Object369, Object374, Object379, Object384, Object389, Object394 |

**<Entity_Type>**
Object304

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "PRIVATE CLIENT" |
| description | "has significance as a client of Robinson Motors who is the personal owner of a vehicle serviced by Robinson Motors" |
| containing_diagram | Object303 |
| characteristic_partial_description | Object305, Object306, Object307, Object308, Object309 |
| relationship_end_group_partial_description | Object363 |

**<Non_Key_Attribute>**
Object305

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "name" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object304 |
| constraint | Object342 |

**<Non_Key_Attribute>**
Object306

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "address" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object304 |
| constraint | Object343 |

**<Non_Key_Attribute>**
Object307

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "home telephone number" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object304 |
| constraint | Object344 |

**<Non_Key_Attribute>**
Object308

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "work telephone number" |
| minimum_cardinality | "Zero" |
| maximum_cardinality | "One" |
| described_entity_type | Object304 |
| constraint | Object344 |

**<Non_Key_Attribute>**
Object309

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "mobile telephone number" |
| minimum_cardinality | "Zero" |
| maximum_cardinality | "One" |
| described_entity_type | Object304 |
| constraint | Object344 |

**<Entity_Type>**
Object310

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "COMPANY CLIENT" |
| description | "has significance as a client of Robinson Motors who is the company owner of a vehicle serviced by Robinson Motors" |
| containing_diagram | Object303 |
| characteristic_partial_description | Object311, Object312, Object313, Object314 |
| relationship_end_group_partial_description | Object371 |

**<Non_Key_Attribute>**
Object311

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "name" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object310 |
| constraint | Object345 |

**<Non_Key_Attribute>**
Object312

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "address" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object310 |
| constraint | Object343 |

**<Non_Key_Attribute>**
Object313

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "telephone number" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object310 |
| constraint | Object344 |

**<Non_Key_Attribute>**
Object314

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "contact name" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object310 |
| constraint | Object342 |

**Figure D.6 – Registration of the Ellis-Barker example (Part 1 of 6)**

**<Entity_Type>**
Object315

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "MECHANIC" |
| description | "has significance as an employee of Robinson Motors who is qualified to repair vehicles" |
| containing_diagram | Object303 |
| characteristic_partial_description | Object316, Object317 |
| relationship_end_group_partial_description | Object396 |

**<Non_Key_Attribute>**
Object316

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "name" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object315 |
| constraint | Object342 |

**<Non_Key_Attribute>**
Object317

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "grade" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object315 |
| constraint | Object346 |

**<Entity_Type>**
Object318

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "VEHICLE MODEL" |
| description | "has significance as the specification of one or more of the vehicles serviced by Robinson Motors" |
| containing_diagram | Object303 |
| characteristic_partial_description | Object319, Object320, Object321, Object322, Object323 |
| relationship_end_group_partial_description | Object376, Object377 |

**<Non_Key_Attribute>**
Object319

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "manufacturer" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object318 |
| constraint | Object345 |

**<Non_Key_Attribute>**
Object320

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "model name" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object318 |
| constraint | Object350 |

**<Non_Key_Attribute>**
Object321

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "engine type" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object318 |
| constraint | Object351 |

**<Non_Key_Attribute>**
Object322

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "first sale date" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object318 |
| constraint | Object354 |

**<Non_Key_Attribute>**
Object323

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "last sale date" |
| minimum_cardinality | "Zero" |
| maximum_cardinality | "One" |
| described_entity_type | Object318 |
| constraint | Object354 |

**<Entity_Type>**
Object324

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "VEHICLE" |
| description | "has significance as a vehicle serviced by Robinson Motors" |
| containing_diagram | Object303 |
| characteristic_partial_description | Object325, Object326, Object327, Object328 |
| relationship_end_group_partial_description | Object367, Object372, Object391 |

**<Non_Key_Attribute>**
Object325

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "registration number" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object324 |
| constraint | Object355 |

**<Non_Key_Attribute>**
Object326

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "colour" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object324 |
| constraint | Object356 |

**<Non_Key_Attribute>**
Object327

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "first on-road date" |
| minimum_cardinality | "Zero" |
| maximum_cardinality | "One" |
| described_entity_type | Object324 |
| constraint | Object354 |

**<Non_Key_Attribute>**
Object328

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "modification" |
| minimum_cardinality | "Zero" |
| maximum_cardinality | "One" |
| described_entity_type | Object324 |
| constraint | Object357 |

