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Aerospace series — LOTAR — Long Term Archiving and Retrieval of digital technical product documentation such as 3D, CAD and PDM data

Part 004: Description methods

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Foreword

This document (EN 9300-004:2013) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2013, and conflicting national standards shall be withdrawn at the latest by July 2013.

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Introduction

This European Standard was prepared jointly by ASD-STAN and the PROSTEP iViP Association.

The PROSTEP iViP Association is an international non-profit association in Europe. For establishing leadership in IT-based engineering, it offers a moderated platform to its nearly 200 members from leading industries, system vendors and research institutions. Its product and process data standardization activities at European and worldwide levels are well known and accepted. The PROSTEP iViP Association sees this European Standard and the related parts as a milestone of product data technology.

Users should note that all European Standards undergo revision from time to time and that any reference made herein to any other standard implies its latest edition, unless otherwise stated.

All EN 9300-xxx standards quoted in this document have been either published as ASD-STAN prestandards or are in preparation at the date of this European Standard.

1 Scope

This European Standard presents methods which are divided into four main categories:

1) scope and scenario description;

2) process description;

3) data;

4) system architecture.

For scope and scenario description, the modelling methods are based on Unified Modelling Language (UML) Use Case diagrams. The process descriptions are done using Simplified Activity diagrams. Data modules are described by Express G diagrams. Rules and constraints are described via Express-Where-Rules. Further descriptions, for example, for a data dictionary, are based on tabular forms.

To support the development of a system architecture, the modelling method of UML Package diagrams is used.

2 Normative references

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

EN 9300-007, *Aerospace series — LOTAR — Long Term Archiving and Retrieval of digital technical product documentation such as 3D, CAD and PDM data — Part 007: Terms and References* [1)]

ISO 10303-11, *Industrial automation systems and integration — Product data representation and exchange — Part 11: Description methods: The EXPRESS language reference manual*

3 Terms, definitions and abbreviations

For the purposes of this document, the terms, definitions and abbreviations given in EN 9300-007 apply.

4 Applicability

EN 9300-004 provides an overview of the used methods to support an equal level of understanding of the standards context. EN 9300-004 recommends the usage of standardized methods.

If not otherwise specified by contractual requirements, EN 9300-004 is applicable to all records which provide objective evidence covering:

a) archiving requirements;

b) data quality requirements.

EN 9300-004 is applicable to existing records, on current and earlier products, produced using previous regulations.

1) Published as ASD-STAN Prestandard at the date of publication of this standard (www.asd-stan.org).

5 Method for scope/scenario description: UML Use Case diagram

The Unified Modelling Language (UML) is an industry-standard language for specifying, visualising, constructing, and documenting software systems. It simplifies the complex process of software design by making a "blueprint" for construction. The diagrams are realised with the specification of UML version 1.4.

According to UML definitions, Use Case diagrams identify the functionality provided by the system (use cases), the users who interact with the system (actors), and the association between users and functionality. Normally Use Cases are used in the analysis phase of software development to articulate the high-level requirements of the system.

The primary goals of a Use Case diagram include:

— providing a high-level view of what the system does;

— identifying the users (actors) of the system.

Within this document, a Use Case diagram is used to apply the permutation of the requirements into specific scenarios.

The following UML elements are used:

