SLOVENSKI STANDARD

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Neporušitveno preskušanje - Splošno veljavni model formata za podatke neporušitvenih preiskav

Non-destructive testing - Generic NDE data format model

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Non-destructive testing - Generic NDE data format model

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Foreword

This CEN Report has been prepared by Technical Committee CEN/TC 138 « Non-destructive testing », the secretariat of which is held by AFNOR.

Taking into account the specific character of this CEN report, it was decided to give some explanations in an introduction given in the 3 languages.

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Introduction

This CR assumes knowledge of the Object Modelling Technique (OMT) and of NDE.

There is a growing interest to manage the results of non-destructive testing (NDT) by the use of computers with data in a digital form. As a result, the NDT activities are undergoing an evolution which makes them face new needs, such as the handling of huge volumes of digital data and the growing complexity of analysis processes, involving, in many cases, multitechnique procedures.

The NDT service business is evolving towards a more open market, in which the prime contractor requires transparent access to the data provided by the supplier, in order to ensure the comparison of data obtained from different sources and at different periods of time. Existing formats are often proprietary formats released by instrument manufacturers, generally dealing with a unique NDT method and not including complementary information on acquisition : consequently, they often fail to meet emerging requirements.

It is a natural evolution to express the need of a standard format model for the exchange of non-destructive examination (NDE) data, which can be recognized by all involved in the main NDT methods.

The expected characteristics of such a format are the following :

— exchange : the format can be used mainly for data exchange, but could be used for real-time data processing ;

— multitechnique : the format must take into account the different forms taken by the data (e.g. time/amplitude vectors for ultrasonics A-scans, complex values for eddy currents, 2-D images for radiography) ;

— traceability : the format must include all the relevant complementary information on the acquisition (e.g. date of the acquisition, component name, procedure identification, list of NDT equipment, ...) ;

— reproducibility : the format must contain all information allowing the reproduction of the acquisition (e.g. set-up parameters) ;

— completeness : the format must contain all information necessary for data analysis (e.g. probe position) ;

— compatibility with NDT standards.

The objective of this technical report is to define a format model for the organisation of NDE data for exchange (transmission, comparison, remote computer-processing) and computer-processing (traceability, archiving, retrieval, signal processing, comparative analysis). The format described is independent of the system and method used. It applies to digital data issued from the NDE methods on which general standards are being defined in CEN/TC138 working groups, i.e. radiology, ultrasonics, eddy currents, penetrant testing, magnetic particle testing, leak testing, acoustic emission, visual inspection. However, other methods (thermography, Barkhausen noise, shearography, microwave testing,...) may comply with this organisation with additional definitions required to ensure satisfactory performance. Interpretation of data is outside the scope of the technical report.

Digital data can be obtained in each of the main NDT methods in the following ways :

Radiography	Computed radiography
	Computed tomography
	Digitised film radiography
	Radioscopy
Ultrasonics	Digital equipment
Eddy currents	Digital equipment
Penetrant testing	Digital camera
Magnetic particle testing	Digital camera
Leak Testing	Digital recording device
Acoustic emission	Digital equipment
Visual inspection	Digital camera

It is important to note that this technical report proposes a format model. It can be implemented practically in many ways. To do so, a standard or a document describing the application programming interfaces is necessary.

The examination data is described as an integration of acquisition data (made of the NDE data and of setting and positionning data) and of complementary data, which are all the other data relevant to the examination, e.g. the data necessary to identify the inspection conditions, the examination object or the testing equipment.

The working method used in this report is the Object Modelling Technique (OMT), a recognised object modelling approach.

This technical report :

— defines the objects : one must be very careful, during the interpretation of the document, to distinguish between the object names and the actual terms used in the definitions ; some ambiguities may arise from the fact that these names are sometimes identical ; to avoid that, a specific typology has been adopted throughout the document ;

— defines the relationships between objects ;

— defines the attributes of the objects (dictionary).

A generic overview of the model can be seen on Figure I.1. This representation gathers the objects in object groups and gives a global view of the model. It can be observed that a set of data on which the format is applied relates to a single examination. A different examination will then create a different data set.

