USE OF DRAFT ISO 13584 PARTS LIBRARY STANDARD[1] FOR DESIGN DECISION SUPPORT

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ABSTRACT: The ability of project decision makers to access decision support information as and when required is be a key factor in making more effective use of the information resources of the Building Construction Industry. This paper examines the potential role of computer based library systems in meeting such requirements with particular reference to the Draft ISO 13584 Parts Library Standard.

ISO TC184/SC4 - STEP AND PARTS LIBRARY

ISO TC184/SC4, Industrial Data, has two International Standards at an advanced stage of development: ISO 10303, Product Data Representation and Exchange (known as STEP) and ISO CD 13584, Parts Library.

STEP is developing Application Protocols (APs) which define specific data exchange frameworks to meet industry requirements. There is strong activity in Architecture, Engineering and Construction (AEC), and Building and Construction (B&C) has active AP projects for Structural Steelwork and HVAC, and a Building Core Model. An AP for Spatial Systems is under discussion, and other projects will follow as interested groups and funding resources are identified.

In 1990 a project was set up within TC184/SC4 under the title *Standard for the Neutral Representation of Standard Parts*, to develop

> "an International Standard for the implementation of standard parts that is independent of any computer-aided design system. This should take into account the mapping of the external standard representations into the internal representations of a CAD system."

This work, titled *ISO CD 13584 - Parts Library*, has been carried forward primarily by European groups in the automotive, aerospace and manufacturing sectors. The Committee Draft ballot stage for the initial set of seven Parts has just closed.

This Paper reviews the potential relevance of ISO CD 13584 to the AEC and B&C sectors in the overall context of initiatives by the STEP Building and Construction Sub-Group in the area of representation, exchange, and availability of project data.

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AEC/B&C RESPONSE TO PARTS LIBRARY DOCUMENTS

At the May 1994 meeting of SC4 Working Groups in Davos, Switzerland, a task was set up by the B&C Sub-group, under the leadership of Australian delegates Richard Wittenoom and Howard Leslie, to investigate the requirements of AEC for design support libraries, and to see whether these could be met within the Draft ISO 13584.

In support of this work the Australian STEP Demonstration Project (SDP) was set up in November 1994 by the Department of Industry, Science and Technology (DIST) in the context of a National Strategic Initiative into the Information Resources of the Construction Industry. A primary area of interest was the information requirement of building projects, particularly during the early project stages.

The SDP Project Team studied examples of creation, realization, exchange and use of data during the briefing, conceptual design and detailed design stages. Prototypes of some operations were implemented. The result was a good understanding of the creation and flow of data: who generates it, who manages it, who needs to know about it, and how it needs to be made available. Reports on the implications for design support libraries in AEC/B&C were presented in workshops at meetings of SC4 Working Groups in Sydney (March 1995) and Washington (June 1995).

MODEL REALIZATION STAGES

Although the B&C APPP planning effort acknowled the existence of temporal and project stage axes in the overall project model space, most STEP AP development has focused on defininition and exchange of product model data which had already evolved through one or more stages of model realization.

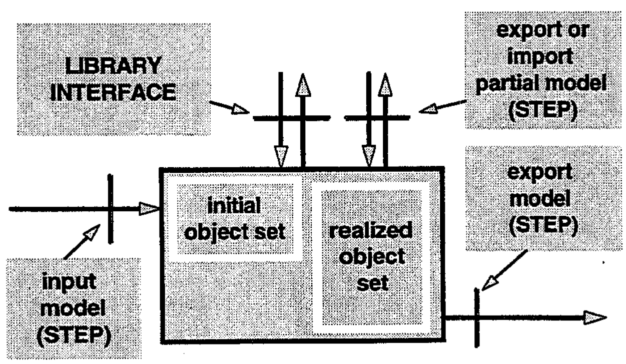

Fig 1 - Logical model of realization stage

In fact a project model evolves through a series of stages during which there is significant change in the content of the model as a result of local activity by design applications, partial exchanges of sub-models with other project workgroups (for example with structural or building services consultants), and retrieval of information from libraries. The beginning and end of such model realization stages are likely to align with project milestones which involve exchange of model information. At these points the conceptual content of the model is relatively stable and it is possible to define the scope and content of such interfaces using a static methodology such as STEP.

STEP has no way of dealing with information inside a model realization stage, although proposals for defining parametric operations (which are in effect realization operations) are under discussion. Nor does STEP yet deal adequately with the two offline interfaces shown in Figure 1: **partial model exchanges** with other project groups and **library transactions**.

The typical model stage shown in Figure 1 is likely to correspond to the union of a number of application models, and is referred to in this paper as an **application model domain.** The destination of library information in a model realization stage will in most cases be such an application model domain, rather than a domain defined by a STEP Application Protocol. ISO CD 13584 appears to have missed this point.

