

Evaluation report on CIM architectures

Committees responsible for this Published Document

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- EEA (The Electronics and Business Equipment Association)
- Gauge and Tool Makers' Association
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- Institution of Mechanical Engineers
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- Machine Tool Trades Association

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National foreword

This Published Document, which has been prepared under the direction of the Advanced Manufacturing Technology Standards Policy Committee, is the English language version of the CEN/CENELEC Report entitled Evaluation report on CIM architectures, R-IT-01 — August 1989.

This CEN/CENELEC Report is the result of the completion of the first phase of work in the area of Architectures for CIM with a view to producing an ENV. It presents a compiled collection of several standards organizations' initiatives and the results from some major development projects which together comprise a consolidated evaluation report.

Cross-references

International Standard	Corresponding British Standard
ISO 3309:1984	BS 5397 <i>High-level data link control (HDLC) procedures</i> Part 1:1985 <i>Specification for frame structure</i> (Identical)
ISO 4335:1987	Part 2:1985 <i>Specification for consolidation of elements of procedures</i> ^a (Technically equivalent)
ISO/IEC 8073:1988	BS 7223:1990 <i>Open Systems Interconnection: Connection oriented transport protocol specification (including Network connection management sub protocol)</i> ^b (Identical)
ISO 8473:1988	BS 7235:1990 <i>Open Systems Interconnection: Specification for protocol to provide the connectionless-mode network service</i> ^b (Identical)
ISO 8602:1987	BS 7222:1990 <i>Open Systems Interconnection: Connectionless-mode transport protocol specification</i> ^b (Identical)

^a Under revision.

^b In preparation.

Up-to-date information on existing and projected British Standards publications is included in the "Basic List" publication as part of the BSI Information Technology Service (BITS) initiative. For details contact: Marketing Department, BSI, Linford Wood, MILTON KEYNES, MK14 6LE.

Additional information

In the references, the extracts from the Danish report and the German report include contents lists which give page numbers. Annex A contains a contents list which gives page numbers. Users of this Published Document should be aware that the page numbers given relate to the page numbers of those reports and not to the page numbers of this Published Document.

IMPORTANT NOTE. It should be noted that there is no clause **2.12.4** in this standard, hence the clause numbering is not consecutive.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the R-IT-01 title page, pages 2 to 100, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Key words: Automated manufacturing, system architecture, enterprise reference model, communication procedures, implementation.

English version

Evaluation report on CIM architectures

This CEN/CENELEC Report was elaborated by the CEN/CENELEC Advanced Manufacturing Technologies (AMT) Working Group on Architectures (CEN/CLC/IT/WG/ARC).

It was adopted by the Information Technology Ad hoc Expert Group on AMT (ITAEGM) on 1989-01-25. It was subsequently adopted as a CEN/CENELEC Report by the Information Technology Steering Committee (ITSTC) on 1989-04-24.

CEN/CENELEC members are the national standards organizations and national electrotechnical committees, respectively, of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN/CENELEC

The Joint European Standards Institution
Organisation Commune Européenne de Normalisation
Die Gemeinsame Europäische Normungsorganisation

Central Secretariat: rue de Stassart 36, B-1050 Brussels

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Foreword

As an element of the European Harmonization aiming at an open internal market by 1992 the Commission of the European Communities has initiated a number of actions ranging from Precompetitive Research and Development towards standardization and implementation.

In the area of Computer Integrated Manufacturing (automated manufacturing) CEN/CENELEC/ETSI have mandated an ad hoc advisory expert group (ITAEGM) to set up and coordinate the European programme. ITAEGM is reporting to the Information Technology Steering Committee of CEN, CENELEC and ETSI, named ITSTC.

The ITAEGM has established some working groups, one with the purpose of developing and maintaining the programme. As a consequence of this programme, one other group responsible for identifying the European Architectures of Computer Integrated Manufacturing systems (CEN/CLC/IT/WG/ARC).

This evaluation report constitutes the results of the working group on Architectures in its first phase.

The Evaluation Report has been considering a number of National, European and International activities, including the work of ISO (the International Standardization Organization). The work of ISO has been reflected in sub-sections 2.4 and 2.5 of the report.

The Evaluation Report has been approved by ITAEGM on its meeting 1989-01-25, and has been handed to the CEN/CENELEC Central Secretariat for future processing. The report has been ratified by ITSTC on 1989-04-24, and is now published as R-IT-01.

Progress in Work, January 1989

Following finalization of the Evaluation Report, the Working Group on Architecture has entered the work on phase 2 in its mandate.

The Working Group is in good and close collaboration with the ESPRIT I projects CIM-OSA and Open CAM Systems. It was decided for phase 2 of the work as outlined by the BC-IT-62 mandate, to concentrate its efforts on developing a Framework European Prestandard (ENV) based on CIM-OSA but influenced by Open CAM Systems and Open Distributed Processing.

This priority has been decided, based on the mandate BC-IT-62, based on the work programme M-IT-04, and based on the fact that other organizations are putting efforts in the creation of functional standards in the area of Physical System Integration.

Close attention will be given in the future to international work.

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Section 1. Introduction

The principal aim of Advanced Manufacturing Technology (AMT) standardization is to provide industry with a set of tools to allow the integration of dissimilar hardware, software and data into a single coherent system. An overall framework is required to identify individual elements of AMT systems and the interfaces required between them.

The framework thus becomes the core of a set of tools for standards developers, vendors and users to ensure that elements of a system will be compatible to a known degree of certainty.

A number of separate initiatives have been launched nationally and internationally to fulfil this requirement and thus harmonization is necessary to provide a common, international framework.

Based on recommendations for CEN/CLC/ITAEGM as given in the European Standardization Work Programme for Advanced Manufacturing Environment Architecture, it was decided by ITAEGM to progress the Development of Manufacturing Environment Architecture as the basic framework for AMT standards (section 1.1 and 7.1 of the ITAEGM work programme), based on the work of ESPRIT and other national and international initiatives.

The scope of this Evaluation Report is to present a compiled collection of information on separate initiatives from Standards Organisations and results from development projects for the purpose of establishing a consolidated Evaluation Report.

1.1 Status of Work

The present Evaluation Report constitutes the first step for such harmonization and similarly the first step in the preparation of a set of European Standards defining a Manufacturing Environment Architecture. In its consolidated form the Architecture will provide a framework for hardware and software standards in an AMT system and the production of a consistent set of methods for the analysis and representation of industrial enterprises and AMT systems within that Architecture.

