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Napredna proizvodna tehnologija – Sistemska arhitektura – Konstrukti za podjetniško modeliranje

Advanced Manufacturing Technology - Systems Architecture - Constructs for Enterprise Modelling

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Avanced Manufacturing Technology - Systems Architecture - Constructs for Enterprise Modelling

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CEN

European Committee for Standardization
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Central Secretariat: rue de Stassart,36 B-1050 Brussels

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Foreword

This European Prestandard has been prepared by the Technical Committee CEN TC 310 "Advanced Manufacturing Technology" of which the secretariat is held by BSI.

The document was submitted to the formal vote and was approved by CEN TC 310 as ENV 12204 on 1995-12-24.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

Background

European Standardization in the field of AMT is undertaken by CEN TC310, Advanced Manufacturing Technology. In turn, its working group CEN TC 310 WG1, "Systems Architecture", hereafter referred to as TC310 WG1, is concerned with standardization work in the field of CIM Systems Architecture. This work is to be a precursor and a contribution to the development of CEN and ISO standards in this area.

In 1990 CEN/CENELEC WG-ARC (the predecessor to TC310 WG1) completed the European Prestandard ENV 40 003, CIM Systems Architecture, Framework for Enterprise Modelling, which set out a basis for identifying and co-ordinating the common conceptual constructs necessary for computer-based modelling of enterprises, focusing on Discrete Parts Manufacturing.

In 1992 WG-ARC completed an Evaluation of Constructs for Function View as defined in ENV 40 003 – that evaluation has been published by CEN/CENELEC as Technical Report R-IT-06. The evaluation showed that no one initiative contained all the methods, constructs, semantics and representation that were needed, and that additional input was required from projects active on this area. Since that time, major new input has been received (References[1] 1, 2 and 3). This ENV incorporates that input but the base for the work and the terminology used continues to be ENV 40 003.

CEN TC 310 WG1 recognises that the discipline of enterprise modelling is under continuous development, e.g. in its extension from application in one commercial company to the extended, virtual enterprise requiring that all process and objects dealt with in the enterprise are modelled as information. For this reason, new concepts and associated constructs are likely to emerge incrementally and replacing or modifying those described herein, which should therefore be regarded as a view of today's state of the art.

The Framework for Enterprise Modelling, ENV 40003

ENV 40 003 sets out a number of modelling concepts for CIM requirements and for the various perceptions of the needs of the enterprise. The concepts have been accepted as being sufficiently general to describe a wide range of types of manufacturing and the various concerns of the suppliers of products, systems and services, and of those who need to deploy these in moving to achieve the goals of CIM.

From all possible dimensions of modelling, the Framework selected three for their ability to represent the concepts that are required:

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1 Bibliographic references are contained in Annex A.

- One dimension is concerned with the development and evolution of the enterprise model itself, starting from the statement of requirements to a processable model; this is the dimension of Model of an enterprise.
- One dimension is concerned with the structure and behaviour of a model to express key aspects of an enterprise; this is the dimension of View.
- One dimension is concerned with the specialisation of models and model components from general to particular; this is the dimension of Genericity.

The vision for enterprise modelling

Because of the evolving state of the art, the Framework and its constructs should not restrict the choice of methods used in the development, operation and evolution of CIM models but should still provide constructs whose use would assist model components to be aligned with an enterprise's particular mission, objectives, structure and operations.

Because different enterprises have both similar and very particular requirements, components are to be composed from generic and partial modelling entities which have been chosen and specialised to accommodate specific enterprise requirements.

Because of the complexity of the task of realising CIM, computer-aided methods are required. To allow this, the required specific properties and behaviours need to be represented explicitly in a formalism capable of computer manipulation and in a graphic representation to assist human comprehension.

A modern vision for enterprise modelling consists in viewing the enterprise both as:

- an open set of concurrent business processes achieving enterprise objectives and goals
- a federation of functional entities (machines, humans or applications) processing enterprise objects to execute process steps of business processes.