Sources of Design Decision Information

Information about projects is rarely created completely afresh for each project. The process of populating a project model will usually draw on manufacturers' product information, building regulations, design codes and standards, marketplace perceptions, current architectural or engineering design practice, "accepted industry practice" and solutions developed in previous projects.

In the past such information has been gathered and filtered by personal experience, or by reference to regulatory publications, textbooks or manufacturers' calalogues, the decision process generally being that shown in Figure 2.

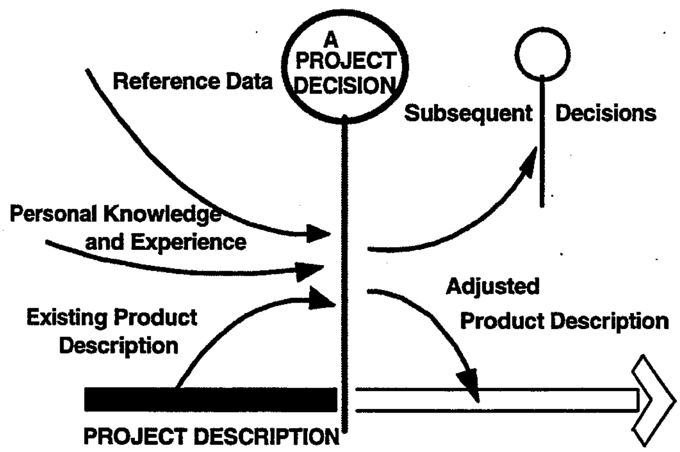

Fig 2 - Factors Involved in a Project Decision

As project processes are increasingly automated and the work load on individual project design professionals increases, a much greater proportion of the information required for such decisions will need to be supplied by computer based reference sources. Ultimately the responsibility for project decisions must be carried by the project team as it carries out the process of assuring the quality and value of the required project.

An efficient, effective information system can help a project team realize that responsibility as long as the system does not dictate to decision makers. In other words, while the information system must be integral to the decision making process, it must remain separate and as neutral as possible (Leslie and McKay, 1995).

Information Requirements of Project Stages

The information required to support project decisions changes as the project advances through its various stages. In the **briefing stage** such information is largely in the form of **constraints** or **functional requirements.** In current industry paractice this information is substantially text based. Examples of this type include:

- Background resources for use in determination of clients' requirements
- Reference libraries of climatic, geographical or social data
- Local Authority planning and zoning information
- Client organisation internal operational guidelines

In the **conceptual planning** and **detailed design and documentation** stages a different kind of information is required, progressively providing technical **solutions** to the constraints and functional requirements information set out in project briefs.

Information in these stages is usually of a type more amenable to encoding for access by automated design or management systems. Examples of such information sources are being considered by other Sessions of this Workshop. Some examples of requirements would include

- Building regulations
- National and international standards and design codes of practice
- Design procedures, manuals and texts
- Materials and properties data
- Assembly data
- Performance data
- Solutions based on previous project experience

During the **tendering, contract negotiation** and **construction** stages the past experience of the actors concerned becomes significant in respect to such matters as costing, submission of alternative proposals, work planning, work breakdown for construction, and procurement.

During **operation** and **facility management** stages the requirement for information will include operational models, maintenance related product information and, ideally, models of the designed and as-constructed facility.