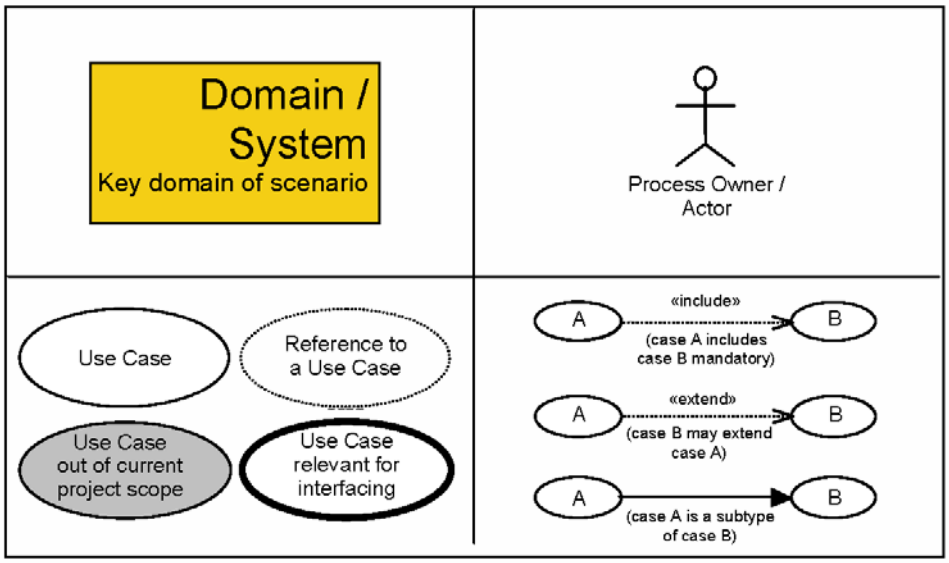

Figure 1 — Used UML elements

The UML Use Case diagram describes the dependencies which can occur between identified use cases and involved participants (actors) within the environment of a specific system or domain. The diagram differs in four types of use case representations:

1) use cases;

2) references to a use (further detailed descriptions);

3) use cases which are relevant within this specific domain but not relevant for the project;

4) use cases which are relevant for data exchange and interfacing (within the use case description a combination of use case representation is possible).

The dependencies between the use cases are described by different line style of arrows. Dashed line arrows describe the relationships between the use cases (include or extend). Solid line arrows describe the inheritance between the use cases. Solid lines describe the interaction between actors and use cases.

Figure 2 gives an example.

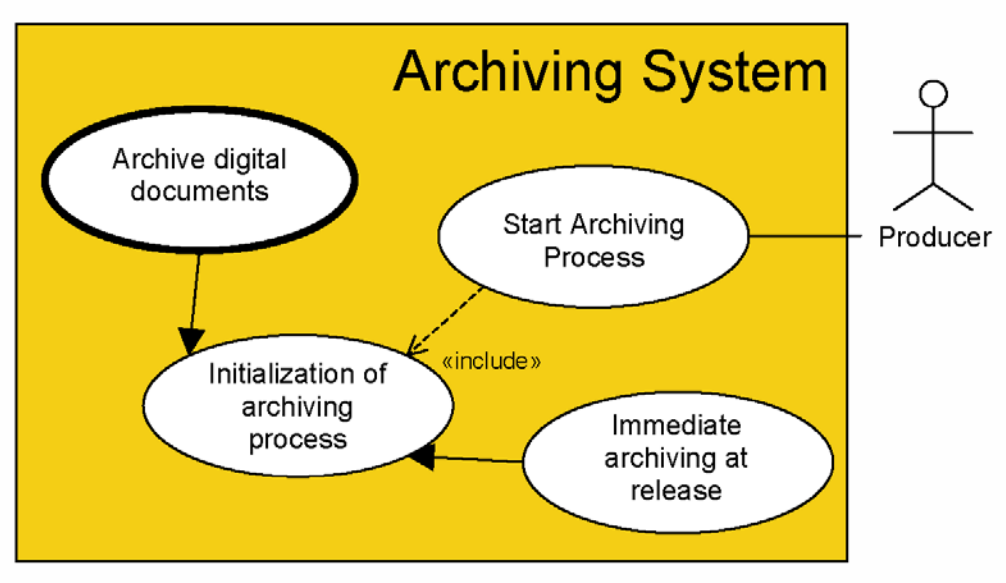

Figure 2 — Example UML Use case diagram

The “start archiving process” is triggered by the actor “producer”. The use case includes the use case “initialisation of archiving process”, which inherits all functionalities of the sub cases “immediate archiving at release” and “archive digital documents”. Additionally “Archive digital documents” indicates a use case which is relevant for data exchange between two systems via an interface.

6 Method for process description: Simplified activity diagram

The detailed description and analysis of scenarios and resulting processes are shown by simplified activity diagrams based on the UML and IDEF0. IDEF0 is a method designed to model the decisions, actions, and activities of an organisation or system. IDEF0 was derived from a well-established graphical language, the Structured Analysis and Design Technique (SADT). IDEF0 models help to organise the analysis of a system and to promote good communication between the analyst and the customer. IDEF0 is useful in establishing the scope of an analysis, especially a functional analysis.

