

NEUTRAL BUILDING PRODUCT MODEL FOR COMPUTER INTEGRATED CONSTRUCTION ("The KBS Model")

Kjell Svensson, M.Sc. (Civ.Eng)
Deputy head of division



BYGGNADSSTYRELSEN

The National Board of Public Building

Technical Division
S-106-43 STOCKHOLM, Sweden
Karlavägen 100
Telephone +46 8 783 11 86 Telex 10446 build s
Telefax +46 8 783 11 68

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Abstract

The purpose of this project is to achieve a uniform, systemneutral (portable) structure for handling information throughout the Swedish building industry that is accepted by all for the process of designing, constructing and maintaining a building. The model is capable of containing all kinds of information needed to construct and maintain a building.

The basic concepts of the conceptual model are "objects", "properties" or "attributes" that describe the object, different types of "relations between objects" and "time". The foundation for the evaluation work is the classification and coding system for building parts and attributes called the BSAB (or SfB) system. The objects represent an information entity or physical object and are described together with their attributes. The attributes have both a name and a type classification.

The exchange of data between different participants in the building process and the product model are standardized. The ASCII standard is used for plain alphanumeric information. The Neutral Integrated CAD Communication (NICC) format is used for geometric and associated alphanumeric information. The structure of the NICC format is object oriented.

The project is divided into four phases. Phases one (a pre-study) and two (specification of the product model) have been completed. Phases three (implementation) and four (testing) are at present in progress. The project will be completed in 1991.

Introduction

The purpose of this project is to achieve a structure for information handled throughout the construction process that is uniform, system-neutral and accepted by all the participants in the construction process.

Here, the construction process is taken to mean all the activities that go into the creation and maintenance of a building. The construction process can be roughly divided into product specification (designing), production (tendering and building) and use of the product (maintenance).

The building process is a long one and involves many participants. During this process a wealth of information, is added, retrieved, updated and deleted. This information is of alphanumeric as well as graphic nature. It is used to convey information for use in design, production and surveillance activities in the construction process.

The project is actuated by the motive that, inter alia, in Sweden there is a keen interest in improving the exchange of information between the numerous and heterogeneous groups of participants in the construction process. It is hoped that this will lead to savings and rationalization in the whole construction process and better buildings.

The building sector, like other industrial sectors, is influenced by the evolution from an industrial society to an information society. This, of course, is to a large extent due to the fast development of computer sciences. Now, it is primarily a matter for the building industry itself to work out how to integrate information technology and the building sector.

The most efficient way to achieve a complete flow of information throughout the construction process is to exchange information via data bases in a digitized building product model.

"The KBS model"

The idea of this project is to develop a system to handle information about building and civil engineering works in the design and construction stages as well as the management stage. Information on drawings (graphic information) must be connected to specifications of work and tables (alphanumeric information) and vice versa.

The information handling system is arranged as an object-oriented data base, i.e. a data base in which information is structured in object classes and relations between these classes. A object class is characterized by its attributes (properties). These object classes relate to the physical phenomena represented in the data base, in this case the building and construction process.

For the success of this project it is very important to create a common and generally accepted classification and coding system of the entities (object classes) to which information is related.

The BSAB system classification tables

The BSAB product classification system is generally accepted in Sweden. The product classification tables of the BSAB system are aids for the arrangement of technical and financial information in documents and data bases. The 1983 generation of the system contains two product classification tables - Product Tables 1 and 2. These tables contain codes and headings for the components we use to make up a project or structure.

Using Product Table 1, civil engineering works, buildings and building services installations can be classified with respect to the materials the components contain and the type of labour required for the production of these components. This table contains objects such as structures and installed equipment. It is also used as a principle for division of the (AMA) General Material and Workmanship specifications. Detailed technical specifications are usually drawn up with reference to AMA.

Using Product Tables 2, earthworks, buildings and building services systems can be classified with respect to the technical functions of their components. This table contains objects such as elements of civil engineering works, buildings and building services installations.

Object classes

In the KBS model we have used the 1983 BSAB system as a basis for the definition of the object classes in the object-oriented data base. In order to do this we had to supplement the system in two ways:

1. Provide new headings, so that the system contains all the elements of a modern building.
2. Provide a completely new table for different types of space in different types of building.

The first supplement involved adjusting the present BSAB tables, especially the P2 tables. The second supplement involved creating a new table (matrix) for classification and coding of spaces with a construction analogous to the present BSAB-system P2 tables. The buildings and spaces are classified on the basis of their main application.

