



SLOVENSKI STANDARD

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Napredna proizvodna tehnologija – Sistemska arhitektura – Storitve za izvajanje podjetniškega modela in integracijo

Advanced Manufacturing Technology - Systems Architecture - Enterprise Model Execution and Integration Services

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Advanced Manufacturing Technology - Systems Architecture - Enterprise Model Execution and Integration Services

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

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

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

This European Standard has been prepared under mandate BC-IT-225B given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

Introduction

Clause 1 sets out the formal statement of scope for the Enterprise Model Execution and Integration Services (EMEIS) which are needed to provide the functionalities needed in enterprise engineering for creating and using enterprise models. They are organised into:

- Model Development Services (MDS) to support the co-operative development, analysis, management and release of model components, partial models and executable particular models of business entities of some enterprise (Clause 4),
- Model Execution Services (MXS) to provide for the operational use of models (Clause 5), and
- Shared Services applicable to both the development and the operational environments (Clause 6).

Annex A describes the previous work on which this ENV depends, how the formal statement of scope has been interpreted, and the staged model development process which the services have been defined to support.

Annex B lists other standards identified as relevant to this ENV and Annex C contains a supporting bibliography.

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Figure 1 shows the spectrum of model components and models in different phases of model development and execution. It also shows the dependencies of model engineering and operations on EMEIS (Model Development Services, Model Execution Services, Shared Services) and in turn the services on which EMEIS depends for properties such as system distribution and system-wide information access (Base IT Services). The remainder of this standard is organised to correspond to these four classes of service.

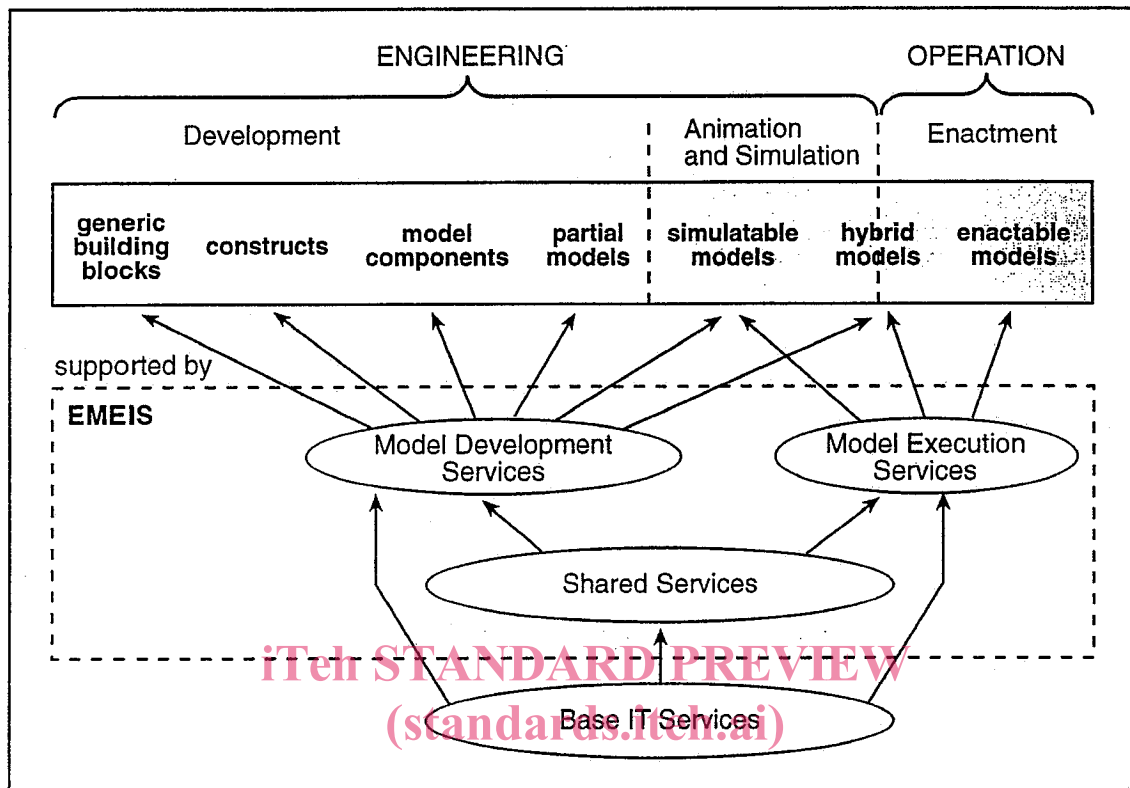


Figure 1: EMEIS in support of phases of model usage

As described in Clauses 4.1 and 4.2, models are developed for execution by a process of specialising partial models which are themselves composed of building blocks (model components). They are then released for execution (simulation or enactment) in which events trigger the scheduling of activities, the acquisition of the necessary information and resources and finally the controlled simulation or enactment of those activities.