The report is composed of a edited collection of descriptions of national and international projects or initiatives identified by the CEN/CLC ITAEGM Working Group on Architecture. As far as possible these have been reported in a common style, but where the form and the content of some description given does not fit with that common structure of the present evaluation report, that information has been included in the form of separate annexes. This also goes for various background information and unstructured discussions. Those projects identified so far are

INITIATIVES	Computer Aided Manufacturing — International, Inc. (CAM-I), USA	
	Industrial Technology Institute (ITI), University of Michigan, USA	
	National Bureau of Standards, Advanced Manufacturing Research Facility Programme, NBS – AMRF (USA)	
	Deutsches Institut für Normung, DIN Commission for Computer-Integrated Manufacturing (DIN-CIM)	
	Principal Model for CIM, Danish Standards Association's Programme	
ESPRIT	P322	CAD-Interfaces
	P418	Open CAM System (OCS), including MMCS (Manufacturing Management Control System)
	P688	European Computer Integrated Manufacturing Architecture, CIM-OSA (AMICE)
	P909	Economic Evaluation of CIM in Smaller Manufacturing Companies
	P932	Knowledge-Based Real-Time supervision in CIM, Intelligent Cell
	P955	Communication Network for Manufacturing Application (CNMA)
ISO	ISO TC 184/SC5/WG1 — Reference Model	
	ISO JTC1/SC21/WG1-ODP (Open Distributed Processing)	

PROJECTS MAP/TOP, Manufacturing Automation Protocol/Technical Office Protocol
 PDES/STEP, Standard for Exchange of Product Definition Data
 EDIF, Electronic Design Interchange Format
 EDIFACT, Electronic Data Interchange For Administration Commerce and Transport
 FIELDBUS
 DOD IISS — US Department of Defense, Integrated Information Support System

1.2 The purpose of “Architecture”

An overall CIM system architecture should provide a framework for the hardware and software elements identified in the European Standardization Work Programme for Advanced Manufacturing Technology.

The architecture will then become the basis for identifying and classifying specific industrial requirements, which include but are not restricted to Intercommunication and Interworking.

Classification of Industrial Networks and the Identification of specific interworking problems are part of the Architecture.

It has to be realised, though, that the term “Architecture” carries a lot of different meanings spanning the whole range from Generic or Principal descriptions of an Organization constituting the Manufacturing Enterprise and its Environment to a specific decomposition and identification of standards expanding the factory floor.

The present work will not establish a European standard for a specific architecture but rather provide some sets of information allowing the appropriate institutions to exploit the information and to develop their architectural descriptions. At the same time and in line with such exploitation the working group will prepare the ground for European standards, in concert with International activities.

1.3 Administrative Information

The constitutional basis of the CEN/CLC ITAEGM Working Group on Architecture originates from mandate AMT BC-IT-62 given by CEC SOGITS.

The responsibility has been given to Danish Standards Association and is carried out by

T. Jacobsen, Computer Resources International (convenor)

H-J Mølstrand, Danish Standards Association (secretary)

The following experts have been nominated and have agreed upon the document

Belgium	S. Bourgeois P. Lecocq	CIG Sud CRIF
France	G. Dureau P. Volpert	CGE ALCATEL IBM FRANCE
Germany	R. Panse	IBM Germany
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U. K.	D. Shorter D. Hughes	SD Scicon plc Plymouth Polytechnic

The Working Group has constituted itself with an editorial group

S. Bourgeois	B
D. Hughes	UK
R. Panse	D
D. Shorter	UK
P. Volpert	F

1.4 The Structure of this report

Section 2 is composed of a number of reviews of activities that are of significance in this evaluation. Each description has the common format of

- 2.x.1 Scope and objectives
- 2.x.2 Assessment
(This covers a review in textual form against the requirements for interoperability identified as being of high priority in the ITAEGM AMT Work Programme)
- 2.x.3 Intersystems Communication (relative to OSI)
- 2.x.4 Architecture/Method Working Group Check list (This discusses issues identified as important by the Working Group)
- 2.x.5 A check list in tabular form, against specific subitems of 2.x.2. .2.x.4. This check list assigns ratings against criteria which have been extracted from the CEN/CLC/AMT/ARC-N2 document and additional criteria identified during the CEN/CLC/AMT/ARC meetings. For a better understanding of the criteria one can refer to the corresponding paragraph of the ITAEGM document (Ref. 1) mentioned in parenthesis. The key to the ratings is:
 - negative sign means that the corresponding criterion is not supported
 - plus sign means that the corresponding criterion is supported
 - no sign means that an answer cannot be given from the available documents
 - “na” means that the criterion is not applicable

Section 3 is a consolidation of these ratings and an overall evaluation.

Section 4 contains conclusions.

Annexes contain additional unstructured material.

1.5 Supporting Material

The main body of the report contains information in a common format on a variety of projects. Where appropriate some additional material has been included as Annexes.

Annex A, Factory Management and Control Architecture, defines an “Architecture” and reviews approaches undertaken by industry, research institutions and Standards Organisations in Europe and the USA involved in the development and specification of overall CIM architecture or components of such an architecture. The Annex concludes with a speculation on likely future developments.

Annex B, International Standardised Profiles, describes the moves to develop functional standards in basic manufacturing activities that have been “internationally harmonised”.

Annex C, Small and Medium Size Enterprises, presents a short paper which examines the dilemmas and risks confronting such companies in developing CIM Systems and identifies characteristics of architecture which would help to reduce these problems.

Annex D, FIELDBUS, gives an overview of the activities of the various committees working on the special requirements for a low-level industrial data bus.

Annex E, Pragmatic Migration, contains a short paper outlining the difficulties of achieving full integration which requires a new structuring of all the software. The paper presents an argument that from the standardisation strategy point of view, it will be useful to proceed step by step, from general guidelines and framework up to classical standards.

Annex F, Key issues of Open CAM System, presents the work programme and the key issues of ESPRIT project No 418, Open CAM System. The chapters in the annex describe the manufacturing management and control architecture, models and methods, test beds and work plan to some details.

Section 2. Review of activities

2.1 DIN Technical Report No 15

(The Standardisation of Interfaces for Computer-Integrated Manufacturing).

2.1.1 Scope and objectives

The DIN technical report 15 has been created by DIN (Deutsches Institut für Normung e.V) in cooperation with German industry and German scientific establishments. The scope of the document is to evaluate the standardisation relating to technology as well as to organisational aspects within computer integrated manufacturing (CIM) in a multi-vendor environment. Also some aspects of personnel qualification have been addressed.

Emphasis has been put on “interfaces” not on “systems”. “Reference models” have been created for different working groups, working on parts of the total environment. These “reference models” by no means are meant to be binding in any respect, they are just for the purpose of demarcation between working groups, to avoid overlapping.

Attention has been given to:

- needs for standard interfaces;
- existing and/or overlapping work on standardisation,
- time and resources required for the interfaces not yet under standardisation considerations;
- the need of prerequisite research and prerequisite and/or parallel pilot modelling has been addressed, where required.

Since the scope of the report was to define the necessary work programme, specific recommended solutions or standard proposals are not part of this document.

2.1.2 Assessment

2a) Data.

The aspects of data are addressed in sections:

- 5.1.2.6** for sales and marketing,
- 5.1.3.6** for development and design
- 5.1.4.6** for machinery and equipment planning,
- 5.1.5.6** for work planning
- 5.1.6.6** for production planning and control,
- 5.1.7.6** for production and manufacturing,
- 5.1.8.6** for quality assurance
- 5.2.2.3** for data repositories.