**Figure D.6 – Registration of the Ellis-Barker example (Part 2 of 6)**

**<Entity_Type>**
Object329

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "ROUTINE SERVICE TYPE" |
| description | "has significance as the specification of a routine service that is specified for a particular vehicle model" |
| containing_diagram | Object303 |
| characteristic_partial_description | Object330, Object331, Object332 |
| relationship_end_group_partial_description | Object381, Object 382 |

**<Non_Key_Attribute>**
Object330

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "name" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object329 |
| constraint | Object358 |

**<Non_Key_Attribute>**
Object331

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "specification" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object329 |
| constraint | Object359 |

**<Non_Key_Attribute>**
Object332

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "standard duration" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object329 |
| constraint | Object360 |

**<Entity_Type>**
Object333

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "SERVICE" |
| description | "has significance as a job of work carried out on a vehicle by Robinson Motors; it may be a routine service or a repair service" |
| containing_diagram | Object303 |
| classification_scheme_partial_description | Object334 |
| characteristic_partial_description | Object335, Object336, Object337, Object338 |
| relationship_end_group_partial_description | Object387, Object392 |

**<Entity_Specialisation_Hierarchy>**
Object334

| Attribute/Reference | Literal/Instance |
|---|---|
| completeness_indicator | True |
| exclusivity_indicator | True |
| described_entity_type | Object333 |
| subtype_entity_type | Object339, Object341 |

**<Non_Key_Attribute>**
Object335

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "date" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object333 |
| constraint | Object354 |

**<Non_Key_Attribute>**
Object336

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "planned start time" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object333 |
| constraint | Object361 |

**<Non_Key_Attribute>**
Object337

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "actual start time" |
| minimum_cardinality | "Zero" |
| maximum_cardinality | "One" |
| described_entity_type | Object333 |
| constraint | Object361 |

**<Non_Key_Attribute>**
Object338

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "actual end time" |
| minimum_cardinality | "Zero" |
| maximum_cardinality | "One" |
| described_entity_type | Object333 |
| constraint | Object361 |

**<Entity_Type>**
Object339

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "REPAIR SERVICE" |
| description | "has significance as a type of service which is carried out as a result of a malfunction of the vehicle or an accident" |
| containing_diagram | Object303 |
| containing_hierarchy | Object334 |
| characteristic_partial_description | Object340 |

**<Non_Key_Attribute>**
Object340

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "description" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object339 |
| constraint | Object362 |



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**<Entity_Type>**
Object341

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "ROUTINE SERVICE" |
| description | "has significance as a type of service which is carried out as part of the routine maintenance of the vehicle" |
| containing_diagram | Object303 |
| containing_hierarchy | Object334 |
| relationship_end_group_partial_description | Object386 |

**<Described_Domain>**
Object342

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "person names" |
| constrained_attribute | Object305, Object314, Object316 |

**<Described_Domain>**
Object343

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "addresses" |
| constrained_attribute | Object306, Object312 |

**<Described_Domain>**
Object344

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "telephone numbers" |
| constrained_attribute | Object307, Object308, Object309, Object313 |

**<Described_Domain>**
Object345

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "company names" |
| constrained_attribute | Object311, Object319 |

**<Enumerated_Domain>**
Object346

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "mechanic grades" |
| constrained_attribute | Object317 |
| constrained_value | Object347, Object348, Object349 |

**<Valid_Value>**
Object347

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "Mechanic Class 1" |
| containing_domain | Object346 |

**<Valid_Value>**
Object348

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "Mechanic Class 2" |
| containing_domain | Object346 |

**<Valid_Value>**
Object349

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "Trainee Mechanic" |
| containing_domain | Object346 |

**<Described_Domain>**
Object350

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "model names" |
| constrained_attribute | Object320 |

**<Enumerated_Domain>**
Object351

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "engine types" |
| constrained_attribute | Object321 |
| constrained_value | Object352, Object353 |

**<Valid_Value>**
Object352

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "Petrol" |
| containing_domain | Object351 |

**<Valid_Value>**
Object353

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "Diesel" |
| containing_domain | Object351 |

**<Described_Domain>**
Object354

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "calendar dates" |
| constrained_attribute | Object322, Object323, Object327 Object335 |

**<Described_Domain>**
Object355

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "vehicle registration numbers" |
| constrained_attribute | Object325 |

**<Described_Domain>**
Object356

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "vehicle colours" |
| constrained_attribute | Object326 |

**<Described_Domain>**
Object357

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "vehicle modifications" |
| constrained_attribute | Object328 |