The examination is made on an object (i.e. the volume of the component on which NDE information is required), using a procedure and a data organisation (i.e. the definition of the structure of acquisition data). The procedure defines the equipment. The acquisition data is produced by the equipment and arranged according to the data organisation related to the equipment.
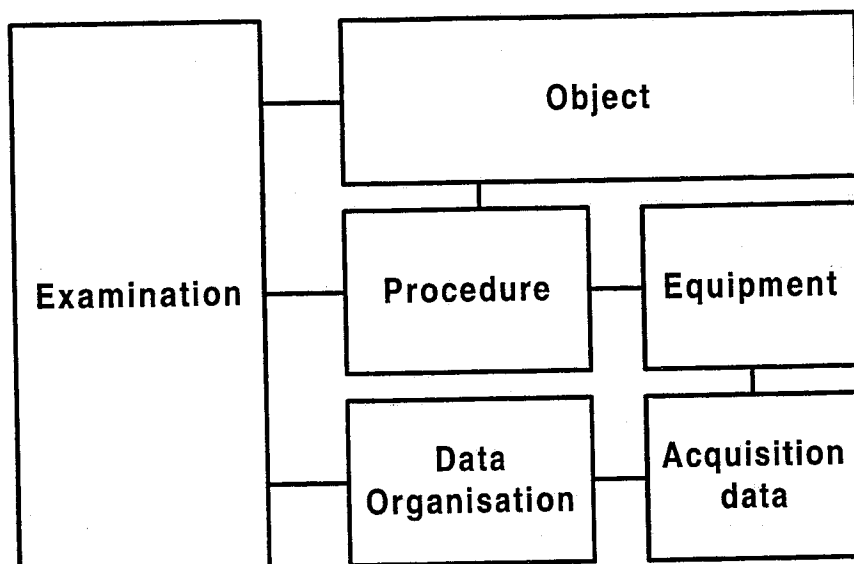
Figure I.1 — Generic overview of the model

Figure I.2 represents the main view of the model, including all the objects and relationships, the detailed definition of which is given in paragraph 8.2.1. The object groups of Figure I.1 have also been represented on Figure I.2, for easier comprehension. This main view is common to all the NDT methods.

The characteristics specific to each method are included in the DEVICE object. A DEVICE is an element of a NDT equipment. The technical report aims to define standard DEVICE objects for the standardised NDT methods. This model intends to be open to new techniques or to the evolution of conventional techniques, and the possibility is given to define "non-standard devices", under restrictions which are given in the document ("general rules for use").

Finally, this report provides a detailed model of the acquisition data, which describes all the possible forms which can be taken by NDE data : 0D (scalar or complex), 1D (sampled - cf. ultrasonics A-scans - or unsampled - cf. ultrasonics time/amplitude data), 2D (images) or 3D (volumes).

In annex B, a formal description of the model can be found, using the Express language, based on the STEP (STandard for the Exchange of Product model data) standardised approach (ISO 10303).