The used elements for the process description are displayed in the following figure.

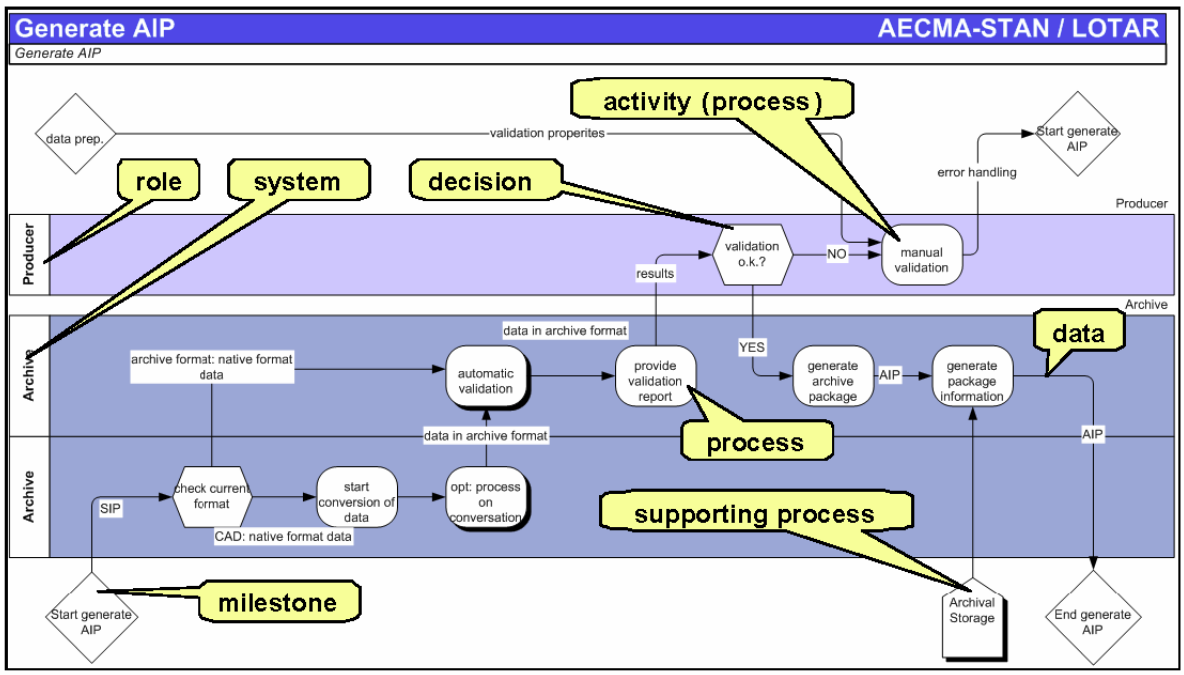

Figure 3 — Example of a simplified activity diagram

Every process step is started by a milestone. The use of milestones allows the integration of required references to and from other processes. In this example, the reference “validation properties”, coming from the milestone ”data preparation” displays the input information for process step “manual validation”. The simplified activity diagram identifies the participating roles via swim lanes. The swim lanes differentiate the various roles (persons) and systems (e.g. CAD system or the archive). The interaction between single activities within the process chain is represented by the data flow. In cases of decisions, the role has the chance to take corrective action. For single process steps, a supporting process gives further information, e.g. about archiving policies for “generate package information”.

To reduce the amount of information within one description level, the simplified activity diagrams are based on a hierarchical structure, following IDEF0. A shadow behind a process element indicates a further detailed description for this specific process.

The hierarchy structure is displayed within the following figure.