**<Described_Domain>**
Object358

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "service names" |
| constrained_attribute | Object330 |

**<Described_Domain>**
Object359

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "service specifications" |
| constrained_attribute | Object331 |

**<Described_Domain>**
Object360

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "intervals" |
| constrained_attribute | Object332 |



**Figure D.6 – Registration of the Ellis-Barker example (Part 4 of 6)**

**<Described_Domain>**
Object361

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "times" |
| constrained_attribute | Object336, Object337, Object338 |

**<Described_Domain>**
Object362

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "repair service descriptions" |
| constrained_attribute | Object340 |

**<Relationship_End_Group>**
Object363

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object304 |
| mutually_exclusive_component | Object364 |

**<Relationship_End>**
Object364

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| link_phrase | "owner of" |
| containing_relationship | Object365 |
| containing_group | Object363 |

**<Relationship>**
Object365

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_diagram | Object303 |
| contained_relationship_end | Object364, Object366 |

**<Relationship_End>**
Object366

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "Zero" |
| maximum_cardinality | "Many" |
| link_phrase | "owned by" |
| containing_relationship | Object365 |
| containing_group | Object367 |

**<Relationship_End_Group>**
Object367

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object324 |
| mutually_exclusive_component | Object366, Object368 |

**<Relationship_End>**
Object368

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "Zero" |
| maximum_cardinality | "Many" |
| link_phrase | "owned by" |
| containing_relationship | Object369 |
| containing_group | Object367 |

**<Relationship>**
Object369

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_diagram | Object303 |
| contained_relationship_end | Object368, Object370 |

**<Relationship_End>**
Object370

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| link_phrase | "owner of" |
| containing_relationship | Object369 |
| containing_group | Object371 |

**<Relationship_End_Group>**
Object371

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object310 |
| mutually_exclusive_component | Object370 |

**<Relationship_End_Group>**
Object372

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object324 |
| mutually_exclusive_component | Object373 |

**<Relationship_End>**
Object373

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "Zero" |
| maximum_cardinality | "Many" |
| link_phrase | "specified as" |
| containing_relationship | Object374 |
| containing_group | Object372 |

**<Relationship>**
Object374

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_diagram | Object303 |
| contained_relationship_end | Object373, Object375 |

**<Relationship_End>**
Object375

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| link_phrase | "specification of" |
| containing_relationship | Object374 |
| containing_group | Object376 |

**<Relationship_End_Group>**
Object376

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object318 |
| mutually_exclusive_component | Object375 |

**<Relationship_End_Group>**
Object377

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object318 |
| mutually_exclusive_component | Object378 |

**<Relationship_End>**
Object378

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "Many" |
| link_phrase | "subject of" |
| containing_relationship | Object379 |
| containing_group | Object377 |

**Figure D.6 – Registration of the Ellis-Barker example (Part 5 of 6)**

**<Relationship>**
Object379

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_diagram | Object303 |
| contained_relationship_end | Object378, Object380 |

**<Relationship_End>**
Object380

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "Zero" |
| maximum_cardinality | "Many" |
| link_phrase | "of" |
| containing_relationship | Object379 |
| containing_group | Object381 |

**<Relationship_End_Group>**
Object381

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object329 |
| mutually_exclusive_component | Object380 |

**<Relationship_End_Group>**
Object382

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object329 |
| mutually_exclusive_component | Object383 |

**<Relationship_End>**
Object383

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| link_phrase | "description of" |
| containing_relationship | Object384 |
| containing_group | Object382 |

**<Relationship>**
Object384

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_diagram | Object303 |
| contained_relationship_end | Object383, Object385 |

**<Relationship_End>**
Object385

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "Zero" |
| maximum_cardinality | "Many" |
| link_phrase | "described by" |
| containing_relationship | Object384 |
| containing_group | Object386 |

**<Relationship_End_Group>**
Object386

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object341 |
| mutually_exclusive_component | Object385 |

**<Relationship_End_Group>**
Object387

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object333 |
| mutually_exclusive_component | Object388 |

**<Relationship_End>**
Object388

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "Zero" |
| maximum_cardinality | "Many" |
| link_phrase | "of" |
| containing_relationship | Object389 |
| containing_group | Object387 |

**<Relationship>**
Object389

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_diagram | Object303 |
| contained_relationship_end | Object388, Object390 |

**<Relationship_End>**
Object390

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| link_phrase | "subject of" |
| containing_relationship | Object389 |
| containing_group | Object391 |