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If this report is translated, the Object Modelling Technique (OMT) terminology (written in capitals) shall remain in English.
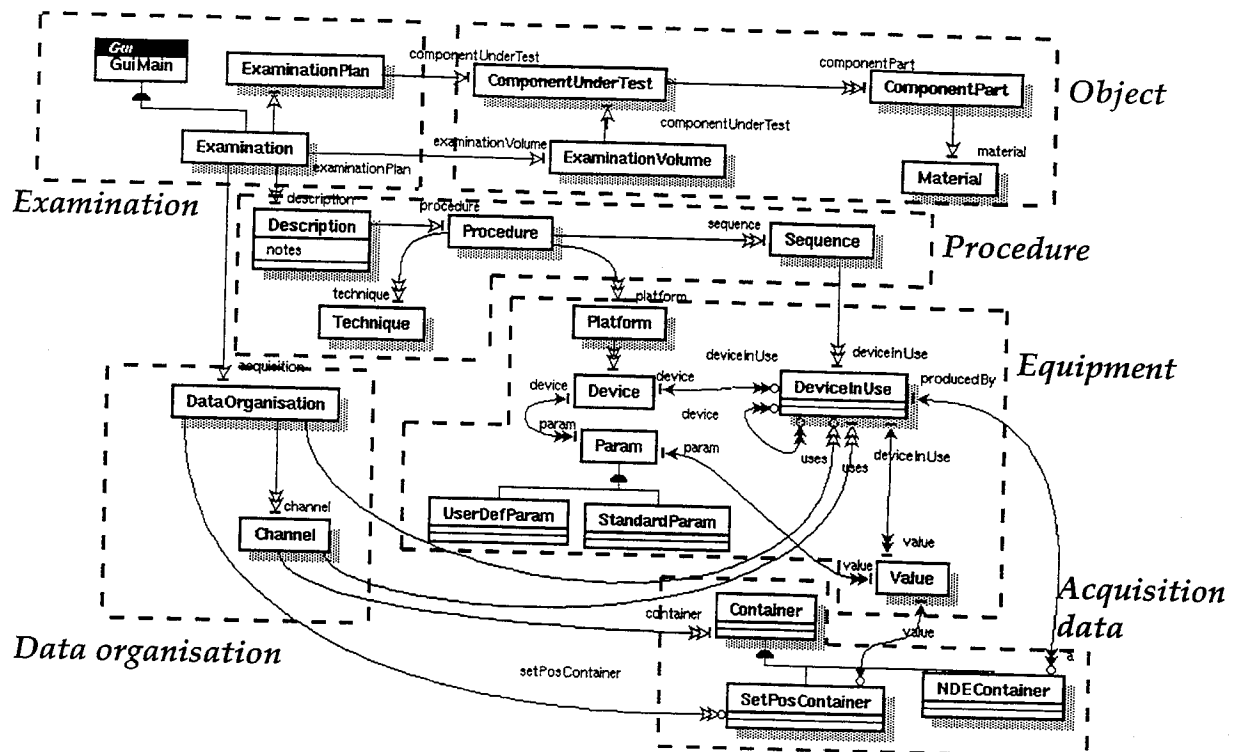
Figure I.2 — Main view of the model (DOM representation)

1 SCOPE

So far, existing formats for non-destructive examination (NDE) data are specific to a given system and method, and do not include all the necessary information to allow an exchange of the data.

This technical report defines a format model for NDE data organisation, in order for them to be exchanged (transmission, comparison, remote computer-processing) and computer-processed (traceability, archiving, retrieval, signal processing, comparative analysis). This format is independent of the used system and method. It applies to digital data issued from the following NDE methods : radiology, ultrasonics, eddy currents, penetrant testing, magnetic particle testing, leak testing, acoustic emission, visual inspection. Other methods (thermography, Barkhausen noise, shearography, microwave testing, ...) may comply with this model with additional definitions required to ensure satisfactory performance.

Interpretation of data is outside the scope of this technical report.

2 REFERENCES

This CEN Report incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this CEN Report only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ISO 10303, *Industrial automation systems and integration – Production data representation and exchange, (STEP : STandard for the Exchange of Product model data)*

EN 462-1, *Non-destructive testing – Image quality of radiographs – Part 1: Image quality indicators (wire type) - Determination of image quality value*

EN 462-2, *Non-destructive testing – Image quality of radiographs – Part 2: Image quality indicators (step/hole type) - Determination of image quality value*

EN 462-5, *Non-destructive testing – Image quality of radiographs – Part 5: Image quality indicators (duplex wire type), determination of image unsharpness value*

EN 12543-2, *Non-destructive testing – Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing - Part 2: Pinhole camera radiographic method*

EN 12679, *Non-destructive testing – Determination of the size of industrial radiographic sources – Radiographic method*

3 DEFINITIONS RELATED TO THE MODELLING METHOD

STEP : STandard for the Exchange of Product model data (ISO 10303) bearing on the representation and exchange of the product data, aiming to integrate conception and development processes.