No general methodology for the definition of data content and structure is provided, but the coverage of application data and standard parts is adequate. Libraries of standard parts are covered in detail.

b) Processing.

Although the report specifically addresses “interfaces” and not “systems” the interworking aspects of data base systems are covered in section **5.2.2**.

c) Control equipment.

Aspects of control equipment are covered in section **5.1.7**.

d) Man Machine interface.

Man machine interface aspects are covered in section **5.2.3**.

e) Mechanical aspects.

Mechanical interfaces for machine shop floor equipment are covered in section **5.1.7**.

f) General aspects.

Organisational models have been created for the different areas investigated. They are not meant to be binding, however they define very well the major and intermediate organisational levels within CIM.

The required activities for data standardisation are identified within the areas addressed, but there is no general data methodology across all these areas.

The needs and resources required for conformance testing are generally addressed but not specified in detail.

Since the report is meant to identify the areas for additionally required standardisation requirements and does not offer immediate solutions, implementation guidelines and/or migration paths have not been addressed.

2.1.3 Intercommunication

Intercommunication aspects are covered in section 5.3.1, and the OSI, MAP and TOP activities as well as OSI standardisation activities in process are very well covered in this section.

2.1.4 Architecture/Method work group checklist

Since the report is meant to identify the area and requirements for additional standards, solutions are not represented.

2.1.5 Assessment against criteria for characterisation of a CIM architecture

Criterion 1.

The ARCHITECTURE (1 and 1.1) must identify the overall requirement for achieving interoperability between different computer environments, taking into account all the high priority items identified in the ITAEGM report:

	DIN TR15
a. data (2)	
1) general methodology (2.1)	—
2) application data (2.2)	+
3) standard parts (2.3)	+
b. processing (3)	
1) software portability (3.1)	—
2) software modularity (3.2)	—
3) operating system (3.4)	—
4) database systems (3.5)	+
5) application languages (AMT systems) (3.8)	—
6) software tools (3.9)	—
7) interworking with other applications	—
c. control equipment (4)	+
d. man machine interface (5.1)	+
e. mechanical aspect (6)	+
f. general aspects (7)	
1) Methodology (7.1) A consistent set of methods of analysis and representation of industrial enterprises, factories, workshop and industrial automation systems which addresses:	
a) organisational structures (including entities, levels)	+
b) data definition and exchange	+
c) logical system architecture (incl. basic, generic, recursive functions)	—
d) physical system architecture	—
2) conformance testing (7.2)	+
3) documentation standards (7.4)	na
4) implementation guidelines (7.6)	—
5) operating environment (7.8)	—
6) pragmatic migration (from existing systems)	—

Criterion 2

INTERCOMMUNICATION must be addressed (1):

- a. using ISO/OSI 7 layers model and the associated OSI standards (1)
- b. using basic std for industrial sces. (1.2)
eg: half-duplex, MMS
- c. using basic std for industrial envt. (1.3)
eg: real-time network, fieldbus
- d. using funct st on industrial com. (1.4)
eg: TOP; MAP

DIN
TR15+
+
+
+

Criterion 3

ARCHITECTURE/METHOD work group checklist

- a. adequate for analysis of requirements
- b. adequate for representation of solutions
- c. adequate for identification of standards for users
- d. adequate for identification of new standards work-item for standards organisation
- e. adequate for CIM equipment suppliers
- f. adequate for CIM users
- g. compatible, integrates with existing and developing standards
- h. consistent
- i. free standing, (generic, design independent)
- j. well explained

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2.2 ESPRIT CIM-OSA

2.2.1 Scope and objectives

Within the ESPRIT CIM-OSA project it is intended to define and develop an Open Systems Architecture for CIM, to support present and future needs. Design criteria for the architecture include:

- openness i.e. the criteria of an environment in which multi-vendor systems can be supported. In this context, the architecture will be ISO-OSI compatible.
- protection of existing investment, i.e. a migration path will be identified from the present to future implementations.
- capability for progressive implementation, with special attention to the needs of small manufacturers enterprises.
- applicability across a wide spectrum of industry

CIM-OSA is defined at several levels ranging from the purely generic to the highly particular.

The “Reference Level” is entirely generic in nature, essentially acting as a reference catalogue of CIM-OSA architectural components, constraints, rules and terms.

The “Particular Level” is entirely dedicated to a given enterprise. For such an enterprise the CIM system implementation is to be ultimately described by a “Particular Model” which embodies all necessary knowledge of the enterprise in a form which can be used directly for the specification of the required IT hardware and software.

Although the “Reference Level” is the definite base for all “Particular Models” the application of CIM-OSA is being foreseen in practice on an intermediate footing somewhere between the “Reference” and the “Particular Levels”. This base is represented by the definition of a number of “Reference Shells”, each shell being applicable to a particular category of enterprises.

In order to ensure that the required hardware and software for a particular model is optimally designed, different viewpoints must be taken. Within CIM-OSA three viewpoints are defined: the “Enterprise Viewpoint”, the “Information Viewpoint” and the “Implementation Viewpoint”.

The “Enterprise Viewpoint” describes “what” has to be done within the enterprise. The “Information Viewpoint” describes the information required within the enterprise activities and the “Implementation Viewpoint” embodies all necessary knowledge of the enterprise in a form that can be used directly for the specification of the required IT hardware and software.

For the “Implementation Viewpoint” a more detailed reference model is defined, specifying components (services) which appear to be required for all particular enterprise models. The services presented within the IIS (Integrated Information System) however can also be implemented in the particular enterprise models as required, i.e. not all of the identified services must necessarily be implemented in all particular enterprise models.

2.2.2 Assessment

a) Data

One of the CIM-OSA objectives is to provide a methodology for building up a structure of information and for identifying generic information. The methodology results in the creation of the Information Model. Since the Information Model is dependent upon the Enterprise Model, the particular information model of each enterprise must select data structures according to its particular needs. However schema to schema conversion is an important part of the information model and therefore differently selected data structures do not present a unsolvable problem.

Although standard parts library is not mentioned explicitly in the CIM-OSA deliverables; it has been considered in the “state of the art” investigation and can easily be incorporated as part of the application and data services.

b) Processing.

Openness is one of the major goals of CIM-OSA. Thus extreme attention has been given to software portability at the application level and interworking with other applications, by specifying an application interface, which makes the applications independent from the operating system used.

Schema conversions allow for data flexibility.

Although a global programming language for advanced manufacturing systems is not addressed, adoption of such a language as it becomes available will easily be possible, by providing the necessary schema (language) conversion. In order to avoid definition of one and only one operating system, limited adjustments to the operating system used is unavoidable, this however can most likely be done by drivers freely available at the market, as CIM-OSA matures.

The concept of business processes ensures that applications will be available in small portable modules.

The feasibility of the above concept needs to be proven during a follow-on project.

c) Control equipment.

