SYDOX/MATCOMP/Xi: AN INFORMATION SYSTEM ADAPTED TO THE NEEDS OF CONSTRUCTION ACTORS
SYDOX/MATCOMP/Xi

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Abstract

This paper presents the SYDOX/MATCOMP/Xi French project, whose goal is to provide the construction actors with an IT-based, on-line aid for component specification and selection at different levels of the construction life cycle. We will describe the main features of the information systems (IS), then specific aspects addressed by the project. SYDOX is aimed at defining and demonstrating a prototype to access information about MATerials and COMPonents used in construction, implemented on a WWW server and focused on a restricted sub-part of construction products. We will present the work done: methodology for data structuring, structure of the IS, database structuring, user interface, use of scenarios (enabling a selection and an adaptation of the information retrieved, on the basis of a set of criteria commonly used by professionals), hypertext links towards a taxonomic structuring of the information, application to window and floor, and some perspectives for the IS.

Keywords: building and construction, complex information, interactive information system, product and component databases, scenarios, WWW

1   Introduction

Construction activities (CONST) have been and are still basic contributions to our societies. Their wide scope and diversity are such that even systemic analysis does not help so far to handle their complexity with success.

A general system SYDOX, designed to deal with Complex Data and Information (DOX), is defined to facilitate and enhance communication between CONST experts, designers, manufacturers and end users. We combine two strategies to generate an optimised representation of the MATerials and COMPonents (MATCOMP) information and its attributes, both for storage

(archiving) and intelligent access. The first one is a bottom up creation of MATCOMP data and information representation carried out to produce a practical CONST ontology and thesaurus recognised by all experts in the field. To downsize our work, we have limited the project through the choice of few CONST components, notably the « window component ». In the second strategy, we use a top down holistic mechanism, using specific scenarios through which we identify the part played by some CONST data at different levels and time locations of the CONST cycle. As we foresee to exchange and use « *external data and information* », we have to stress the importance of standardising materials, products and processes data in our evaluation: special attention is paid to standardisation work undertaken in the domain of the *Industrial Data* (ISO TC 184 International Committee) (SC4 1998), leading to the STEP (ISO 10303 - Industrial automation systems and integration - Product data representation and exchange) (Nell 1998), P-LIB (ISO 13584-1 1995), MANDATE (ISO 15531-1 1997) standards, and *Business data* (Electronic Data Interchange (EDIBUILD 1998), but also to other kinds of documents, such as technical agreements and regulations.

The initial objective of improving communications between experts and companies of industrial CONST components proved to be a powerful approach to the sector, leading for the future, since their participation increases in modern building concepts.

2   The SYDOX/MATCOMP/Xi project

The analysis will be done through three axes, which are:

1. *a database approach*: an information system (IS) relies on a database structuring a collection of basic information needed by the system;
2. *a query approach*: to help formalising interrogations on the databases;
3. *a communication approach*: to define the whole set of communication procedures needed by the important heterogeneity of the storage/retrieval facilities, the communication protocols and the geographical location of computers.

2.1   General context of the proposal

Information systems are more and more needed by industrial companies for acquiring, structuring, and exchanging complex technical data they have to handle during the production process. Nevertheless, a second complexity axis must be added to the intrinsic complexity of the data, coming from the relational structuring of the data, necessary to enable a selection of competitive solutions able to answer given specifications.

This information system is mainly aimed at small and medium enterprises (SMEs), since they often have to face situations for which they do not have either the necessary skill or the tools enabling a permanent follow-up of the normative texts, or a continuous updating of the technical information needed by the projects they work on.

Fundamentally, this need is common to numerous industrial sectors. The methodology carried out will thus have to be applicable to different industrial

sectors, with possible consequences on the level of complexity of the IS. A selection will probably have to be made between the complexity related to the degrees of freedom in the choice of candidate solutions and the technological level of the sector: high level technology and low degree of freedom or low level technology and high degree of freedom. The construction industry is characterised by:

- an *increasing complexity* with acceleration of the relations among the partners;
- an *increasing diversity* of the information and data handled, mainly due to the development of new representation structures (message standards such as EDIFACT messages, product or production management data standards: STEP, MANDATE and P-LIB);
- the *development of new software tools* able to deal with more and more important amounts and diversity of information.

2.2 Objectives of the project

SYDOX (« *Système de données complexes* » - complex data management system) defines an « intelligent » software system built on an integrated knowledge based approach. Its use in the domain of (construction) products and materials (SYDOX/MATCOMP) must provide the user with key-information, including innovative materials and/or use. The project can be viewed at several levels:

- SYDOX: software system enabling access to complex documents;
- MATCOMP: applied to the domain of materials and components;
- Xi: application to a specific sector: here: construction sector.

The aim of the project is the development of an « *information access* point », as an Internet WWW server enabling:

- a *dissemination of basic knowledge* essential for industrial companies which have to deal with the organisation and processing of their internal data, the use of data coming from clients, sub-contractors, professional associations;
- *updating and dissemination of information* related to the status of new standards and rules (decisions or discussions able to generate subsequent modifications);
- *development of relations between « providers » and « users »* of technologies and tools for complex technical data structuring and processing;
- *training* by means of interactive examples of the realisation of products using entity-relationship or object oriented modelling: industrial subsets or components.