**<Relationship_End_Group>**
Object391

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object324 |
| mutually_exclusive_component | Object390 |

**<Relationship_End_Group>**
Object392

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object333 |
| mutually_exclusive_component | Object393 |

**<Relationship_End>**
Object393

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "Zero" |
| maximum_cardinality | "Many" |
| link_phrase | "responsibility of" |
| containing_relationship | Object394 |
| containing_group | Object392 |

**<Relationship>**
Object394

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_diagram | Object303 |
| contained_relationship_end | Object393, Object395 |

**<Relationship_End>**
Object395

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| link_phrase | "responsible for" |
| containing_relationship | Object394 |
| containing_group | Object396 |

**<Relationship_End_Group>**
Object396

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object315 |
| mutually_exclusive_component | Object395 |

**Figure D.6 – Registration of the Ellis-Barker example (Part 6 of 6)**

## D.5 UML Class Diagram example

This example is based on a sales order processing scenario which is drawn as a UML Class Diagram (see Figure D.7). Figure D.8 provides the object instances to illustrate the registration of this model.

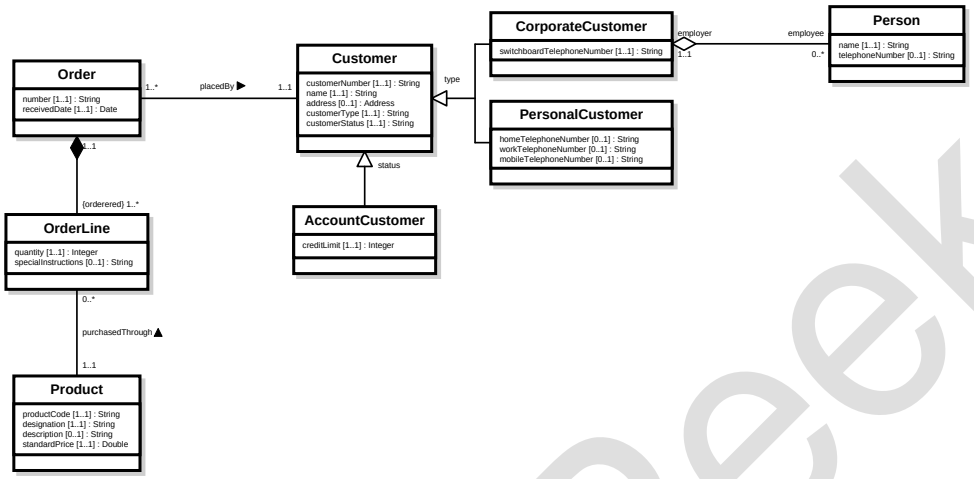


**Figure D.7 – Example information model drawn as a UML Class Diagram**

**<Information_Modelling_Language>**
Object401

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "UML Class Diagram" |
| expressed_model | Object402 |

**<Information_Model>**
Object402

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "Johnson Brothers Ltd sales order processing system (implemented)" |
| describing_language | Object401 |
| diagram_model_element | Object403 |

**<Diagram>**
Object403

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "Johnson Brothers Ltd sales order processing system (implemented) Diagram 1" |
| containing_model | Object402 |
| entity_type_model_element | Object404, Object412, Object414, Object418, Object420, Object423, Object426, Object429 |
| relationship_model_element | Object447, Object452, Object457, Object462 |

**<Entity_Type>**
Object404

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "Customer" |
| containing_diagram | Object403 |
| classification_scheme_partial_description | Object405, Object406 |
| characteristic_partial_description | Object407, Object408, Object409, Object410, Object411 |
| relationship_end_group_partial_description | Object450 |

**<Entity_Specialisation_Hierarchy>**
Object405

| Attribute/Reference | Literal/Instance |
|---|---|
| completeness_indicator | True |
| exclusivity_indicator | True |
| description | "type" |
| described_entity_type | Object404 |
| subtype_entity_type | Object412, Object414 |
| category_discriminator | Object410 |

**<Entity_Specialisation_Hierarchy>**
Object406

| Attribute/Reference | Literal/Instance |
|---|---|
| completeness_indicator | False |
| exclusivity_indicator | True |
| description | "status" |
| described_entity_type | Object404 |
| subtype_entity_type | Object418 |
| category_discriminator | Object411 |

**<Non_Key_Attribute>**
Object407

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "customerNumber" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object404 |
| constraint | Object440 |

**Figure D.8 – Registration of the UML Class Diagram example (Part 1 of 5)**

**<Non_Key_Attribute>**
Object408

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "name" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object404 |
| constraint | Object440 |