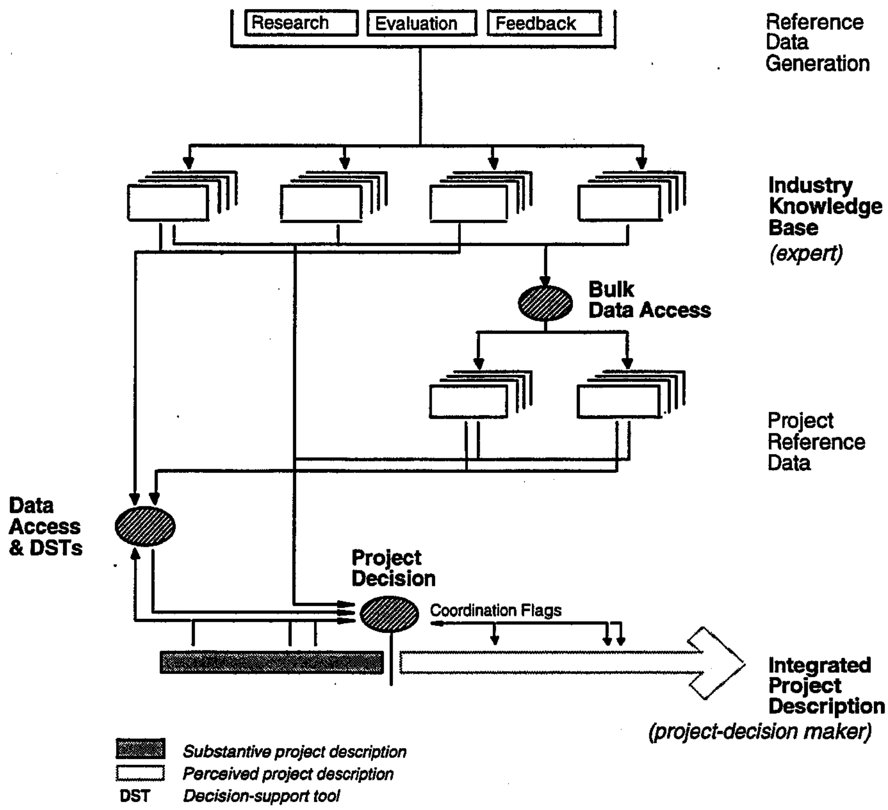

Fig 3 - Logical Model of Design Decision Support Information

LIBRARY IMPLEMENTATION

Within the framework shown in Figure 3, the responsibility for the preparation of reference libraries will remain with manufacturers and information providers. The role of industry or government needs to focus on provision and adoption of appropriate guidelines or frameworks for compliance of supplier libraries.

The availability of decision support information has to fit into the dynamics of the project development process - in other words it must be available when required by project teams. This means that almost all library information will be prepared on an industry basis, well in advance of decisions on a particular project.

Among the frameworks identified by the SDP as necessary to permit orderly development of libraries, library management software and design applications that use them, will be an overall industry information reference model or models. This will make it possible for specific industry knowledge bases to be developed to meet the information needs of project decision makers as particular needs or opportunities arise, without fragmented and inconsistent development resulting.

Commercial library suppliers will obviously tend to address immediate needs or opportunities. However it is essential that methods of encoding and storage and of user access and selection, are developed in a way that is consistent across industry, if the real benefits of industry reference libraries are to be achieved.

THE ISO CD 13584 PARTS LIBRARY STANDARD

The ISO CD 13584 Parts Library Standard documents were produced by Working Group 2 of TC184/SC4. This work has been supported largely by the European automotive, aerospace and manufacturing industries, with little input from AEC during the early stages of this work. As a result the development work has tended to focus on manufactured items such as nuts, bolts and bearings and assemblies of these.

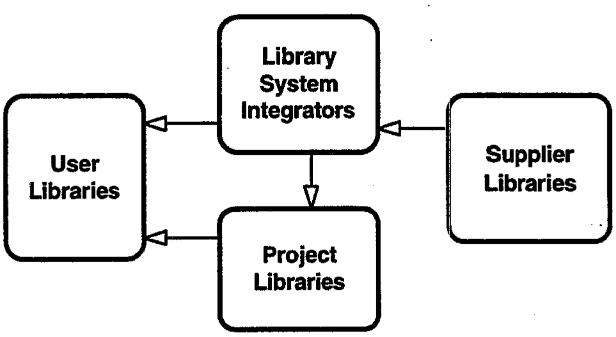

Fig 4 - ISO CD 13584 - Industry Model

ISO CD 13584 is based on the industry model shown in Figure 4. It assumes that parts libraries originate from some form of supplier, who defines the library structure and content and accepts responsibility for the content of the library supplied. Library Suppliers can be of a number of different types, as described below and as indicated in Figure 5.

Supplier libraries are assumed to be assembled by library integrators into integrated libraries, which consist of the content of supplier libraries integrated with a library management system - a software system provided by the library integrator. The end result of this process is a user library, which is the combination of software and data associated with a user's CAD system. In Figure 4, above, project libraries are shown as a separate library type. ISO CD 13584 considers organisations which configure libraries for in-house use as a form of library supplier. However in the Building Construction environment it is considered that the establishment of project wide libraries would be more a matter of administration and agreement than formal integration of hardware and software.

Functional View of Library System

ISO CD 13584 is conceived as a very open and flexible system that allows almost any kind of library entity to be described and exchanged. Its Library Management System implements a very flexible dictionary structure based on named dictionary entity types which are linked into a complex structure describing the library and its data.

The dictionary structure supports object based hierarchies of parts families, both simple and structured. The architecture supports the creation of **general model classes,** which describe the generic nature of the families, and corresponding **functional model classes,** which implement the range of functional views possible for the defined families. These views are intended to be realized through calls across a **representation transmission interface**, which is a software interface specific to the destination CAD system.

The initial set of Parts describes one such system, a FORTRAN based parametric CAD interface. While this is obviously considered appropriate for the development environment, it is probable that other interface methods would be more appropriate in an AEC/B&C environment.

