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FACING A NEW REALITY IN THE COMPUTERIZATION OF THE INDUSTRY

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Abstract

The introduction of computers in the management of building projects has gone on since the early sixties. In recent years the use of personal computers has increased and will soon become widespread within the organizations of the industry. This development has followed the mechanization of manual work on building sites and in component factories in the fifties. The mechanization of information processing is a logical consequence of the ongoing industrialization of the society, because mechanized production requires adequate and efficient management of activities. In this situation organizations will undergo changes and will collaborate according to new patterns in order to profit by the new technology [ref 1]. In Europe the introduction of the Inner Market will have effects which will require measures to ease communication between the parties of the industry. Therefore, the idea of a common artificial language has gained increasing interest. It has become necessary for technical reasons but also in order to facilitate communication among nations that use different natural languages. This paper outlines some of the problems related to formalization of co-ordinated communication in an industry facing a new reality [ref 2].

Keywords
Classification; Communication; Computer-aided Design; Databases; Neuro-linguistics; Project Management; Symbolic Logic.

1. Classification developments within CIB

CIB/SfB is a so-called alpha-numeric system for classification of information statements in the building industry. It originated in Sweden as a system for co-ordination of project and general information in the years immediately after the Second World War. The first SfB-classified General Specification with related Price Books and Product Catalogues were published in 1950 [ref 3]. The SfB-system was recognized by CIB in 1959, after an evaluation of more than 50 existing systems by R. Mølgaard-Hansen, the Technical University of Denmark. Developments now take place in CIB W74.

2. Developments based on SfB

I used the SfB-system in the preparation of specifications, bills of quantities, time schedules, etc., in the decade 1952 through 1962. Since then I have used SfB in computer aided project management. This has meant proposals for alterations to the system. SfB was not based on Set Theory and Symbolic Logic but had the important quality of being a facetted system, easily applicable in relational databases. It was designed to work independently of trade structures. It was "open" in the sense that it contained free symbols to be applied by the user. The application resulting from this development was named CBC/SfB after 22 articles called "Co-ordinated Building Communication" in

Architects' Journal 1964/65 [ref 4]. The computer programs called the "CBC System", included a number of project management modules, i.a. integrated by means of the common database structure. Developments since 1962 have resulted in the project management system PROXIMA for use in micro-computers. This system is open to any classification.

The main difference between original SfB and CBC/SfB was the proposal to introduce mathematical principles of Set Theory and Symbolic Logic and to shift its main area of application from library classification to computer-aided project management with coded integration between drawings and written documentation. CBC/SfB was a proposal to rationalize building administration by mechanizing managerial routines using a propositional calculus programmed to operate intelligently. It foresaw a situation that allowed the industry to store its information according to a common database structure and to operate on this in actual projects.

3. Developments resulting from CBC

In the mid sixties, and later, a number of SfB-versions were developed, all influenced by CBC. Among these the British CI/SfB [ref 5] and the German BRD/SfB. The Italian version PC/SfB was, like other versions, mainly based on CI/SfB. Without access to any statistics, SfB and versions of SfB seem to be fairly widely used in organizations that see a benefit in the structuring of complex projects according to common principles, regardless of trade structure. CBC developments have often attracted the younger generation at universities who wants bureaucratic routines replaced by rational methods based on scientific thinking which open up new vistas in artistic creation. To-day there is a need for project management education in many countries. To satisfy this, systems are needed that include software, database structure, tutorials, etc. The subject of Project Management should have a higher standing at universities than previously appreciated.

4. CIB W74 Systems Research Group

The following is part of my input to the Systems Research Group of CIB W74 in which I have been working for some years with I. Karlén, the Royal Technical University, Stockholm, together with others. It is necessarily lapidary. It concerns our efforts to create a framework for a common paradigm.

5. Importance of classification systems in computer working

One of the main proposals in the AJ-articles of 1964/65 was the idea of coded drawings. It included two types of coding: 1) the coding of drawings as documents, 2) the coding of pictures (graphic statements) on drawings. In both cases SfB-codes were proposed as tools of cross reference to alpha-numeric documents like specifications, bills of quantities, time schedules etc. This idea meant the use of the logical paradigm of CBC/SfB in the structuring of drawings and other documents, necessary in project management. Recently, this has been called the "layer principle" in CAD-systems. In CBC/SfB it was first known as a system for "Catalogues of Items". To-day the term "Database" is in common use. In the sixties and seventies these proposals were relevant to the few working with computers. To-day it is recognized among computer users that classification and coding is essential for information co-ordination in building. This is not a question of "labelling" the components of a project. Components, together with other resources, enter into definite relations, which must be classified. What is needed is an artificial language sophisticated enough to structure any kind of information necessary in the management of projects. An artificial language is evidently important in so-called "artificial intelligence", in knowledge databases and integrated CAD-systems, i.e. systems that include alpha-numeric documentation. In financial administration it is important in order to create key figures for the industry regarding productivity, etc.