It is hoped that both of these supplements will be included in a future new version of the BSAB system. The arrangement of objects we used in the KBS model, corresponding to parts of the building, constructions and spaces, will thereby become a standard for the whole Swedish building industry. To these objects should be coupled the attributes in the KBS model, and the relations that apply between the various objects at different times will be defined on the basis of reality.

Hierarchy of object classes

At different stages and at different times in the construction process it is necessary to have different degrees of detail in the division of the object classes. Seven levels of object class have been defined in the KBS model.

Each object level has been defined using terminology/concepts in the BSAB system in accordance with the table below.

<u>Level No.</u>	<u>Object type</u>	<u>Definition based on the BSAB system</u>
1	Real estate unit	All principal groups in Product Table 2 (P2) together.
2.	Site Building	Principal Group No. 1 in P2. Remaining principal groups in P2.
3.	Principal group	Principal Group in P2.
4.	System	Vertical subdivision in the grid of each group for each principal group in P2.
5.	Sub-system	Horizontal subdivision of each system in the grid for each principal group in P2.
6.	Part	Headings Product Table 1 (P1)/ result by method of construction.
7.	Detail	Resource/smallest calculable building object.

There is also a corresponding seven-level hierarchy for spatial object classes.

Attributes

Attributes are defined to couple information/properties that can be of a certain individual type to objects. They may have both a name and a value. The attribute can describe both concrete and abstract properties and demands on the object. The attributes must describe the objects of

the product model, both as regards the finished product and the processes connected with its production. The list of attributes coupled to a certain object can be very long.

The attributes are classified into different groups depending on their information content. The ten main headings used in classification are shown in the table below. The headings have been taken from the 1983 CIB Master List.

Classes of attribute

0. Identification and complex.
1. External agents and requirements.
2. Product description.
3. Use properties.
4. Design work.
5. Site work.
6. Operation.
7. Maintenance.
8. Supplier and supply.
9. Other attributes.

Relationship between object classes

To be able to describe how the object classes in the product model are related logically and physically, the coupling between them is described. Using these couplings the various object classes are collected to form data-base schedules. The data-base schedules are of two basically different types: hierarchal and functional. Without these couplings the product model would only describe a number of different object classes without indicating their interrelationships.

Each separate schedule normally only comprises a limited part of the building. The functional schedules specify how the structure described in the schedule is connected to other parts of the building.

Together the schedules form a complete picture of how the different objects in a general and logical building are related, both from the hierarchical and function points of view. The theoretical basic information for a product model has thereby been created.

Neutral interface

Standardized formats and structures are used to transfer both alphanumeric and graphic product information between the product model and its user.

An alphanumeric interface is required to transfer text documents such as descriptions, agreements and bills of quantities. Today, this is a well established technique, in the form of ASCII files, which, it is true, exist in a number of variants containing small differences. An ASCII file is readable and employs the alphabet and numbers and a limited number of other characters. By means of coding and location in pre-defined positions, the transmission and reception systems can keep a check on the variables and values transmitted.

Information pertaining to an object can be described using attributes and for each object attributes can be transmitted in unlimited quantities. Communication is done directly against the product model.

The transmission of graphic information requires a more advanced interface than that required for alphanumeric data. IGES is an established standard but it cannot handle attributes tied to graphics. CAD drawings consist of vectors, in contrast to raster pictures, which consist of points that are either switched on or switched off. Vectors can be transferred as alphanumeric information if agreement is reached on the appearance of the format and structure.

In Sweden, we in the building industry work on a well-structured basis in accordance with BSAB and other systems. Extensive experience of integrated design involving many participants is also available in Sweden. This are two reasons why we in Sweden have specified a format that is capable of transferring graphic and associated information between different CAD systems. The format is called NICC, which stands for Neutral Integrated CAD-Communication. The structure of the NICC format is object oriented. Transmission of graphics between the product model and its user is done using the NICC format.

(The NICC format will be presented in detail in a separate address.)

Projects divided into stages

The project has been divided into four stages. Stage 1 was a prestudy of the project. The product model was specified during Stage 2. Work is at present in progress on Stages 3 and 4. Stage 3 involves implementing parts of the product model in a suitable object-oriented data-base system. Stage 4 involves testing the product model on an actual building. The project will be completed during 1991.