**<Non_Key_Attribute>**
Object409

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "address" |
| minimum_cardinality | "Zero" |
| maximum_cardinality | "One" |
| described_entity_type | Object404 |
| constraint | Object444 |

**<Non_Key_Attribute>**
Object410

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "customerType" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object404 |
| constraint | Object434 |
| discriminated_hierarchy | Object405 |

**<Non_Key_Attribute>**
Object411

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "customerStatus" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object404 |
| constraint | Object437 |
| discriminated_hierarchy | Object406 |

**<Entity_Type>**
Object412

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "CorporateCustomer" |
| containing_diagram | Object403 |
| characteristic_partial_description | Object413 |
| containing_hierarchy | Object405 |
| relationship_end_group_partial_description | Object449 |

**<Non_Key_Attribute>**
Object413

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "switchboardTelephoneNumber" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object412 |
| constraint | Object440 |

**<Entity_Type>**
Object414

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "PersonalCustomer" |
| containing_diagram | Object403 |
| characteristic_partial_description | Object415, Object416, Object417 |
| containing_hierarchy | Object405 |

**<Non_Key_Attribute>**
Object415

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "homeTelephoneNumber" |
| minimum_cardinality | "Zero" |
| maximum_cardinality | "One" |
| described_entity_type | Object414 |
| constraint | Object440 |

**<Non_Key_Attribute>**
Object416

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "workTelephoneNumber" |
| minimum_cardinality | "Zero" |
| maximum_cardinality | "One" |
| described_entity_type | Object414 |
| constraint | Object440 |

**<Non_Key_Attribute>**
Object417

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "mobileTelephoneNumber" |
| minimum_cardinality | "Zero" |
| maximum_cardinality | "One" |
| described_entity_type | Object414 |
| constraint | Object440 |

**<Entity_Type>**
Object418

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "AccountCustomer" |
| containing_diagram | Object403 |
| characteristic_partial_description | Object419 |
| containing_hierarchy | Object406 |

**<Non_Key_Attribute>**
Object419

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "creditLimit" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object418 |
| constraint | Object442 |

**<Entity_Type>**
Object420

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "Person" |
| containing_diagram | Object403 |
| characteristic_partial_description | Object421, Object422 |
| relationship_end_group_partial_description | Object445 |

**<Non_Key_Attribute>**
Object421

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "name" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object420 |
| constraint | Object440 |



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**<Non_Key_Attribute>**
Object422

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “telephoneNumber” |
| minimum_cardinality | “Zero” |
| maximum_cardinality | “One” |
| described_entity_type | Object420 |
| constraint | Object440 |

**<Entity_Type>**
Object423

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “Order” |
| containing_diagram | Object403 |
| characteristic_partial_description | Object424, Object425 |
| relationship_end_group_partial_ description | Object454, Object455 |

**<Non_Key_Attribute>**
Object424

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “number” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| described_entity_type | Object423 |
| constraint | Object440 |

**<Non_Key_Attribute>**
Object425

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “receivedDate” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| described_entity_type | Object423 |
| constraint | Object441 |

**<Entity_Type>**
Object426

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “OrderLine” |
| containing_diagram | Object403 |
| characteristic_partial_description | Object427, Object428 |
| relationship_end_group_partial_ description | Object459, Object460 |

**<Non_Key_Attribute>**
Object427

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “quantity” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| described_entity_type | Object426 |
| constraint | Object442 |

**<Non_Key_Attribute>**
Object428

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “specialInstructions” |
| minimum_cardinality | “Zero” |
| maximum_cardinality | “One” |
| described_entity_type | Object426 |
| constraint | Object440 |

**<Entity_Type>**
Object429

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “Product” |
| containing_diagram | Object403 |
| characteristic_partial_description | Object430, Object431, Object432, Object433 |
| relationship_end_group_partial_ description | Object464 |

**<Non_Key_Attribute>**
Object430

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “productCode” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| described_entity_type | Object429 |
| constraint | Object440 |

**<Non_Key_Attribute>**
Object431

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “designation” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| described_entity_type | Object429 |
| constraint | Object440 |

**<Non_Key_Attribute>**
Object432

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “description” |
| minimum_cardinality | “Zero” |
| maximum_cardinality | “One” |
| described_entity_type | Object429 |
| constraint | Object440 |

**<Non_Key_Attribute>**
Object433

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “price” |
| minimum_cardinality | “One” |
| maximum_cardinality | “One” |
| described_entity_type | Object429 |
| constraint | Object443 |