This vision is compliant with the structure of the ENV 40 003 where:

- the Function View represents the business processes, their enterprise activities and necessary triggering events
- the Information View represents the enterprise objects as identified in the Function View
- the Resource View represents the functional entities as active resources, their capabilities and roles
- the Organisation View places functional entities, enterprise objects and enterprise activities under some responsibility and authority defined as organisation units.

How the constructs support this vision

The constructs can be viewed as elements of a common language intended to help industry to build a common perception of enterprise models and a common culture of how to describe these. In more detail:

- The process of enterprise modelling, that is the transformation of different CIM elements and aspects into integrated, computer processable models, should be enabled by generic, easy to use, standardized constructs. The generic constructs may be specialised and/or organised into structures[2] for a specific purpose, such as for an industry sector, or to a particular kind of enterprise concern such as maintenance. In turn such structures and/or the generic constructs are to be used for developing particular models for a particular enterprise.
- The process should be structured by the dimension of Views covering different aspects, and the dimension of Model covering different levels of detail.

The constructs for enterprise modelling are contained in clause 7, which includes definitions, descriptions and templates.

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2 Known as partial models in ENV 40 003.

Benefits of using the constructs

The constructs will be used by those business users who are making decisions based on business rather than technical concerns (e.g. a team or shop floor leader, a user who is also an automation project leader). They will be used for the modelling of business requirements and for the development of complete models for decision support and for model-driven operation control and monitoring. This type of user therefore needs be able to understand the constructs during the phases of:

- Business Planning, to analyse, understand, decide on and represent the business requirements and hence the necessary direction of development.
- Design, to ensure good communication with modellers, developers and integrators, but also to ensure appropriate reusability of constructs, partial models already existing elsewhere in the company etc.
- Installation and validation, in order to make it more reliable and reduce time scales
- Operations, when problems occur or changes are needed, in order to understand the situation more quickly, to improve their communication with developers and integrator etc.

A very clear, simple and understandable representation and formalism is therefore needed for constructs in order to make the communication between business users and model builders more easy, more reliable, and unambiguous.

The constructs are also intended to assist a wide community[3] . This includes:

- Application users
- Application architects
- Communicators
- Documenters of systems
- IT Vendors
- Model builders (manufacturing systems engineers, consulting engineers, systems integrators)
- Manufacturing Technology/IT strategists
- Re-engineers
- Researchers
- Software tool-makers
- Standards-makers

The constructs will help this community by:

- Assisting the development of modelling methods and tools that can be used by manufacturing personnel rather than IT specialists;
- Improving understanding (of requirements, of design, of implementation) through common relationships of system elements and a common language; and
- Providing support for four key system modelling qualities (efficiency, understandability, reliability, modifiability).

More specific benefits to be obtained are better and safer decision-making, multiple sourcing of model components, faster model building, the ability to carry out alternative what-if co-operative analyses, the provision of guidance for special out-of-line situations, and faster implementation of policy.

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3 It is recognised that new skills, training and tools will be needed for the application of model-based integration.

1 Scope

This ENV constitutes a European Prestandard on Constructs for Enterprise Modelling, supporting the Views defined in ENV 40 003, CIM systems architecture framework for modelling. It contains definitions and descriptions of the common constructs necessary for computer-based modelling of enterprises, focusing on Discrete Parts Manufacturing. Models generated using constructs in accordance with this framework will be computer processable and ultimately enable the daily operations of an enterprise to be run, monitored and controlled by such models.