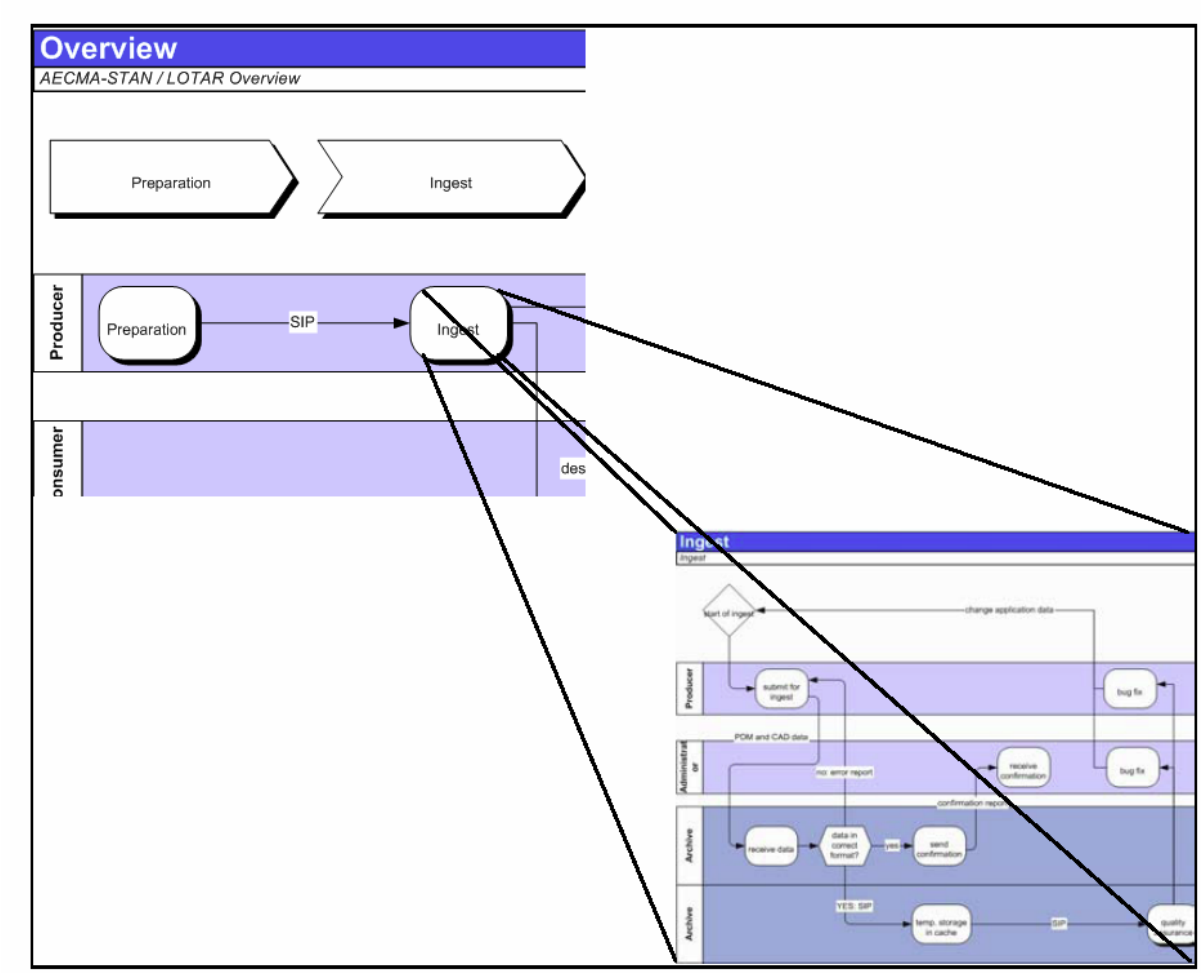

Figure 4 — Hierarchy structure within simplified activity diagrams

The simplified activity diagrams will be provided via a HTML Representation. The HTML Representation simplifies the handling, the search for information and the navigation through the process description and is divided into two main windows:

— Navigation bar,

— Process description window.

Within the HTML representation of the process description, the different levels are connected via hyperlinks, so that navigation between the detail levels is possible. After a click on a process step, the display will change to the next level. The HTML representation offers the possibility of getting detailed information for a single process step (blue mark in the corner of the process symbol). Further functionalities are print and zoom.

The following figure gives an example.