Domain : in the STEP methodology, the domain describes what is inside the limits of application of the model.

Analysis model : the definition of the objects constituting the domain and of the relationships between them.

4 CONVENTIONS AND SYMBOLS

SMALL CAPITALS are used in this document to refer to model objects, as defined in the OMT (Object Modeling Technique) formalism. UNDERSCORED SMALL CAPITALS refer to object groups.

Bold characters refer to terms defined in the "Terminology" see clause 7.

5 GENERAL REQUIREMENTS FOR COMPLIANCE

A NDE data format complies with this technical report if it satisfies to the following conditions :

— it is organised according to the model described hereafter ;

— the attributes of the objects are fulfilled as described in the dictionary ;

— all numerical values are expressed in the SI system.

6 CHARACTERISTICS OF NDE DATA

From a general point of view, **examination data** is made of acquisition data and complementary data.

Acquisition data, which is all the data acquired during the **examination,** can be :

— NDE data, which has been derived from the various NDE methods and can be scalar (0-dimensional), 1-dimensional, 2-dimensional or 3-dimensional ;

— setting and position data.

Complementary data is all the other data relevant to the examination, e.g. the data necessary to identify the inspection conditions, the examination object, the testing equipment, the requested position of the equipment relative to the examination object.

All data must be in a digital form.

7 TERMINOLOGY RELATED TO NDE

This clause contains the definition of terms related to NDE which are necessary for this standard.

Component : a part of a construction or a manufactured product.

Data set : a collection of data.

Equipment : all devices (e.g. probes, instruments, filters, cables, robots, etc.) and inspection media (e.g. dye penetrant, magnetic particle media, film, etc.) useable to perform an examination.

Examination : testing of a component in accordance with a standard, a specification or a procedure.

Examination data : information available from an examination.

NDE Method : discipline applying a physical principle in nondestructive testing (e.g. ultrasonic method).

NDE Technique : a specific way of utilizing a NDE method (e.g. ultrasonic immersion technique).

Operating procedure : the detailed list of the requirements of the examination and of the sequential operations necessary to perform it.

Set : an assembly of equipments/devices used to perform a specific examination.

Testing : activities associated with the preparation, performance and control of nondestructive examination.

8 NDE FORMAT MODEL - Functional description

8.1 Domain description

The domain of the NDE format model shall include the following basic information :

— the geometry of the **component** ;

— the NDE **set** : description and set-up ;

— the position of each inspecting device relative to a reference system ;

— the general examination information : date, environment, operator, historical data ... ;

— the examination **operating procedure** ;

— the acquisition data.

The **data set** described by the NDE data format shall correspond to a single examination.

8.2 Main view of the model

8.2.1 Generic overview

DEFINITION OF OBJECT GROUPS :

EXAMINATION : the identification of the **examination** to be performed.

OBJECT : the volume of the **component** on which NDE information is required.

procedure : the description of the way the OBJECT is examined.

equipment : the complete combined **equipment** used to perform the **examination**.

DATA ORGANISATION : the definition of the structure of acquisition data.

These five object groups constitute the complementary data of the examination.

ACQUISITION data : the acquisition data produced during the **examination**.

An EXAMINATION is made on an **object**, using an PROCEDURE and an DATA ORGANISATION. The PROCEDURE defines the EQUIPMENT. The ACQUISITION DATA is produced by the EQUIPMENT and arranged according to the DATA ORGANISATION related to the EQUIPMENT.