2 Normative References

This European Standard 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 European standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ENV 40 003	CIM Systems Architecture –Framework for Enterprise Modelling (1990)
ISO IS 7498	Information Processing Systems –Open Systems Interconnection –Basic Reference Model. International Organization for Standardization, 1984.
ISO TR10314	Reference Model for Shop Floor Production Standards, Part 1. (ISO TC 184/SC5/WG1 N126) and Part 2 (ISO TC 184/SC5/WG1 N160), 1990.
ENV ISO 10303-11	EXPRESS, Language Reference Manual, 1994
CEN CR 1831	CIM Systems Architecture –Enterprise model execution and integration services –Evaluation report (1995).
CEN CR 1832	CIM Systems Architecture –Enterprise model execution and integration services –Statement of Requirements (1995).
CEN/CENELEC R-IT-06	CIM Systems Architecture –Evaluation of Constructs for Function View (1992)

3 Definitions and Abbreviations

3.1 Terms and Definitions

For the purpose of this ENV, the following terms and definitions apply. Capitalised terms are terms introduced in this ENV for a particular purpose, while others are general concepts interpreted in a particular way for the purposes of this ENV. The relevant subclause is referred to for definitions which are introduced in the main body of the text with accompanying explanation.

abstraction: The (mental) process of concentrating on and describing those characteristics of a thing or set of things that represent its essential nature, or the abstract concept which results from that process. See also 5.6.

aggregation: See 5.9.

aspect: See 5.5.

attribute: See 6.1.

Building Block: A single realisation of a construct which represents a class of phenomena in the real world, with respect to the enterprise.

NOTE –A building block is defined as part of the user model when the model is built. It is a specialisation of the constructs provided by this ENV.

Business Process: See 7.9.

Capability Set: See 7.11.

class: An abstraction representing properties, relationships, behaviour and semantics which are common to a collection of similar phenomena in the real world.

classification: The process of arranging abstractions into a structure organised according to their distinguishing properties. See also 5.7.

Conditional Relationship: See 7.9.

Construct: A textual or graphical artefact devised to represent in an orderly way the diverse information on common properties and elements of a collection of phenomena. See also 7.

NOTE –A construct is an element of a modelling language, the syntax and semantics of which is to be defined as precisely as possible for the purposes of compliance testing. However, in its present stage of development this ENV does not propose a formal notation for this purpose.

Construct Set: A grouping of constructs and rules for valid groupings which define the syntax of the modelling language.

NOTE –An example might be a construct set to represent the functions of a system, where sequencing rules define how these functions can be combined to provide a particular system behaviour.

Construct template: See 6.2.

decomposition: See 5.9.

Design Model Level: A specification of how the enterprise operations are to be performed, that is the Business Processes and Enterprise Activities that are to be performed to achieve the requirements.

domain: See 5.3.

Enterprise Activity: See 7.8.

Enterprise Model: An information model representation of processes and objects (concrete or abstract) as they are established and dealt with for the purpose of running an enterprise.

Enterprise View: A selective perception of an Enterprise which emphasises some particular aspect and disregards others. (See also 5.5.)

Enterprise Object: See 7.1.

entity: Any concrete or abstract thing in the universe of discourse.

Event: See 7.12

execution environment: A set of computing resources on which a model will be executed.

exemplification: The process of selecting a typical example or occurrence from a particular class or abstraction. See also 5.7.

extrinsic property: See 6.1.

Function View: A structured description of the enterprise processes, their behaviour (dynamic) and their functional structure (static), based on the objectives of the enterprise, reflecting external constraints and relevant inputs and outputs.

generalisation: The process of developing a more abstract or more generic description of a class or classes which applies to all members of that class or classes. Generalisation is the inverse function of specialisation. Generalisation also refers to the state of being generalised. See also 5.8.

Generic Level: A collection (reference catalogue) of basic modelling constructs and the rules and constraints for their use in creating models at the partial and particular levels[4] .

Implementation Model Level: A description of the means and/or rules to be used in executing the enterprise operations as described at the Requirements and Design Model Levels.

Information Technology Components: Those components that are required to transform, transport, store and verify data for all activities in the enterprise.