6. Main characteristics of a common artificial language

In my experience a future common artificial language for computer use in the building industry must possess certain basic properties to satisfy the requirements of project management. Among these, the following may be important:

(a) Symbols in a classification system should not classify "things out there" but propositions or statements about things. Any predicative statement is a member of a class. Since a class could contain many members, all statements should be identified by a separate reference number or "primary key". This could be unique or sub-ordinated to the class in question.

(b) Classification systems are systems of classes. A class is the abstraction or extension of a concept. In scientific usage the term "hypostazation" means the understanding of abstract concepts as self-contained realities. In many applications of SfB its symbols are understood in a hypostatic way. One example is the interpretation of 1st table symbols as concrete "elements". The misunderstanding is easily explained by the fact that the term "element" has always been used in official SfB versions. Such use, however, will lead to difficulties in computer working and will hamper its application in CAD-systems. It is an example of the fact that language can be misleading. Understanding of the class concept is, therefore, essential for the introduction of co-ordinating systems. Class systems are close to what is called the "inner language" in neuro-linguistics [ref 6].

(c) Classification tables should be structured according to the principles of Set Theory and Symbolic Logic. That is, class operations like complement classes (negation), union classes (disjunction) and intersection classes (conjunction) should be inherent. This is clear because many predicative statements are complementary to other statements or deal with the union of two or more statements. E.g., statements about "work" deal with the union of statements regarding labour, tools and materials. Statements about "user activities" are complementary to "production activities", because production and use need each other to establish a function. "Prefabrication activities" are complementary to "construction activities" because, taken together, they form the union class of "production". Conjunctions are necessary for syntagmatic reasons. A user should be free to allocate any statement to a class. Symbolic Logic seems necessary for future computerization of natural language.

(d) A class system for project management should be related to the management stages of a project, i.e., to a logical decision process. The combined SfB-tables have the quality of reflecting the administration stages of planning (design), recording (registering) and control (comparison of plans and records). This has lead to development of the CBC/SfB administration model (a) which has its "isomorphic" counterpart in the work model (z). The quality of these models seems confirmed by findings in the science of neuro-linguistics. The primary, secondary and tertiary zones of the model by A.R. Luria [ref 7] correspond with the CBC/SfB administration and work models [ref 9]. Stage a6, for example, corresponds with the tertiary zone in Luria's model, because it deals with the overlying, spatial area in the recording activity (receptive block) of the brain. The design and control areas in stage a1 and a9 correspond to the tertiary zone of Luria's activity programming and regulating block. The z-areas correspond with related motor-areas in his model.

(e) Drawings of the design process illustrate the "finished" product, not the building process over time. Documents like specifications, bills of quantities, time schedules, building accounts, etc., describe the building process over time. They are, therefore, complementary to drawings which lack the time parameter. Drawings, however, are mainly dimensional statements. Consequently, they illustrate relations between the elements of the product in spatial terms. Although this may indeed express important architectural qualities, the quality of building works must be expressed in natural language, i.e., in alpha-numeric documents. It is a peculiar feature of architectural education that its curriculum is normally lacking with regard to physical quality and quantity statements in project management documents which, because of their operational character, include time and quantity. It is an encouraging feature of CAD-systems that the interrelationship between spatial dimensions and quality and quantity statements (alpha-numeric documents) has been realized.

(f) Complementarity between the spatial representation of drawings and the process representation of alpha-numeric description leads to a dualism in classification tables. This is illustrated by a quotation by R. Restak [ref 8]: "Throughout our study of the human brain we will repeatedly encounter this dualism of form vs. function, structure vs. activity." To see drawings as a model of the "result" of production and use, means to understand it - at a certain point in time - as well defined human activities that take place in well-defined spaces and which consist of well-defined operational and material activity factors (resources). An artificial language must fulfill the role as a spatial structure in drawings and a process role in alpha-numeric documents. Co-ordination between the documents is satisfied by using the code symbols as a cross reference. Co-ordination between CAD-programs and project management programs is achieved by using ASCII-symbols to transfer CBC/SfB-codes or similar.