One of the IIS proposed services (the Machine Front End service) provides for the coordination and control of machines at the manufacturing shop floor. MMS and its companion standards will be the prime communication means with the manufacturing control equipment.

d) Man Machine Interface.

One of the IIS proposed services (Human Front End service) provides for presentation management and interaction management. Human interface to the applications is provided through the Human Front End service via the Application Interface.

e) Mechanical aspects.

Not within the scope of CIM-OSA.

f) General Aspects.

The CIM-OSA enterprise model will allow the analysis of enterprise operations and will define business processes and activities, constrained by rules and triggered by events. The business processes and activities will then be associated with the necessary data, thus generating the information model of the enterprise. Both the enterprise model and the information model will be used as input for the particular implementation model. This general methodology is a concept, which needs to be proven during a follow-on project.

2.2.3 Intercommunication

One of the IIS proposed services (the Communication Management service) provides for intersystems communication. Open Systems Communication and profiles like MAP are part of that service. Migration from proprietary networks to OSI is included.

2.2.4 Architecture/Method work group checklist

Since CIM-OSA concentrates on the models and on systems architecture, it is adequate for requirements, solutions and identification of standards only in a limited scope. The identification of new standard work items especially the areas of enterprise constructs and intrasystems communication is being addressed.

This architecture is not totally free standing because it has made architectural choices. Among them it assumes the concept of business process management (activities and rules) independent from applications and the common information interchange level.

The documentation available to the public is totally inadequate, does not reflect in a well understandable manner the concepts used and solution offered, and does not communicate in any way the great amount of highly valuable basic work performed.

Needless to say, such problems have influenced the evaluation. But even so, the CIM-OSA project is considered to be highly important for the future work.

2.2.5 Assessment against criteria for the characterisation of a CIM architecture

Criterion 1.

The ARCHITECTURE (1 and 1.1) must identify the overall requirement for achieving interoperability between different environments, taking into account all the high priority items identified in the ITAEGM report:

	CIM-OSA
a. data (2)	
1) general methodology (2.1)	+
2) application data (2.2)	+
3) standard parts (2.3)	+
b. processing (3)	
1) software portability (3.1)	+
2) software modularity (3.2)	+
3) operating system (3.4)	+
4) database systems (3.5)	+
5) application languages (AMT systems) (3.8)	+
6) software tools (3.9)	+
7) interworking with other applications	+
c. control equipment (4)	+
d. man machine interface (5.1)	+
e. mechanical aspect (6)	—
f. general aspects (7)	
1) Methodology (7.1) A consistent set of methods of analysis and representation of industrial enterprises, factories, workshop and industrial automation systems which addresses:	
a) organisational structures (including entities, levels)	+
b) data definition and exchange	+
c) logical system architecture (incl. basic, generic, recursive functions)	+
d) physical system architecture	—
2) conformance testing (7.2)	—
3) documentation standards (7.4)	na
4) implementation guidelines (7.6)	—
5) operating environment (7.8)	—
6) progmatic migration (from existing systems)	+

Criterion 2

INTERCOMMUNICATION must be addressed (1):

- a. using ISO/OSI 7 layers model and the associated OSI standards (1)
- b. using basic std for industrial sces. (1.2)
eg: half-duplex, MMS
- c. using basic std for industrial envt. (1.3)
eg: real-time network, fieldbus
- d. using funct st on industrial com. (1.4)
eg: TOP; MAP

CIM- OSA
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Criterion 3

ARCHITECTURE/METHOD work group checklist

- a. adequate for analysis of requirements
- b. adequate for representation of solutions
- c. adequate for identification of standards for users
- d. adequate for identification of new standards work-item for standards organisation
- e. adequate for CIM equipment suppliers
- f. adequate for CIM users
- g. compatible, integrates with existing and developing standards
- h. consistent
- i. free standing, (generic, design independent)
- j. well explained

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2.3 MAP/TOP, CNMA and FIELDBUS

2.3.1 Scope and objectives

MAP/TOP, CNMA and FIELDBUS represent a type of project addressing network requirements for enterprises and are described together in this section to avoid duplication. Particular distinctions are given in the assessment.

To improve the administrative, design and manufacturing processes, enterprises install large numbers of terminals, computers and different type of programmable devices. Manufacturing robots, controllers and programmable devices require computer support for programming, documentation and back-up. Video screens are important in the control of manufacturing processes as well as for information distribution. To enable communication between the aforementioned devices, local area networks (LANs) are installed in the enterprises. To enable communication between LANs of different vendors the Open Systems Interconnection standards have been established. OSI however allows a wide variety of different media and options.

The Manufacturing Automation Protocol (MAP) profiles have been defined to limit the OSI defined media and options to an absolute minimum, streamlined to the manufacturing requirements. Similarly OSI profiles (TOP) for the Technical and Office Protocol profiles have been defined, streamlined to the special requirements defined.

Within the European Community the MAP profile has been investigated to assess whether special European requirements exist. For that purpose the ESPRIT CNMA project has been launched, which added a few additional options especially for the small manufacturing enterprises.

Both the MAP/TOP and CNMA profiles however are claimed to be too slow in terms of response time for time critical applications. To provide for the “real time” requirements several solutions are being discussed, like Enhanced Performance Architecture (EPA)/MiniMAP in the MAP profiles and FIELDBUS or similar developments. There is as yet no internationally agreed upon standard for the real time requirements.

2.3.2 Assessment

a) Data.

Since MAP/TOP and CNMA are communication profiles which define protocols between the communicating systems, this section is not applicable for assessment.

b) Processing.

Since MAP/TOP and CNMA define a limited number of OSI Application Layer standards, interworking with applications supporting the same OSI standards is possible.

c) Control Equipment.

MAP and CNMA both define the Manufacturing Messaging Service with its companion standards in the Application Layer and therefore provide for a consistent format for the control of communication within manufacturing environment.

MAP/TOP and CNMA have initiated and helped in the detailing of FTAM and MMS and have thereby significantly improved software portability.

d) Man Machine Interface.

Since MAP/TOP and CNMA are communication profiles which define protocols between the communicating systems, this section is not applicable for assessment.

e) Mechanical Interfaces.

Since MAP/TOP and CNMA are communication profiles which define protocols between the communicating systems, this section is not applicable for assessment.

f) General Aspects.

The discussed profiles are part of the OSI standardization activities and as such conformance testing, documentation and pragmatic migration are defined in conformance with OSI standards.

2.3.3 Intercommunication

Except for FIELDBUS, the profiles discussed are part of the OSI standardization activities. MAP/TOP and CNMA have initiated and helped in the detailing of FTAM and MMS and have thereby significantly improved software portability.

2.3.4 Architecture/Method work group checklist

MAP/TOP and CNMA are specific profiles of OSI standards as far as they are available. Where standards are not available in final form proprietary specifications are published, however it is the clearly expressed intention that newly available standards or mature standards proposals will be adopted as they become available.