**<Enumerated_Domain>**
Object434

| Attribute/Reference | Literal/Instance |
|---|---|
| name | “customerTypes” |
| constrained_attribute | Object410 |
| constrained_value | Object435, Object436 |

**<Valid_Value>**
Object435

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | “Corporate” |
| containing_domain | Object434 |

**<Valid_Value>**
Object436

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | “Personal” |
| containing_domain | Object434 |

**Figure D.8 – Registration of the UML Class Diagram example (Part 3 of 5)**

**<Enumerated_Domain>**
Object437

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "customerStatus" |
| constrained_attribute | Object411 |
| constrained_value | Object438, Object439 |

**<Valid_Value>**
Object438

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "Account" |
| containing_domain | Object437 |

**<Valid_Value>**
Object439

| Attribute/Reference | Literal/Instance |
|---|---|
| literal | "Casual" |
| containing_domain | Object437 |

**<Described_Domain>**
Object440

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "String" |
| constrained_attribute | Object407, Object408, Object413, Object415, Object416, Object417, Object421, Object422, Object424, Object428, Object430, Object431, Object432 |

**<Described_Domain>**
Object441

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "Date" |
| constrained_attribute | Object425 |

**<Described_Domain>**
Object442

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "Integer" |
| constrained_attribute | Object419, Object427 |

**<Described_Domain>**
Object443

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "Double" |
| constrained_attribute | Object433 |

**<Described_Domain>**
Object444

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "Address" |
| constrained_attribute | Object409 |

**<Relationship_End_Group>**
Object445

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object420 |
| mutually_exclusive_component | Object446 |

**<Relationship_End>**
Object446

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "Zero" |
| maximum_cardinality | "Many" |
| entity_role | "employee" |
| aggregation_indicator | True |
| composition_indicator | False |
| containing_relationship | Object447 |
| containing_group | Object445 |

**<Relationship>**
Object447

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_diagram | Object403 |
| contained_relationship_end | Object446, Object448 |

**<Relationship_End>**
Object448

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| entity_role | "employer" |
| aggregation_indicator | False |
| composition_indicator | False |
| containing_relationship | Object447 |
| containing_group | Object449 |

**<Relationship_End_Group>**
Object449

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object412 |
| mutually_exclusive_component | Object448 |

**<Relationship_End_Group>**
Object450

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object404 |
| mutually_exclusive_component | Object451 |

**<Relationship_End>**
Object451

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| aggregation_indicator | False |
| composition_indicator | False |
| containing_relationship | Object452 |
| containing_group | Object450 |

**<Relationship>**
Object452

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "placedBy" |
| containing_diagram | Object403 |
| contained_relationship_end | Object451, Object453 |

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965 **Figure D.8 – Registration of the UML Class Diagram example (Part 4 of 5)**

**<Relationship_End>**
Object453

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "Many" |
| aggregation_indicator | False |
| composition_indicator | False |
| containing_relationship | Object452 |
| containing_group | Object454 |

**<Relationship_End_Group>**
Object454

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object423 |
| mutually_exclusive_component | Object453 |

**<Relationship_End_Group>**
Object455

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object423 |
| mutually_exclusive_component | Object456 |

**<Relationship_End>**
Object456

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| aggregation_indicator | False |
| composition_indicator | False |
| containing_relationship | Object457 |
| containing_group | Object455 |

**<Relationship>**
Object457

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_diagram | Object403 |
| contained_relationship_end | Object456, Object458 |

**<Relationship_End>**
Object458

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "Many" |
| collection_type | List |
| aggregation_indicator | False |
| composition_indicator | True |
| containing_relationship | Object457 |
| containing_group | Object459 |

**<Relationship_End_Group>**
Object459

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object426 |
| mutually_exclusive_component | Object458 |

**<Relationship_End_Group>**
Object460

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object426 |
| mutually_exclusive_component | Object461 |

**<Relationship_End>**
Object461

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "Zero" |
| maximum_cardinality | "Many" |
| aggregation_indicator | False |
| composition_indicator | False |
| containing_relationship | Object462 |
| containing_group | Object460 |

**<Relationship>**
Object462

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "purchasedThrough" |
| containing_diagram | Object403 |
| contained_relationship_end | Object461, Object463 |

**<Relationship_End>**
Object463

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| aggregation_indicator | False |
| composition_indicator | False |
| containing_relationship | Object462 |
| containing_group | Object464 |