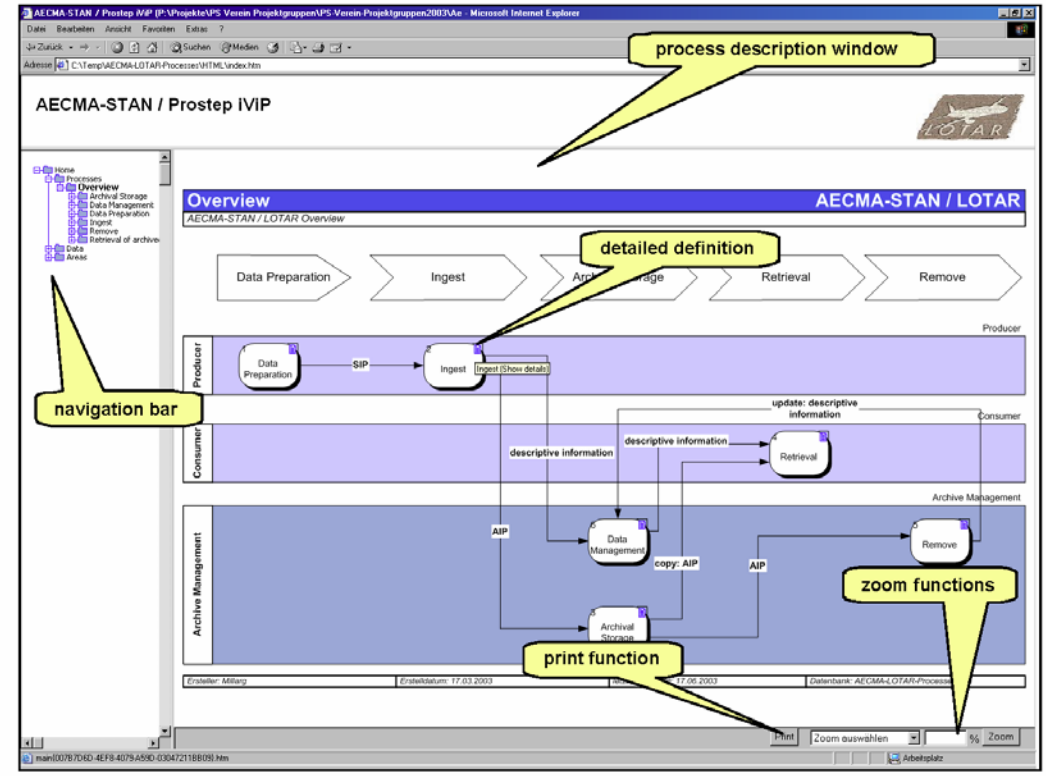

Figure 5 — HTML Representation of simplified activity diagrams

7 Methods for data description

7.1 General

The description of data uses the graphical representation of Express G Diagrams and the definition of rules and constraints via “EXPRESS WHERE Rules”. An overview of the recommended usage of entities and attributes is provided in tabular form (Data dictionary). For example, ISO 10303-11 (STEP) AP 214 specifies the recommended archiving data format.

7.2 Express G diagrams

An Express G Diagram describes formally the used data elements and their constraints.

ASD-STAN LOTAR uses the EXPRESS-G (ISO 10303-11, version 2) as modelling method. It visualises the logical context and the relationships between the information objects. EXPRESS-G is not a programming language, instead it is characterised by a specification language which is based on the Entity Relationship Method [2]. It is possible to model objects, as well as relationships and constraints between the objects.

EXPRESS-G is directly related to the EXPRESS data modelling language. Everything that is drawn in EXPRESS-G can be defined in EXPRESS. However, not everything that can be defined in EXPRESS can be drawn in EXPRESS-G.

The following figure provides an overview of the main Express G syntax and elements.