The real time requirements are not agreed upon by the various user communities and the solutions offered vary by country and vendor. This area must be explored in more detail. A possible committee is the newly created work-item on real-time discrete parts manufacturing communications architecture in ISO/TC184/SC5/WG2, provided all relevant industries are involved.

The profiles discussed are free standing to the extent that they are subsets of the OSI work.

2.3.5 Assessment against criteria for the characterisation of a CIM architecture

Criterion 1.

The ARCHITECTURE (1 and 1.1) must identify the overall requirements for achieving interoperability between different computer environments, taking into account all the high priority items identified in the ITAEGM report.

	MAP	TOP	CNMA	FBUS
a. data (2)				
1) general methodology (2.1)	na	na	na	na
2) application data (2.2)	na	na	na	na
3) standard parts (2.3)	na	na	na	na
b. processing (3)				
1) software portability (3.1)	+	+	+	na
2) software modularity (3.2)	na	na	na	na
3) operating system (3.4)	na	na	na	na
4) database systems (3.5)	na	na	na	na
5) application languages (AMT systems) (3.8)	na	na	na	na
6) software tools (3.9)	na	na	na	na
7) interworking with other applications	+	+	+	na
c. control equipment (4)	+	na	+	+
d. man machine interface (5.1)	na	na	na	na
e. mechanical aspect (6)	na	na	na	na
f. general aspects (7)				
1) Methodology (7.1) A consistent set of methods of analysis and representation of industrial enterprises, factories, workshop and industrial automation systems which addresses:				
a) organisational structures (including entities, levels)	na	na	na	na
b) data definition and exchange	na	na	na	na
c) logical system architecture (incl. basic, generic, recursive functions)	na	na	na	na
d) physical system architecture	na	na	na	na
2) conformance testing (7.2)	+	+	+	—
3) documentation standards (7.4)	na	na	na	na
4) implementation guidelines (7.6)	+	+	+	
5) operating environment (7.8)	—	—	—	—
6) pragmatic migration (from existing systems)	—	—	—	

Criterion 2.

INTERCOMMUNICATION must be addressed (1.):

- using ISO/OSI 7 layers model and the associated OSI standards (1.)
- using basic std for industrial sces. (1.2)
eg: half-duplex, MMS
- using basic std for industrial envt. (1.3)
eg: real-time network, fieldbus
- using funct std on industrial com. (1.4)
eg: TOP, MAP

+	+	+	—
+	+	+	—
+	na	+	+
na	na	na	—

Criterion 3.

ARCHITECTURE/METHOD work group checklist

- a. adequate for analysis of requirements
- b. adequate for representation of solutions
- c. adequate for identification of standards for users
- d. adequate for identification of standards work-items for standards organisations
- e. adequate for CIM equipment suppliers
- f. adequate for CIM user
- g. compatible, integrates with existing and developing standards
- h. consistent
- i. free standing, (generic, design independent)
- j. well explained

MAP	TOP	CNMA	FBUS
—	—	—	—
+	+	+	+
+	+	+	+
+	+	—	+
+	+	+	+
+	+	+	+
+	+	+	—
+	+	+	—
—	—	—	—
+	+	+	+

2.4 ISO/TC184/SC5/WG1 Discrete Parts Manufacturing Reference Model

2.4.1 Scope and objectives

The Reference model of ISO/TC184/SC5 is intended to provide a basis for long-range planning for standardization in the area of system automation. It limits its scope to parts manufacturing and within it to shop floor production.

The model described in Part One of the Reference Model document [see 2.4.2 f)] is composed of three sub-models of the Enterprise:

- a Context for Shop Floor Production which identifies function of Discrete Parts Manufacturing.
- the Shop Floor Production Model (SFPM) which represents a 4-level hierarchy of generic Shop Floor production activities.
- the Generic Action Model (GAM) which depicts activities and flows between them.

A methodology, which consists of cross checking between the sub-model characteristics, will allow generation of a list of areas of standardization.

2.4.2 Assessment

a) Data

Data is treated as one sort of “Information” (the other sort relating to Control) and is an element of the Part One model for which the Part Two methods should elicit standards requirements. The Model does not itself define the form of data structures, only the need for standards across interfaces and for interworking. (In fact this is a general characteristic of the model).

Some internal working material has mapped specific standards and activities onto these identified requirements.

b) Processing

The Reference Model has generic “processing” to mean the processing actions of transform, transport, verify and store which are applied to the three (four) subjects of material, resource and information (further specialised into data and control) in the GAM. It will be possible to represent processing of information at each level of the model, but only upto and including shopfloor.

In the particular sense of (Data) Processing used in N2, the specific interfaces to information processing resources are not represented but will be represented by the use of the resource subject.

c) Control equipment

The model supports (the identification of standards for) control of equipment at the lowest level but also control of one level from a higher level. Corresponding to each control command downward, provision is made for status flow upward. The recent generalisation to allow peer-to-peer control signals adds request and response between peers.

d) Man-machine interface

Resource is assumed to include all entities that enable the manufacturing actions and so (with some reservations) can include the human resource(s) having responsibilities at each level. The interface between the manufacturing actions and the human resource can therefore be identified.

e) Mechanical Aspects

Material (that is changed by manufacturing actions) and physical resources (that are needed to perform such actions) are concepts in the model and it should be possible to describe standards requirements for the interfaces and interdependencies between equipment, tools, products and resources.

f) General Aspects

Part One sets out the concepts of the Reference Model and should be published in 1988. Part Two will set out methods by which needs for standards can be identified but will not give guidance on the design of such standards or the detailed design of a manufacturing system to meet a specific requirement. It does not (and this is probably a major shortcoming) cover the need for standards in the design, implementation, operation and maintenance of the manufacturing process itself (as distinct from the parts that are manufactured). Part Three — for which work has not yet started — will cluster standard areas that have identified by application of the methods in Part Two.

2.4.3 Intercommunication

The transport of information (control and data) within a Shop Floor Production activity is recognised, as are the needs for one activity to communicate with its neighbours (above/below, peer-to-peer).

2.4.4 Architecture/Method Work Group checklist

The document describing the concepts of the model is at an intermediary stage and has been subject to many comments which are currently being processed for publication of a new release. In particular, at a recent meeting of WG1 significant changes to Part One of the Reference Model report were agreed which clarified the underlying concepts and made them more consistent. Specifically the previous Factory Automation Model (FAM) has become an overall context for the four level Shopfloor Production Action Model rather than an essential Part of the Reference Model itself; the Generic Activity Model (GAM) has been generalised to allow instantiation for both strictly hierarchical and peer-to-peer control structures; a number of definitions and cross references have (in principle) been cleaned up; a form of graphical representation has been agreed to introduce the methods for application of the model, and a stronger link has been drafted to set the reader's expectations for Part Two of the report.

The merit of the model is that it concentrates on equipment control, associated AMT languages and industrial networks. Its main objective is to give a list of standards work-items for TC184 but with apparently no reference to an architecture model. The model itself is only an intermediary step for application of a methodology. At the time of evaluation, the status of the work made it difficult to make a precise evaluation. The logic of the methodology is not yet clearly stated and some inconsistencies remain.