**<Relationship_End_Group>**
Object464

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object429 |
| mutually_exclusive_component | Object463 |

**Figure D.8 – Registration of the UML Class Diagram example (Part 5 of 5)**

## D.6 SQL CREATE TABLE statements example

This example is based on a vehicle manufacturing scenario which is depicted as a set of SQL CREATE TABLE statements (see Figure D.9). Figure D.10 provides the object instances to illustrate the registration of this set of SQL CREATE TABLE statements.

```
CREATE TABLE organisation
( organisation_name VARCHAR(20),
  organisation_address VARCHAR(250),
  PRIMARY KEY (organisation_name)
);

CREATE TABLE vehicle_model
( organisation_name VARCHAR(20),
  model_name VARCHAR(40),
  specification VARCHAR(250),
  PRIMARY KEY (organisation_name, model_name),
  FOREIGN KEY (organisation_name) REFERENCES organisation
);

CREATE TABLE vehicle
( organisation_name VARCHAR(20),
  model_name VARCHAR(40),
  chassis_number VARCHAR(30),
  first_registration_date DATE,
  PRIMARY KEY (organisation_name, chassis_number),
  FOREIGN KEY (organisation_name, model_name) REFERENCES vehicle_model
);
```

**Figure D.9 – Example information model depicted as a set of SQL CREATE TABLE statements**

**<Information_Modelling_Language>**
Object501

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "SQL" |
| expressed_model | Object502 |

**<Information_Model>**
Object502

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "SQL Catalog #1" |
| describing_language | Object501 |
| diagram_model_element | Object503 |

**<Diagram>**
Object503

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "SQL Schema for Vehicle Manufacturing" |
| containing_model | Object502 |
| entity_type_model_element | Object504, Object509, Object516 |
| relationship_model_element | Object528, Object533 |

**<Entity_Type>**
Object504

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "organisation" |
| containing_diagram | Object503 |
| characteristic_partial_description | Object505, Object506 |
| relationship_end_group_partial_description | Object526 |
| identifier_partial_description | Object507 |

**<Native_Key_Attribute>**
Object505

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "organisation_name" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object504 |
| constraint | Object524 |
| object | Object508 |

**<Non_Key_Attribute>**
Object506

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "organisation_address" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object504 |
| constraint | Object524 |

**<Unique_Identifier>**
Object507

| Attribute/Reference | Literal/Instance |
|---|---|
| primary_indicator | True |
| described_entity_type | Object504 |
| identifier_element_partial_description | Object508 |

**<Attribute_Unique_Identifier_Element>**
Object508

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object507 |
| subject_attribute | Object505 |

**Figure D.10 – Registration of the example set of SQL CREATE TABLE statements (Part 1 of 3)**

**<Entity_Type>**
Object509

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "vehicle_model" |
| containing_diagram | Object503 |
| characteristic_partial_description | Object510, Object511, Object512 |
| relationship_end_group_partial_ description | Object530, Object531 |
| identifier_partial_description | Object513 |

**<Relationship_End_Foreign_Key_Attribute>**
Object510

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "organisation_name" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| rank | 1 |
| described_entity_type | Object509 |
| constraint | Object524 |
| object | Object514 |
| represented_relationship_end | Object529 |

**<Native_Key_Attribute>**
Object511

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "model_name" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object509 |
| constraint | Object524 |
| object | Object515 |

**<Non_Key_Attribute>**
Object512

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "specification" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object509 |
| constraint | Object524 |

**<Unique_Identifier>**
Object513

| Attribute/Reference | Literal/Instance |
|---|---|
| primary_indicator | True |
| described_entity_type | Object509 |
| identifier_element_partial_ description | Object514, Object515 |

**<Attribute_Unique_Identifier_Element>**
Object514

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object513 |
| subject_attribute | Object510 |

**<Attribute_Unique_Identifier_Element>**
Object515

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object513 |
| subject_attribute | Object511 |

**<Entity_Type>**
Object516

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "vehicle" |
| containing_diagram | Object503 |
| characteristic_partial_description | Object517, Object518, Object519, Object520 |
| relationship_end_group_partial_ description | Object535 |
| identifier_partial_description | Object521 |

**<Relationship_End_Foreign_Key_Attribute>**
Object517

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "organisation_name" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| rank | 1 |
| described_entity_type | Object516 |
| constraint | Object524 |
| object | Object522 |
| represented_relationship_end | Object534 |

**<Relationship_End_Foreign_Key_Attribute>**
Object518

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "model_name" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| rank | 2 |
| described_entity_type | Object516 |
| constraint | Object524 |
| represented_relationship_end | Object534 |