This execution scenario is generally applicable to both model simulation and model enactment. However model enactment in support of enterprise operations (model-based control) generates additional requirements, e.g. for real-time monitoring, security, information access privileges and availability of and communication with enterprise resources. In contrast, simulation operates on simulated resources and does not generate output signals to affect manufacturing operations.

During model development and when models are used to visualise and evaluate alternative courses of action (animation), it is possible for models to be executed in hybrid fashion, with parts of the model being used to drive the manufacturing process directly, while other parts are used in simulation mode and possibly driven by manual intervention rather than enterprise events. For this reason an instance of a part of the model will be qualified by its execution status (animation, simulation or enactment) and its relationships to other models.

1 Scope

This European PreNormative Standard (ENV) identifies the requirements for a basic set of functionalities needed in enterprise engineering for creating and using enterprise models. This set may be expanded in the course of technology evolution. It identifies so far as found possible those standards, services, protocols and interfaces which are necessary for the computer-based development and execution of enterprise models and model components that have been constructed in accordance with ENV 40003 and ENV 12204.

2 Normative References

This European Prestandard 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 reference, subsequent amendments to or revisions of any of these publications apply to this European Prestandard only when incorporated in it by amendment or revision. For undated reference, the latest edition of the publication referred to applies.

ENV 40003:1990 Computer Integrated Manufacturing – Systems architecture – Framework for Enterprise Modelling

ENV 12204:1996 Advanced manufacturing Technology – Systems architecture – Constructs for Enterprise Modelling

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3 Definitions and Abbreviations

3.1 Terms and Definitions

NOTE

Additional and relevant definitions are provided in ENV 40003 and ENV 12204

For the purposes of this standard, the following definitions apply:

Enterprise Integration

The integration of the business entities of the enterprise involving business process communication, co-operation and co-ordination, enterprise-wide knowledge sharing and interoperability as well as enterprise inter-networking, enabled by application and physical integration services.

Enterprise model

The abstract representation of the enterprise capable of being analysed into elements with:

- Structural relationships defined between the elements
- Behaviour defined for each element
- Conditions defined under which that behaviour can be invoked and the Enterprise Objects needed for that invocation
- Organisational responsibility defined for each element or derivable from another element

NOTE – An enterprise model is a model of what the enterprise intends to accomplish and how it operates. It identifies the basic elements and their decomposition to any necessary degree. It also specifies the information requirements of those elements. It provides the information needed to define the requirements for integrated information systems. It is used to improve the effectiveness and efficiency of the enterprise. (From CEN Report CR: 1830 :1995.)

Enterprise Model Execution and Integration Services (EMEIS)

A common set of services which reside within an integrated IT system and which supports execution of enterprise model components.

Event

Solicited or unsolicited happening, timing or request to do something in the real or modelled part of the enterprise or its environment.

Executable model

A computer-processable enterprise model capable of the animation, simulation or enactment (model-based monitoring and control) of an enterprise model, including combinations of these usages.

Model Visualisation

The representation of a computer-based description of an enterprise model or model component in a form which allows user visualisation of its structure and elements.

Model Animation

The dynamic activation of a computer-based description of an enterprise model in a form which allows user visualisation of its possible modes of behaviour and system states.

Model Simulation

The user-directed simulation of an executable model for the purposes of predicting enterprise future states or their properties.

Model Enactment

The execution of an executable model or model component for the purposes of model-based monitoring and control of an enterprise.

Model Execution

The animation, simulation or enactment of an enterprise model or models, including combinations of these usages.

Model use in hybrid mode

The user-directed simulation of a model or model component in combination with other enactable models or model components.

3.2 Abbreviations

(B) (in clause 4), model development functionality intended for the Business expert

CIM Computer Integrated Manufacturing

EMEIS Enterprise Model Execution and Integration Services

ENV European PreStandard (Prenorme Européenne; Europäische Vornorm)

GUI Graphical User Interface

IEC International Electrotechnical Council

ISO International Organisation for Standardization

IT Information Technology

(M) (in clause 4), model development functionality intended for the Modelling expert

MDS Model Development Services

MMS Manufacturing Messaging Specification

MXS Model Execution Services (standards.iteh.ai)

ODP Open Distributed Processing

OMG Object Management Group <https://standards.iteh.ai/catalog/standards/sist/b34967be-b04d-4342-a7c5-920f17d6957a/sist-env-13550-2003>

RDA Remote Database Access

(S) (in clause 4), model development functionality intended for systems-related tasks

SGML Standard Generalised Mark-up Language

SQL Standard Query Language

STEP Standard for the Exchange of Product model data

4 Model Development Services, MDS

4.1 Model development (informative)

The various phases of model development are illustrated in figure 2.