2.4.5 Assessment against criteria for the characterisation of a CIM architecture

Criterion 1.

The ARCHITETURE (1 and 1.1) must identify the overall requirement for achieving interoperability between different computer environments, taking into account all the high priority items identified in the ITAEGM report:

	DPM RM
a. data (2)	
1) general methodology (2.1)	—
2) application data (2.2)	+
3) standard parts (2.3)	na
b. processing (3)	
1) software portability	
2) software modularity (3.2)	
3) operating system (3.4)	—
4) database systems (3.5)	na
5) application languages (AMT systems) (3.8)	+
6) software tools (3.9)	
7) interworking with other applications	+
c. control equipment (4)	+
d. man machine interface (5.1)	+
e. mechanical aspect (6)	+
f. general aspects (7)	
1) Methodology (7.1) A consistent set of methods of analysis and representation of industrial enterprises, factories, workshop and industrial automation systems which addresses:	
a) organisational structure (incl. entities, levels)	+
b) data definition and exchange	—
c) logical system architecture (incl. basic, generic recursive functions)	+
d) physical system architecture	—
2) conformance testing (7.2)	—
3) documentation standards (7.4)	+
4) implementation guidelines (7.6)	—
5) operating environment (7.8)	+
6) pragmatic migration (form existing systems)	

Criterion 2.

INTERCOMMUNICATION must be addressed (1):

a. using ISO/OSI 7 layers model and the associated OSI standards (1)	+
b. using basic std for industrial sces. (1.2) eg: half-duplex, MMS	+
c. using basic std for industrial envt. (1.3) eg: real-time network, fieldbus	+
d. using funct std on industrial com. (1.4) eg: TOP, MAP	+

Criterion 3.

ARCHITECTURE/METHOD work group checklist

- a. adequate for analysis of requirements
- b. adequate for representation of solutions
- c. adequate for identification of standards for users
- d. adequate for identification of new standards work-items for standards organisations
- e. adequate for CIM equipment suppliers
- f. adequate for CIM user
- g. compatible, integrates with existing and developing standards
- h. consistent
- i. free standing, (generic, design independent)
- j. well explained

DPM
RM

+

—

+

+

2.5 ISO/IEC JTC1/SC21/WG7 Open Distributed Processing — applicability to CIM

2.5.1 Scope and Objectives

2.5.1.1 Definitions

The current work-item of JTC1/SC21/WG7 is the definition of a basic reference model of Open Distributed Processing (ODP). The objective is to get a DP (draft proposal) by the end of 1989.

— Distributed processing comprises that class of information processing activities in which discrete components of the overall processing activities may be located, or where there is any reason which necessitates explicit communication among the components.

— Open distributed processing characterizes distributed processing designed to conform to ODP standards.

2.5.1.2 Scope

This standard will provide:

- Common definitions of concepts and terms for distributed processing
- A generalized model of distributed processing using these concepts and terms
- A general framework for identifying and relating together open distributed processing standards

The reference model will identify GENERIC functions. Certain application areas may have functions that are generic to their own specific areas. These are not generic in the wider scope of ODP. The concept is to identify for standardization those functions which are of general applicability to a significant number of distributed applications.

2.5.1.3 Field of application

- Data processing systems, databases systems, office systems, real time processing, transaction processing and industrial control systems.
- Command, control, communication and information systems.
- Integrated data/text/voice/image systems.

2.5.2 Assessment

— ODP provides a model for generic functions and standards in the area of data processing, storage and communication among distributed heterogeneous systems.

While not dedicated to specific areas such as factory automation its intent is to provide a framework which should be applicable to areas such as factory automation.

To that extent, CIM-OSA functions which are not specific to CIM might overlap with ODP.

a) Data aspects

ODP is concerned with data independence which is the immunity of data users to changes in the storage structure and access strategy. Data independence for data bases has been described using a three schema approach:

1. The external schema is positioned close to the user and is concerned in the way in which data is viewed by the individual users.
2. The internal schema is closest to the data container and is concerned with the way in which the data is actually stored.
3. The conceptual schema is a level of indirection between external and internal schema; it provides an abstract representation of all data held by the storage object (storage object: the means of accomplishing data manipulation. Data containers are encapsulated by the storage object)

The ODP-Reference Model will provide inter alia, definitions of information entities and relationship within a model concerned with the purpose of data independence.

b) Processing aspects

— Operating systems: Distributed processing requires the coupling of systems. Operating systems functions such as memory management, interprocess communication, network operating system, novel processing (eg: non procedural language processing, high level of parallel processing)

— Software engineering: ODP requires new process of validation and verification of software, tools to support software during lifecycle, language integration, software oriented approach (hardware-software boundary), typed oriented approach (object oriented programming languages and document architecture), concurrent languages.

— Database technology: multiple aspects of transparency are relevant to ODP:

- Access transparency where local and remote data are equivalent for the user.
- Location transparency where the user does not have to know which parts of the database are located on which machine.
- Concurrency transparency which guarantees consistent database image during parallel activities.
- Replication transparency.
- Failure transparency.
- Migration transparency.

c) Control of equipment

Not applicable

d) Man-machine interface

The man-machine interface will be considered within the ODP reference model. Such an interfacing mechanism will include:

- Presentation
- Dialogue
- User application model

e) Mechanical aspects

Not applicable

f) General aspects

The ODP reference model approaches the problem of modeling through a concept of projections which consider the enterprise using five different viewpoints:

- Enterprise viewpoint: business requirements, organizations but not necessary levels within an enterprise.
- Information viewpoint: logical organization and flow of information.
- Computational viewpoint: application programming.
- Engineering viewpoint: distribution processing support.
- Technology viewpoint: Operating system and communication.

Each viewpoint is a way of describing the structure and the behaviour of the system. These viewpoints are not implementation layers of ODP. The definition of enterprises is a broad view which encompass any type of enterprise such as banking, factories and administrations.

The Enterprise viewpoint is qualified as descriptive (free of constraints) while the technological viewpoint is qualified as prescriptive (with constraints). Information, Computational and Engineering viewpoints are both prescriptive and descriptive. Standards will be associated with prescriptive aspects, while descriptive aspects will provide the context for these standards.

2.5.3 Intercommunication

Communication standardization within OSI is now well established, and use will be made within ODP. However new styles of communication will also be increasingly important and used within ODP:

- High transmission rate of communication will impact the form of distributed processing (process context switching, buffer copying, disc access).
- Multimedia distributed processing (documents, workstations, desktop publishing, integrated services such as LAN and ISDN). Voice and data transmission.
- Data Flow control.

2.5.4 Architecture/Method Work-group checklist

The methodology when available will most probably be:

- Adequate for analysis of requirements and identification of new standards work-items.
- Adequate for CIM user and supplier within the limit of generic ODP functions that is without including typical CIM functions.
- Free standing by definition of its objectives.

2.5.5 Assessment against criteria for the characterisation of a CIM architecture

Criterion 1.