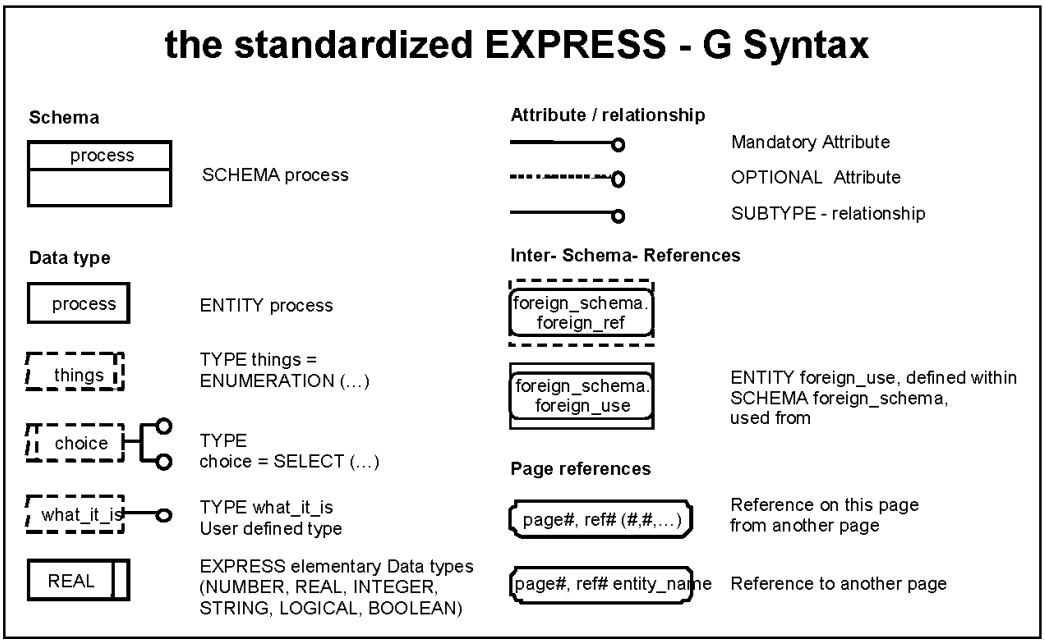

Figure 6 — Express G Syntax

Elements of the Express G Diagrams are displayed in following Figure 7. The figure describes relationships between the entities person and organisation.

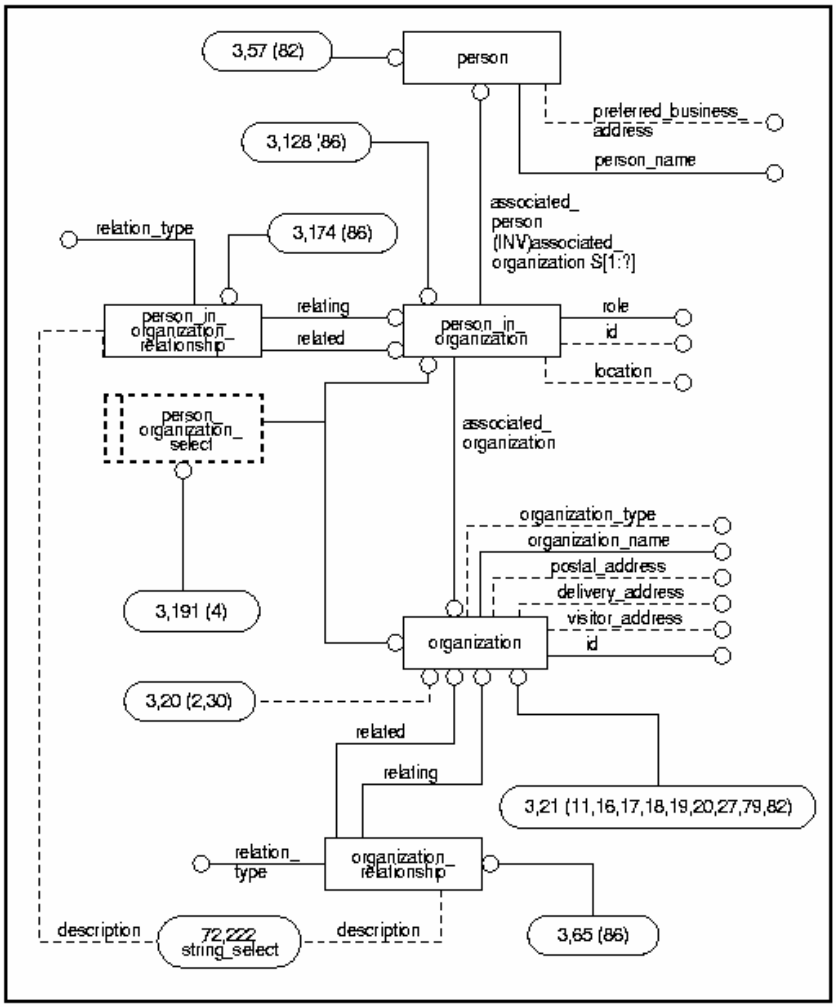

Figure 7 — Example for an Express G Diagram integrate of complete diagram

The entity “person_in_organisation” is further described by its relevant attributes. The attributes are:

— the mandatory attributes “role”;

— the optional attributes “location” and “id”.