Information View: A structured representation of information in the enterprise by information entities and their relationships.

integrate: The method of ensuring the necessary interaction between all enterprise entities in order to achieve a given purpose in a given constrained environment. Integration is the result of that process.

interflow: The channels, processes and signals by which the execution of a model is kept in synchronisation with observable phenomena in the real world. See also 5.13.

intrinsic property: See 6.1.

junction: See 7.9.

life cycle: The sequence of states through which the matter under consideration passes from its conception to termination. See also 5.2

loop: See 7.9.

Manufacturing Technology Components: Those components that are required to transform, transport, store and verify raw materials, parts, (sub-)assemblies and end-products.

model: The explicit expression of one's understanding of a system or situation. It can be expressed in mathematics, symbols or words, but it is essentially a description of entities and the connectivity between them.

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4 This definition is a clarification of that in ENV 40 003; here 'basic modelling constructs' are to be interpreted as being the most generic classes of construct.

Model Level: A level of abstraction corresponding to a particular phase of the business life cycle.

Object State: See 7.3.

Object View: See 7.2.

occurrence (in a model): A single, actual realisation of a building block which represents a particular thing in the real world at the time when the model is processed. See also 5.6.

NOTE –Occurrence is also used in a general sense to refer to a single, actual realisation of something in the real world (particular phenomenon or thing).

order: See 7.5.

Organisational Unit: See 7.6.

Organisation View: A description of the organisational structure of the enterprise and the responsibilities of the individuals and organisational units within the enterprise.

Partial Level: A composition of Partial Models.

Partial Model: A particularised construct or aggregations of these.

Particular Level: That level at which a model is described for a particular, specific enterprise, embodying all necessary knowledge of the enterprise.

processable model: A model with clear syntax and semantics, which can be processed by a computer (for analysis, simulation or execution).

product: See 7.4.

projection: A mapping from a space of n dimensions into one of fewer dimensions.

relation: See clause 7.10.

relationship: See clause 5.10.

Requirements Model Level: A definition of what has to be done in a business sense and terminology, in terms of enterprise operations and without reference to implementation options or decisions.

resource: See 7.7.

Resource View: A description of the resource organisation of the enterprise, that is the set of resources of the enterprise required to execute enterprise operations.

role (of a construct): See 5.11.

serial: See 7.9.

Sequencing Relationship: See 7.9.

specialisation: The making of sub-classes within a class for a particular purpose, where the members of each sub-class have one or more characteristics (attributes, relations, behaviour or semantics) in common which are not shared by all other members of the class. Specialisation is the inverse function of generalisation. Specialisation also refers to the state of being specialised. See also 5.8.

Stepwise Derivation: The process of deriving models of the implemented components for the Implementation Model Level from the Requirements Model Level via the Design Model Level.

Stepwise Generation: The process of generating the contents of the Enterprise Model[5] , by identifying requirements, designs and implementation needs, in whatever order is appropriate and iterating as necessary to achieve solutions.

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5 This definition is a clarification of that in ENV 40 003.

Stepwise Particularisation: The process of orderly development from the constructs of the Generic Level via a Partial Level to the Particular Level.

trigger: See 7.9.

universe of discourse: The collection of entities that ever have been, are, or ever will be in a selected portion of real world or postulated world of interest that is being described by the models.

3.2 Abbreviations

AMICE	The European consortium which developed CIMOSA, originally within the ESPRIT project 688.
AMT	Advanced Manufacturing Technology
CASE	Computer Aided Software Engineering
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CIM	Computer Integrated Manufacturing
CIMOSA	CIM Open Systems Architecture
ENV	European Pre Standard
ESPRIT	European Strategic Programme in Information Technology
IEEE	Institute of Electronic and Electrical Engineers
ISO	International Organisation for Standardization
IT	Information Technology
OSI	Open Systems Interconnection
WG-ARC	The CEN/CENELEC Working Group on CIM Architecture, the predecessor to CEN TC310/WG1