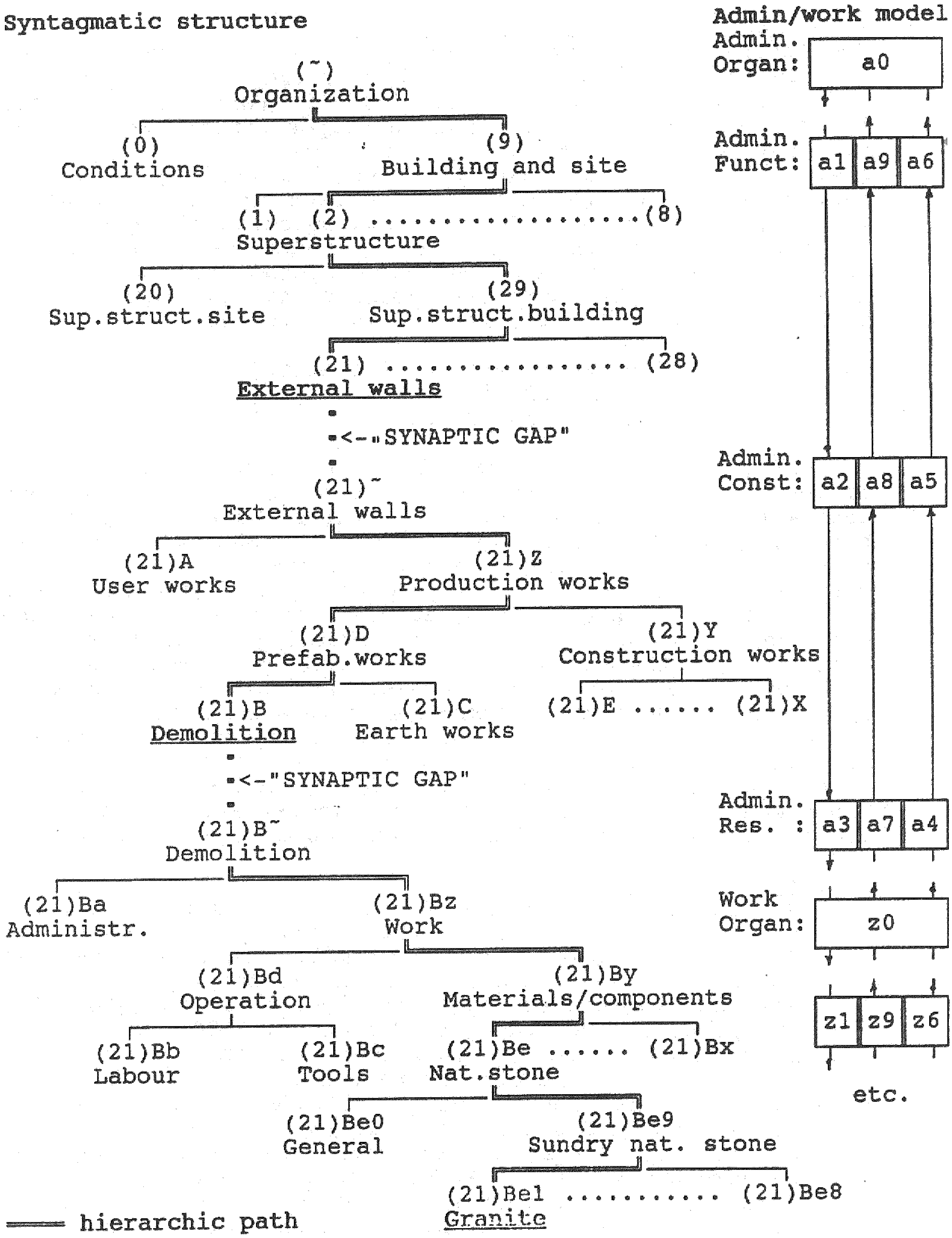

Fig. 1. Creation of a propositional class

To do this, it seems important to prepare databases, logically structured in a way similar to CBC/SfB, serving as Master Files for users [ref 9]. No doubt, other symbols can be invented.

7. Propositional classes in CBC/SfB

The Database Structure for arrangement of drawings is a language that may form the basis of ordinary or computerized generation of items in a specification, a bill of quantities, a follow-up report, etc. Fig. 1 shows that a propositional class is derived by selecting the last phrase from each of the layers in the hierarchical path. According to Leegaard [ref 6], the syntactic synthesis behind the selection of each of the hypotagms (core members) in a table describes the paradigmatic dimension. The synthesis behind the selection process necessary to form a propositional class, describes the syntagmatic dimension (i.e. depending on each member's ability to interact with other members). In Fig. 1 the selection is as follows:

(21)Bel Formed materials of granite]
in demolition]
of external walls] (Stage a3/a7/a4)

By selecting these phrases from the repertoire of SfB, six propositional classes may be formed by the sortations possible, each with different syntactic structures. Considering each of the stages, three classes with different meanings are relevant: planned properties (a3), recorded properties (a4), comparison between planned and recorded properties (a7). The exercise shows that if statements of natural language shall be created, the user must add a number of features regarding ability to withstand actions from the environment, performance, dimensions, etc. At the moment, SfB with the developments of CBC, functions well enough in project management and offers sufficient flexibility (freedom to select level of detail, etc.) for the user. Progress towards integrated CAD-systems depends on the development of coded databases, capable of linking CAD-systems to Project Management systems. It depends on general acceptance of drawing codes that refer to any kind of project management document.

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