**<Native_Key_Attribute>**
Object519

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "chassis_number" |
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| described_entity_type | Object516 |
| constraint | Object524 |
| object | Object523 |

**<Non_Key_Attribute>**
Object520

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "first_registration_date" |
| minimum_cardinality | "Zero" |
| maximum_cardinality | "One" |
| described_entity_type | Object516 |
| constraint | Object525 |

**<Unique_Identifier>**
Object521

| Attribute/Reference | Literal/Instance |
|---|---|
| primary_indicator | True |
| described_entity_type | Object516 |
| identifier_element_partial_ description | Object522, Object523 |

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979 **Figure D.10 – Registration of the example set of SQL CREATE TABLE statements (Part 2 of 3)**

**<Attribute_Unique_Identifier_Element>**
Object522

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object521 |
| subject_attribute | Object517 |

**<Attribute_Unique_Identifier_Element>**
Object523

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_unique_identifier | Object521 |
| subject_attribute | Object519 |

**<Described_Domain>**
Object524

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "VARCHAR" |
| constrained_attribute | Object505, Object506, Object510, Object511, Object512, Object517, Object518, Object519 |

**<Described_Domain>**
Object525

| Attribute/Reference | Literal/Instance |
|---|---|
| name | "DATE" |
| constrained_attribute | Object520 |

**<Relationship_End_Group>**
Object526

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object504 |
| mutually_exclusive_component | Object527 |

**<Relationship_End>**
Object527

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| containing_relationship | Object528 |
| containing_group | Object526 |

**<Relationship>**
Object528

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_diagram | Object503 |
| contained_relationship_end | Object527, Object529 |

**<Relationship_End>**
Object529

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "Zero" |
| maximum_cardinality | "Many" |
| containing_relationship | Object528 |
| containing_group | Object530 |
| partial_representation | Object510 |

**<Relationship_End_Group>**
Object530

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object509 |
| mutually_exclusive_component | Object529 |

**<Relationship_End_Group>**
Object531

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object509 |
| mutually_exclusive_component | Object532 |

**<Relationship_End>**
Object532

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "One" |
| maximum_cardinality | "One" |
| containing_relationship | Object533 |
| containing_group | Object531 |

**<Relationship>**
Object533

| Attribute/Reference | Literal/Instance |
|---|---|
| containing_diagram | Object503 |
| contained_relationship_end | Object532, Object534 |

**<Relationship_End>**
Object534

| Attribute/Reference | Literal/Instance |
|---|---|
| minimum_cardinality | "Zero" |
| maximum_cardinality | "Many" |
| containing_relationship | Object533 |
| containing_group | Object535 |
| partial_representation | Object517, Object518 |

**<Relationship_End_Group>**
Object535

| Attribute/Reference | Literal/Instance |
|---|---|
| described_entity_type | Object516 |
| mutually_exclusive_component | Object534 |

**Figure D.10 – Registration of the example set of SQL CREATE TABLE statements (Part 3 of 3)**

# Bibliography


[1] Arlow, J. and Neustadt, I. (2005) *UML 2 and the Unified Process: Practical Object-Oriented Analysis and Design, Second Edition*. Addison-Wesley

[2] Barker, R. (1989) *CASE*METHOD: Entity Relationship Modelling*. Addison-Wesley

[3] Bruce, T.A. (1992) *Designing Quality Databases with IDEF1X Information Models*. Dorset House

[4] Chen, P. P-S. (1976) *The Entity-Relationship Model - Toward a Unified View of Data*. ACM Transactions on Database Systems, Vol 1, No 1, March 1976, pp 9-36

[5] EPISTLE (European Process Industry STEP Technical Liaison Executive) (2003) *Developing High Quality Data Models* [online], http://www.matthew-west.org.uk/documents/princ03.pdf

[6] IEEE Std 1320.2-1998 *IEEE Standard for Conceptual Modeling Language – Syntax and Ssemantics for IDEF1X$_{97}$*

[7] ISO 10303-11:2004 *Industrial automation systems and integration -- Product data representation and exchange -- Part 11: Description methods: The EXPRESS language reference manual*

[8] Martin, J. (1990) *Information Engineering, Book II: Planning and Analysis*. Prentice Hall

[9] National Institute of Standards and Technology (1993) *Processing Standards Publication 184 Announcing the Standard for INTEGRATION DEFINITION FOR INFORMATION MODELING (IDEF1X)*