The ARCHITECTURE (1 and 1.1) must identify the overall requirement for achieving interoperability between different computer environments, taking into account all the items identified in the ITAEGM report:

	ODP RM
a. data (2)	
1) general methodology (2.1)	+
2) application data (2.2)	na
3) standard parts (2.3)	na
b. processing (3)	
1) software portability (3.1)	+
2) software modularity (3.2)	+
3) operating system (3.4)	+
4) database systems (3.5)	+
5) application languages (AMT systems) (3.8)	—
6) software tools (3.9)	
7) interworking with other applications	+
c. control equipment (4)	na
d. man machine interface (5.1)	+
e. mechanical aspect (6)	na
f. general aspects (7)	
1) Methodology (7.1) A consistent set of methods of analysis and representation of industrial enterprises, factories, workshop and industrial automation systems which addresses:	
a) organisations structure (incl. entities, levels)	+
b) data definition and exchange	+
c) logical system architecture (incl. basic, generic recursive functions)	+
d) physical system architecture	—
2) conformance testing (7.2)	
3) documentation (7.4)	
4) implementation guidelines (7.6)	
5) operating environment (7.8)	
6) pragmatic migration (from existing systems)	

Criterion 2.

INTERCOMMUNICATION must be addressed (1.):

a. using ISO/OSI 7 layers model and the associated OSI standards (1.)	+
b. using basic std for industrial sces. (1.2) eg: half-duplex, MMS	na
c. using basic std for industrial envt. (1.3) eg: real-time network, fieldbus	na
d. using funct std on industrial com. (1.4) eg: TOP, MAP	

Criterion 3.

ARCHITECTURE/METHOD work group checklist

- a. adequate for analysis of requirements
- b. adequate for representation of solutions
- c. adequate for identification of standards for users
- d. adequate for identification of new standards work-items items for standards organisations
- e. adequate for CIM equipment suppliers
- f. adequate for CIM user
- g. compatible, integrates with other systems
- h. consistent
- i. free standing, (generic, design independent)
- j. well explained

ODP RM
+
+
+
na
+
+
+
+

2.6 A Principal Model for CIM

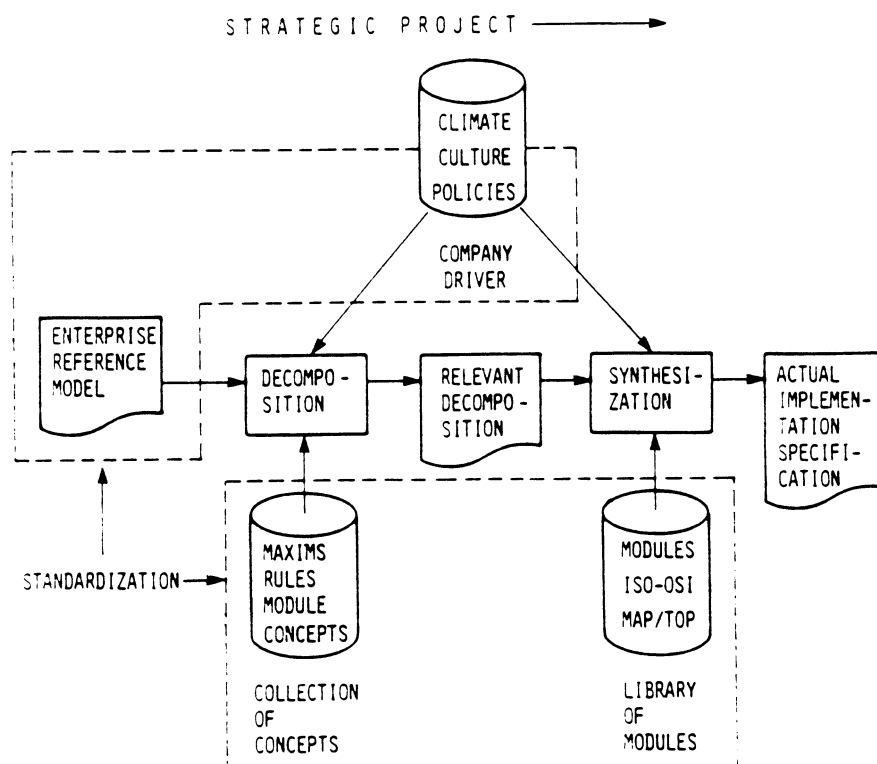
2.6.1 Scope and objectives

The report makes a thorough analysis of the needs for standardization and explains the different views necessary. It gives a comprehensive coverage of existing approaches and models and introduces the philosophy of the Principal Model.

The Principal Model is intended to be a vehicle for the enterprise as well as for Industry in general when analyzing the evolving manufacturing technology and the need for standardization. Further, the Model is intended for individual enterprises when realizing their strategies in implementing Computer Integrated Manufacturing.

The key elements of the Principal Model are the Collection of Concepts, the Library of Modules, and the Methods of Decomposition and Synthesis. A central driver controlling and shaping the process as required by the individual company has been introduced and called a Company Driver.

In use the Principal Model approach supports the development of the CIM part of a strategic plan for the enterprise, which is expressed as an Enterprise-specific Reference Model being the concepts, library of modules and methods. The methods of decomposition and synthesis are guided by the concepts and established standards. So the Principal Model especially uses standards rather than derives standards.



The figure indicates the relationship and uses of the elements of the Principal Model.

2.6.2 Assessment

The Principal Model concentrates on a methodology for user implementation of CIM. The issues of data, processing, communication, and mechanical aspects arise as part of the methodology but are not addressed explicitly.

- | | |
|----------------------------|----------------|
| a) Data | Not applicable |
| b) Processing | Not applicable |
| c) Central Equipment | Not applicable |
| d) Man Machine interaction | Not applicable |
| e) Mechanical Aspects | Not applicable |
| f) General | |

The methodology provides an organisation with the means to develop a strategy for CIM implementation using established standards. It is based on combining the IDEF method with new concepts of Company Driver, Maxims, Rules etc, so producing a network of interrelated concepts which may then be turned into a specification of the CIM system resulting from the stepwise refinement of the Enterprise's CIM implementation strategy. This process includes a synthesis in which concepts are converted into modules and modules are combined into systems. The conversion is performed by means of the Library of Modules controlled by the Company Driver.

2.6.3 Intercommunication

The approach to interworking is that

- Standard modules exist, and their interworking is ensured and controlled through Maxims.
- These Maxims are rules of decomposition that possess universal applicability across all subsystems and interfaces
- The Maxims as well as conceptual descriptions of the standardized modules themselves are qualified and formalized to an extent that makes them available as a Collection of Concepts.

2.6.4 Architecture/Method work Group checklist

Because the emphasis of the model is a methodology, it does not offer implementation or standard solutions for data, processing, control equipment, man machine interface and mechanical aspects.

However it may make a significant contribution in allowing an enterprise to derive its CIM Reference Model based on standards and standards modules.