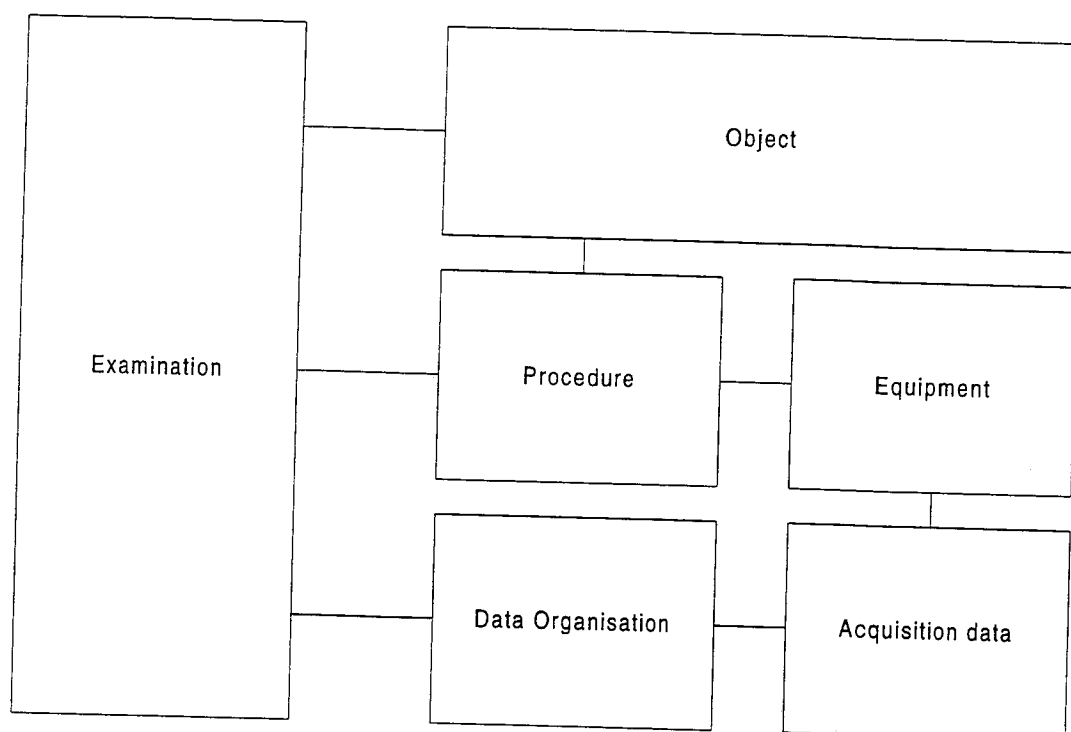Figure 1 — Generic overview of the domain

8.2.2 Objects definitions and relationships

8.2.2.1 Definitions

The generic object groups comprise the objects defined as follows :

__EXAMINATION :__

EXAMINATION PLAN : the description of the way the COMPONENT UNDER TEST is examined.

examination : the **examination** performed on the examination volume.

__OBJECT :__

component under test : the **component** including the examination volume.

examination volume : the volume of the component under test on which NDE data is required.

component part : basic volume of the component under test which is made of a unique material.

material : the material constituting a component part. It corresponds to a set of known physical properties.

__PROCEDURE :__

DESCRIPTION : the generic description of the **examination**.

PROCEDURE : the operating procedure used to perform the examination.

SEQUENCE : set of consecutive operations of the **operating procedure**.

TECHNIQUE : the NDE technique used to perform the examination.

EQUIPMENT :

PLATFORM : a set of given equipment.

DEVICE : each element of an equipment.

PARAMETER : a characteristic of the DEVICE which can be set to a value.

STANDARD PARAMETER : a PARAMETER defined in this document (chapter 8.3).

user-defined parameter : a parameter, defined by the user, which is not a standard parameter.

VALUE : a value or a set of values given to a PARAMETER.

DEVICE IN USE : a DEVICE with a given set of VALUE used within a SEQUENCE.

DATA ORGANISATION :

DATA ORGANISATION : the organisation of the acquisition data of the **examination**.

CHANNEL : an indication of a grouping of acquisition data produced by a particular assembly of DEVICE IN USE.

ACQUISITION DATA :

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CONTAINER : a set of acquisition data.(standards.iteh.ai)

SETPOS CONTAINER : a set of values related to the setting and the positioning of a DEVICE IN USE.
NDE CONTAINER : a set of NDE data coming from a DEVICE IN USE.