The entity stands in relation to the entity “person” via the mandatory attribute “associated_person” and to “organisation” via the mandatory attribute “associated_organisation”. The attribute “associated_person” displays an additional capability, INVERSE attributes. INVERSE attributes can be used to describe the cardinality and existence dependencies between entity types. If the inverse attribute is used, at least one (or more) organisation must exist (indicated by S[1:?]). An instance of entity ”person_in_organisation” can be related to another instance of the same type through an instance of entity “person_in_organisation_relationship". Further attributes point at “Person_in_organisation”. The reference 128, which is described in detail on page 86, points at “person_in_organisation”, indicated through the term: 3,128 (86). SELECT type “person_organisation_select” represents the union of entity types “person_in_organisation” and “organisation”. An attribute of this type can be instantiated as either “person_in_organisation” or “organisation”.

7.3 Express WHERE Rules

EXPRESS WHERE Rules are used for further definition of rules and constraints for the used entities. The WHERE Rules are described using EXPRESS semantics.

The following example describes the instantiation of the entity “date”. The entity is further detailed through the attributes Day, Month, and Year.

The example offers two WHERE rules. The first rule (days_ok:..) assigns the attribute a value range from 1 to 31. The second rule (date_ok:..) hands over the attributes of the entity date to a separate function "valid_date". The function checks the validity of the attribute. The expected results of the check are true or false.

```
ENTITY date
 day: INTEGER;
 month: INTEGER;
 year: INTEGER;
WHERE
 days_ok: { 1 <= day <= 31 };
 date_ok: valid_date(SELF);
END_ENTITY;
```

7.4 Modelling of a scenario into Express G syntax

The example below describes the modelling of a scenario into EXPRESS-G syntax. The following situation is converted into Express G:

EXAMPLE An aircraft is made by a manufacturer. Each manufacturer has a unique name e.g. Airbus or Boeing. A manufacturer produces aircraft in several models and a specific aeroplane is an instance of a particular model. A manufacturer gives a serial number to each aircraft it produces and this is unique across all aircraft produced by that manufacturer. Each model also has a name, and this is unique across all models. An aircraft is further defined by specific information such as the year of production.

Figure 8 shows the resulting Express G objects and the relationships.

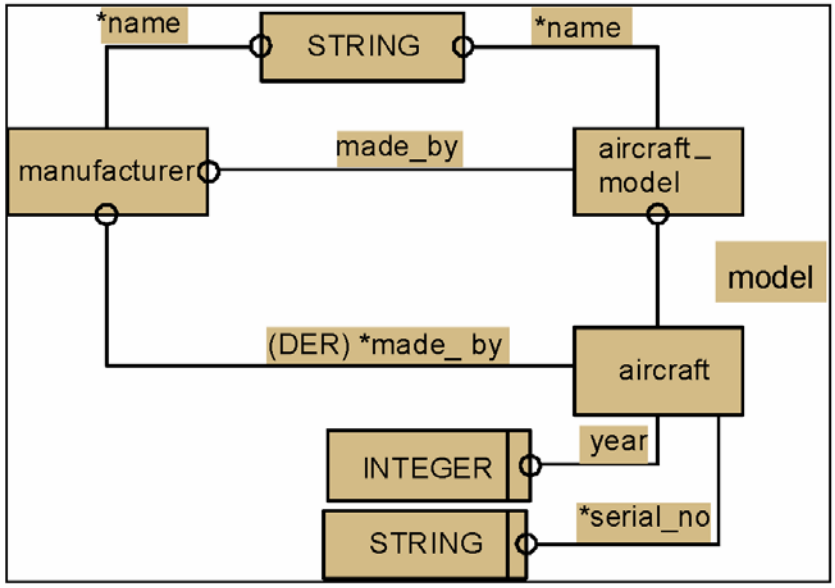

Figure 8 — Example of use of Express G Syntax

7.5 Data Dictionary

The data dictionary describes the semantics of entities and attributes represented in the data model and gives further information over value allocations, rules and constraints. It extends the graphical representation in EXPRESS-G. The data dictionary is provided in tabular form.