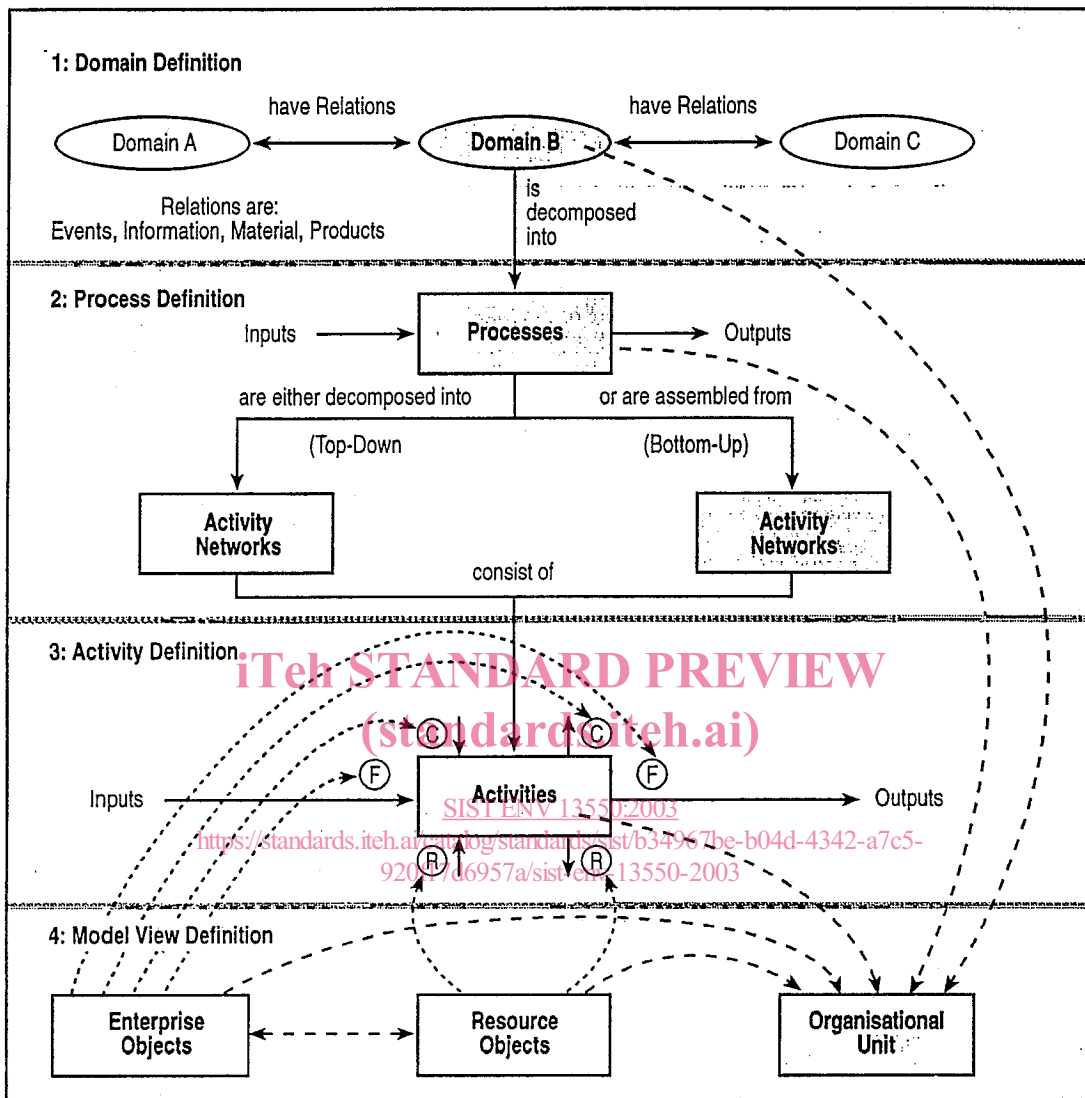


Figure 2: Phases of model development¹⁾

This shows four phases:

- Phase 1 is concerned with the overall enterprise architecture, its domains and relationships between these. Domains have objectives, relations to other domains and an identified responsible Organisational Unit.
- Phase 2 is concerned with the identification and content of the processes, their behaviour and details. In this phase one would expect to have pre-defined partial models and building blocks and to add to or modify these as necessary. Processes have objectives which relate to their inputs/outputs and an identified responsible Organisational Unit.
- Phase 3 is concerned with what do those processes need, how do they acquire those inputs, and what outputs do they deliver. Activities have Functions (F), Controls (C) and Resource (R) inputs and outputs, and an identified responsible Organisational Unit.
- Phase 4 is concerned with building non-redundant structures (sub-models and models). This may include already existing partial models and building blocks (configurations of constructs) which are primarily the province of the modelling expert. Functions (F), Controls

¹⁾ In this figure, the arrowheads indicate the direction in which to read the relationships (and do not signify information flow).