8.2.2.2   Relationships

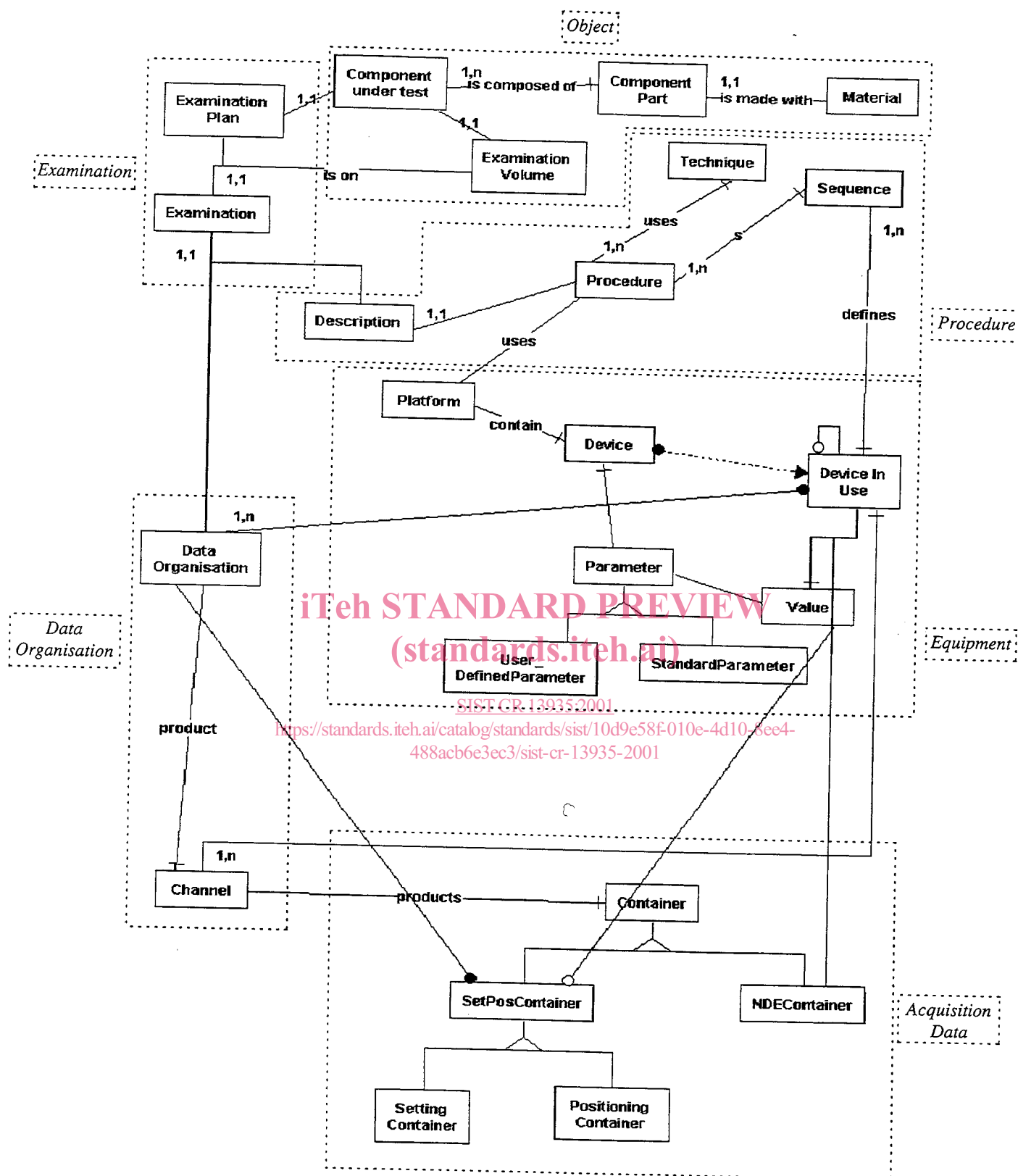The following diagram describes the relationships between objects.

Figure 2 — Relationships between objects (main view of the model)

Relationships between objects :

— a COMPONENT UNDER TEST is examined according to a unique EXAMINATION PLAN ;

— an examination plan refers to a unique component under test ;