2.6.5 Assessment against criteria for the characterisation of a CIM architecture

Criterion 1.

The ARCHITECTURE (1 and 1.1) must identify the overall requirement for achieving interoperability between different computer environments, taking into account all the high priority items identified in the ITAEGM report:

	Princ Mod.
a. data (2)	
1) general methodology (2.1)	na
2) application data (2.2)	na
3) standard parts (2.3)	na
b. processing (3)	
1) software portability (3.1)	na
2) software modularity (3.2)	na
3) operating system (3.4)	na
4) database systems (3.5)	na
5) application languages (AMT systems) (3.8)	na
6) software tools (3.9)	na
7) interworking with other applications	na
c. control equipment (4)	na
d. man machine interface (5.1)	na
e. mechanical aspect (6)	na
f. general aspects (7)	
1) Methodology (7.1) A consistent set of methods of analysis and representation of industrial enterprises, factories, workshop and industrial automation systems which addresses:	
a) organisational structures (including entities, levels)	+
b) data definition and exchange	+
c) logical system architecture (incl. basic, generic, recursive functions)	+
d) physical system architecture	—
2) conformance testing (7.2)	na
3) documentation (7.4)	na
4) implementation guidelines (7.6)	na
5) operating environment (7.8)	na
6) Pragmatic migration (from existing systems)	na

Criterion 2.

INTERCOMMUNICATION must be addressed (1):

- a. using ISO/OSI 7 layers model and the associated OSI standards (1)
- b. using basic std for industrial sces. (1.2)
eg: half-duplex, MMS
- c. using basic std for industrial envt. (1.3)
eg: real-time network, fieldbus
- d. using funct st on industrial com. (1.4)
eg: TOP, MAP

Princ Mod.
+
na
na
na

Criterion 3.

ARCHITECTURE/METHOD work group checklist

- a. adequate for analysis of requirements
- b. adequate for representation of solutions
- c. adequate for identification of standards for users
- d. adequate for identification of new standards work-items for standards organisations
- e. adequate for CIM equipment suppliers
- f. adequate for CIM users
- g. compatible, integrates with existing and developing standards
- h. consistent
- i. free standing, (generic, design independent)
- j. well explained

+
—
—
—
na
+
+
+
+
—

2.7 Functional Standards

2.7.1 Scope and objectives

Existing and developing OSI standards include options to provide flexibility in certain defined aspects. This flexibility however requires negotiations between interworking components to find out which options are being supported by the communicating components, before the actual processing of data can be started. These negotiations occupy considerable resources, therefore attempts are made to reduce the amount of necessary negotiations to an absolute minimum by defining stacks of standards with limited or no options to be negotiated.

Supporting ISO and IEC various organisations have been set up to propose internationally acceptable OSI profiles for:

- Transport, related to subnetwork type
- Application support
- Interchange formats and information characteristics

2.7.2 Assessment

a) Data

Because data representation is the subject of ISO layer, this subject is well covered. Standard Parts are not a subject of OSI profiles.

b) Processing

The aspects of processing are covered by the basic standards from which the profiles are selected. Therefore this section is not applicable.

c) Control Equipment

Currently there are no activities in this field, however further work-items are anticipated as soon as the companion standards for MMS are defined.

d) Man Machine Interface

Functional standards using base standards like Virtual Terminal, Computer Graphics Interchange and work on window management are under investigation for consideration, however they are not yet under development.

e) Mechanical aspects

Not applicable

f) General aspects

Functional standards are intended for predefined functions/applications so the methodology is a very pragmatic approach, using mature base standards.

2.7.3 Intercommunication

All functional standards make use of existing base standards. MAP and TOP are considered proprietary functional standards which will eventually mature into internationally agreed functional standards.

The subject of “real time” will be addressed, but needs a greater understanding of basic concepts. The project is being investigated by ISO/TC184/SC5/WG2 under “time critical applications.”

2.7.4 Architecture/Method work group checklist

Functional standards are new standards by definition, however there are no new base standards defined. Functional standards are not free standing, because they are based on existing standards.

2.7.5 Assessment against criteria for the characterisation of a CIM architecture

Criterion 1.

The ARCHITECTURE (1 and 1.1) must identify the overall requirement for achieving interoperability between different computer environments, taking into account all the high priority items identified in the ITAEGM report:

a. data (2)

- 1) general methodology (2.1)
- 2) application data (2.2)
- 3) standard parts (2.3)

b. processing (3)

- 1) software portability (3.1)
- 2) software modularity (3.2)
- 3) operating system (3.4)
- 4) database systems (3.5)
- 5) application languages (AMT systems) (3.8)
- 6) software tools (3.9)
- 7) interworking with other applications

c. control equipment (4)

d. man machine interface (5.1)

e. mechanical aspect (6)

f. general aspects (7)

- 1) Methodology (7.1) A consistent set of methods of analysis and representation of industrial enterprises, factories, workshop and industrial automation systems which addresses:
 - a) organisational structures (including entities, levels)
 - b) data definition and exchange
 - c) logical system architecture (incl. basic, generic, recursive functions)
 - d) physical system architecture

Func Stds
+
+
–
na
na
na
na
na
na
+
+
na
na
na
na

- 2) conformance testing (7.2)
- 3) documentation (7.4)
- 4) implementation guidelines (7.6)
- 5) operating environment (7.8)
- 6) Pragmatic migration (from existing systems)

Func Stds
+
na
+
na
na

Criterion 2.

INTERCOMMUNICATION must be addressed (1):

- a. using ISO/OSI 7 layers model and the associated OSI standards (1)
- b. using basic std for industrial sces. (1.2)
eg: half-duplex, MMS
- c. using basic std for industrial envt. (1.3)
eg: real-time network, fieldbus
- d. using funct st on industrial com. (1.4)
eg: TOP, MAP

+
+
—
+

Criterion 3.

ARCHITECTURE/METHOD work group checklist

- a. adequate for analysis of requirements
- b. adequate for representation of solutions
- c. adequate for identification of standards for users
- d. adequate for identification of new standards work-items for standards organisations
- e. adequate for CIM equipment suppliers
- f. adequate for CIM users
- g. compatible, integrates with existing and developing standards
- h. consistent
- i. free standing, (generic, design independant)
- j. well explained

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2.8 Integrated Information Support System (IISS)

2.8.1 Scope and objectives

The US DOD's Integrated Information Support System is a computing environment used to investigate, demonstrate and test the concepts of Integrated Applications supported by an Integrated Information Support System. In addition the project establishes a set of interim standards and procedures to guide the design of the IISS and to provide guidance to the ICAM project. In the project the following aspects are addressed:

- data definition
- database design
- use of data dictionary
- standards for data definition
- data manipulation
- message definition

The project operates in a heterogeneous hardware environment, containing old and new applications, communicating via LAN and WAN.

The Common Data Model and the Common Data Model Processors are responsible for making the information on different databases, which may be on different computers, look like a single data repository. This is accomplished by utilising a three schema architecture, which is made up of internal, conceptual and external schema.