(C) and Resource (R) inputs and outputs are Object Views of Enterprise Objects. Enterprise and Resource Objects share relations with each other and have identified responsible Organisational Units.

These four phases are generally iterative and not necessarily sequential. In general, the modelling expert does the information modelling, builds the first model, and develops building blocks and partial models, while business and process experts specialise (particularise) and validate these partial models for specific business processes.

Because development is a joint activity engaged in by both modelling and business or process experts, specific responsibilities and authorities need to be assigned in the model development process so that someone can create a new building block or partial model, while others can configure and particularise a partial or particular model. These responsibilities shall be reinforced by the assignment of appropriate security and access privileges (using the Security Shared Service), and the presentation of an appropriate user interface (Human Dialogue Service).

4.2 Model developers (informative)

There will be at least two groups of people involved in enterprise model development:

- Modelling experts who provide components (building block types, partial models, etc.) at the early stages of engineering development (see figure 1)
- Business experts who select from these prefabricated components to build and maintain models during the later stages of engineering development and during model operation.

In the description of Model Development Services, each service description is qualified by M and/or B to indicate whether that functionality is intended for the modelling or business expert, or for both. Additional functionalities will be provided for systems-related tasks and these are indicated by S.

The modelling of complex manufacturing processes requires training and a methodology to provide and support the necessary abstraction capability. The methodology will be supported by specialised tools for the experienced process modeller (not the subject of this ENV except in so far as they may make use of MDS). The Model Development Services detailed below take account of the fact that parts of models will be developed by different people with different skills (for example in the model management services).

4.3 Development Services

The various constructs of ENV 12204 place particular requirements on the services that are needed for model creation, and the functionality of the services detailed below are derived from that perspective of how to support the creation of models. In particular:

- Model Creation (clause 4.4)
- Model Assessment (clause 4.5)
- Model Management (clause 4.6)
- Model Repository (clause 4.7)

4.4 Model Creation

This service shall provide functionality for:

- a) Creation of construct types
 - Defining, creating and specialising construct types into model components from pre-formed templates with associated semantics; similarly specialising classes and model components into further model components (M)
 - In particular, composing model components from pre-defined constituent parts (for example Business Processes from constituent Enterprise Activities) (M, B)
- b) Creation of partial models
 - Specifying a kind of partial model as a prototypical description of a manufacturing capability, for example a shop floor's capability to make products according to its logical and physical structure (M) or the sequence of make instructions which define how a partial

model representing a manufacturing capability is to be exercised for a specific product or context (B)

- Combining model components into partial models with identifiers and characterisation of its capability and applicability (for example as Class-Responsibility-Collaboration cards) (M)
- Adapting, modifying and extending existing partial models into new partial models (B)
- Provide functionality for describing the conditions under which alternative partial models are to be invoked.

c) Creation of particular models

- Using sequential relationships to combine model components and partial models into an executable model (M)
- Identifying Object Views for particular applications (including those of the model developer) (M, B)
- Defining, creating and specialising new construct instances and relationships between them which have been identified as needed during the particularisation process (M, B)
- Provide functionality for describing conditions (the context) under which alternative particular models are to be invoked
- Providing the ability to define user-selectable object views to control and filter the form of information displayed for some construct instance (M, B)
- Particularising the declaration of appropriate object view bindings for a particular usage of a partial model, for example the specialisation of an assembly operation to the assembly of physical parts into a new part or to the assembly of textual items into a new document (M, B)
- Encapsulating legacy systems as Resources with Capability Sets (M)

d) General

- Browsing, navigating and selecting amongst model components to support the identification of possible choices, for example for assigning responsibilities or selecting amongst candidate Enterprise Activities (M, B)
- Visualising and browsing model components, for example to traverse a tree of relationships (M, B)
- Browsing and navigating amongst model components to support selection between possible choices in the model creation process (M, B)
- Providing the ability to choose between different model views (M, B)

NOTE:

Visualisation requires that a commonly accepted graphical user interface and language shall be deployed to give a common look and feel during the processes of model development, assessment and execution (via Human Presentation Services). A future development of ENV 12204 should address this issue building upon ISO and IEC process symbols.

4.5 Model Assessment

This service shall provide functionality for:

- a) Analysis
 - Analysing model structural analysis, for example consistency, completeness (M)
 - Analysing model dynamics, for example for verifying liveness and reachability properties (M)
- b) Animation
 - Using dynamic test facilities to exercise model dynamics (model animation) so as to visualise anticipated behaviour, for example Petri net animation of sequencing rules (M)