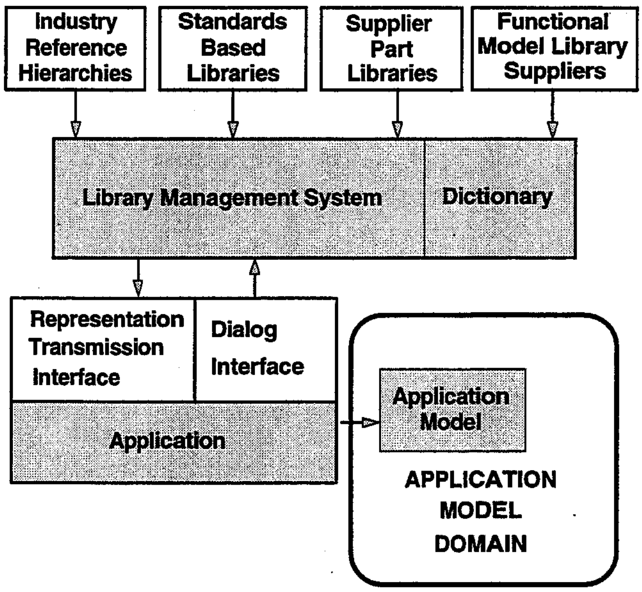

Fig 5 - Logical Model of ISO 13584

An essential part of the Library Management System is a **dialogue interface** which provides the user with access to the semantic dictionary, and thus to the content of the general model class attributes which are used for component selection.

The initial release Parts envisage that applications would include an implementation of the FORTRAN based parametric geometry interface (defined in Part 31 of the Standard), and that the library management system would be linked to the CAD application.

However is is stated in the draft that the Standard is intended to cover all possible configurations of application, library and network. The practical implications of this may not yet have carried through into the Draft.

Library and Supplier Types

Figure 5 shows four different types of library/supplier possibilities. More than one of these could in fact be provided by the same supplier.

- **Supplier Libraries** are likely to be supplied by manufacturers of a part or range of parts. ISO CD 13584 envisages that a Parts Supplier would be responsible for defining the whole environment of his family or hierarchy of Parts.

- **Industry Reference Hierarchies** are industry developed classification hierarchies within which individual Parts Library suppliers would position their own families.

- **Functional Model Libraries:** ISO CD 13584 differentiates between the generic properties of a part and the functional models which define the various views for which the required capabilities have been provided. Functional Model Class Libraries could be supplied by developers other than the originator of the Supplier Libraries.

- **Standards Based Libraries:** To illustrate that a "part" need not be a physical, manufactured object provision has been added in Figure 5 by the Author for a fourth type of Library, to describe the situation where a Standard Document was itself issued as a Library of Parts, the parts being the clauses of the Standard itself arranged in a logical hierarchy.

SUITABILITY FOR AEC/B&C LIBRARY APPLICATIONS

The initial concern with ISO CD 13584 is not the approach taken, but the possible limitations imposed on use in an AEC/B&C environment by restrictions imposed in the Standard itself. Given limited resources and without a great deal of support from other sections of the TC184/SC4 community, WG2 imposed certain bounds on the scope of the initial release parts. As a result, although Part 1 of the draft acknowledges that principles of the Standard could be applied to other types of Library than Part Libraries, it states that the Standard does not directly address other kinds of libraries.

It seems likely that the Parts Library concept can in fact be used for a significant proportion of the Library requirements of the AEC/B&C domain without significant conceptual problem. It is more likely that problems will be encountered with the suitability of the initial implementation approach taken. The only way to determinbe this would be through a program of validation in an AEC/B&C environment.

Any other group that sets out to develop a Library system will eventually have to tackle the same conceptual information modeling issues as those addressed by the

Draft Standard. For example, the following capabilities, already implemented in ISO CD 13584 will be required:

- Define generic abstract classes
- Define manufacturer specific classes
- Define non-dependent (inherent), conditional, and dependent attributes of parts
- Define assembled parts (structured part families) in addition to simple parts (ISO 13584 provides this, but it is not validated).
- Provide a mechanism for defining product selection rules (ISO 13584 provides this through constraint rules and methods).
- Provide a mechanism for describing product behavior
- Provide a mechanism for attaching a product type to an established classification hierarchy and for cross referencing between different hierarchies
- Provide a mechanism for different language mappings (eg English, French, Spanish, Japanese)

CONCLUSIONS

Despite its possible limitations, and regardless of the immediate result of the CD ballot, ISO CD 13584 is a Standard within its final stages of development. It provides a number of innovative and flexible solutions to problems not properly addressed within the STEP environment. If the AEC/B&C Community wishes to take advantage of this Standard, the best way forward would be to initiate validation efforts which apply the methodologies of the Draft to real life AEC/B&C situations.

ACKNOWLEDGEMENT

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