8 Method for system architecture description: UML Package diagram

According to UML, package diagrams provide a mechanism for dividing and grouping model elements (e.g. classes, use cases). In UML, a package is represented as a folder.

— In effect, a package provides a namespace such that two different elements in two different packages can have the same name.

— Packages may be nested within other packages.

— Dependencies between two packages reflect dependencies between any two classes in the packages. For example, if a class in Package A uses the services of a class in Package B, Package A is dependent on Package B. An important design consideration is the minimisation of dependencies between packages.

To specify the first approach of the system architecture, UML package diagrams are used. The UML package diagram gives an overview of functional models. Figure 9 shows an example.

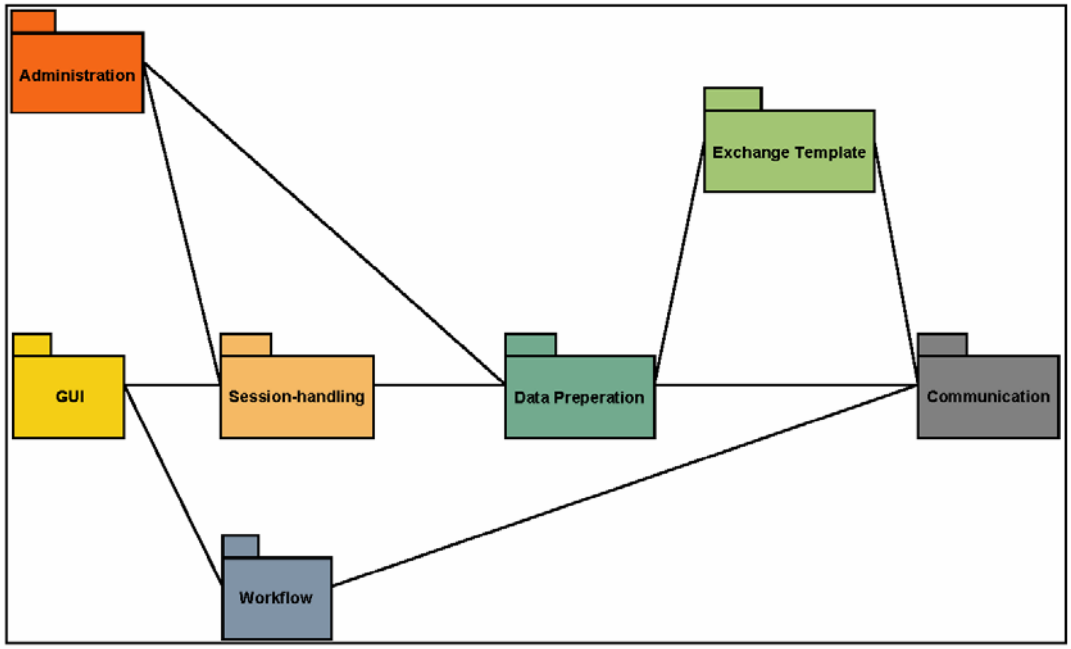

Figure 9 — Example for an UML package diagram

The diagram should be read from left to right, i.e., the module “Session-handling” has a dependency from the module “GUI” and “Administration.

Bibliography

[1] P.P.S. Chen — *The Entity Relationship model - toward a unified view of data, ACM Transactions on Database Systems 1* (March 1976)

[2] VDA Recommendation 4956, *Product Data Exchange — Part 1: Assembly Data Exchange* (November 2002)

[3] **IDEF0:** is a method designed to model the decisions, actions, and activities of an organisation or system. IDEF0 was derived from a well-established graphical language, the Structured Analysis and Design Technique (SADT), introduced by Douglas T. Ross in the early 1970s. — (David A. Marca and Clement L. McGowan, SADT: *Structured Analysis and Design Techniques*. McGraw-Hill, New York, NY, 1988.)

[4] **UML – Unified Modelling Language, v1.4:** A specification defining a graphical language for visualising, specifying, constructing, and documenting the artefacts of distributed object systems.

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