In order to carry out an interactive information system, as quickly as possible, but also to show the feasibility of the basic concepts of the methodology, we proposed to limit the application field of the prototype to materials and industrial subsets used in the construction sector, only focusing on upstream

production processes. We think that it is in this sector that companies (mainly SMEs) have to face the most important needs in terms of data structuring systems.

The objective of the project is to develop both a learning (base of information) and a know-how (base of methods) allowing industrials to structure their data related to materials/components according to their needs, in France and in Europe. In this project, we will analyse the methodology leading to the elaboration of the information and communication system. The result of this work will consist in the elaboration of a software tool prototype aimed at providing an information simple, tailored to the needs of the user and to the kind of question he may ask. This software can also be used as a training tool to learn how to use these new *Information Technologies*.

2.3   Structure of the project and partnership

2.3.1 Organisation of the project
To fulfil its role, the project has been organised through four tasks:

- **Data identification and structuring: state of the art:** to make an inventory of the existing data bases and information sources. This work relies on the good knowledge of the construction domain provided by the Technical Centres.
- **Identification of methods and tools necessary for data representation and structuring:** to identify, when they exist, the corresponding software tools. One of its functions is also be to help SMEs to follow the evolution of new electronic communication means.
- **Formal specifications of the information system:** main result of the project, providing a generic way for structuring the information. The potential users of the system will appear through scenarios, defined as sets of typical requests corresponding to the type of information generally asked for by these users.
- **Software prototype of the information system:** to build on an interactive software system, running in a client/server mode, with several input levels, enabling a use by several types of users. Its aim is to enable a short term validation of concepts defined by the project.

2.3.2 Partnership of the project
The current partners in the project include:

- **CODATA France:** scientific co-ordination **(**The SYDOX software is a development of CYCOGHA SA**)**
- **University of Savoie/ESIGEC/LGCH («** *Laboratoire Génie Civil et Habitat* **»)**
- **Technical Research Centres:** CSTB (« *Centre Scientifique et Technique du Bâtiment* »), CTBA (« *Centre Technique du Bois et de l'Ameublement* »), CTICM (« *Centre Technique Industriel de la Construction Métallique* »).

2.4 State-of-the-art of the information handled in the construction sector

The starting point of the elaboration of an information system can be found in the capacity to identify, to interface, when it is possible, existing document repositories or product databases, whatever their structuring and location.

This project started with an analysis of the data intervening during the production process of a building, made in several ways:

- *identification of the needs of information* in the building sector, through the results provided by a previous sociological study, whose aim was to analyse the ways used by professionals of the sector to access the information they need;
- *identification of the professional stakes* of information related to products, materials and components.
- *usual practices in terms of research of information* related to products and materials, generally combination of different sources resulting from a permanent follow-up, or practical information related to specific points, but also specific needs of information to take decisions.
- *legal aspects of the information*: mentioned in multiple rules, codes of practice or other legal documents whose application is mandatory.

In a second stage, we tried to locate the data related to materials and components within the overall building project. We also explored several ways of classifying information, and meta-data.

The inventory of the sources of information has been done through the research of a possible « categorisation » by means of a table whose lines and columns represent :

- **columns**: possible « approaches » of the construction, in terms of life cycle stage, features of the construction, leading to the following headings: *constitutive elements, general features, achievement, regulation, environment, certification, safety, logistics*;
- **lines**: « themes » proposed for the information sources, based on a functional approach of the building. They have then been developed further to increase the relationship between the theme of a source and the headings of the columns.

This questionnaire has then been sent to the different Technical Research Centres partners of the project, to be completed with the available information. The answers received mainly apply to wood, and all products based on wood, concrete and derived products, regulation about the products, classifications, nomenclatures and steel profiles. An in-depth analysis of the answers highlighted several common characteristics:

- the *important number and diversity* of information sources;
- generally, these *information sources are rarely computerised*: the main part of the information is essentially accessible through paper documents: this was the most surprising feature discovered through this project;
- however, the *current situation is evolving*: development of computerised

catalogues, CD-ROM, use of the Internet/WWW capabilities;

- the *big heterogeneity of the information sources*: with important lack of consistency among the information contained.

3   The SYDOX/MATCOMP/Xi Information system

We will present the information system developed within the framework of the project: presentation of the methodology used for data structuring, then description of the general structure of the IS, logical schema of the database, user interface, then the software prototype currently under development.

3.1   Methodology used for data structuring

The methodology used for structuring the data, provided by the analysis of the answers to the questionnaire, is close to the structuring proposed by the *American Concrete Institute Committee 126 « Database Formats for concrete Materials Properties »*, described in the report (Kaetzel and Galler 1997), aimed at defining a framework for cross-referencing cement properties, data and other information. This format has seemed to us generic enough, powerful, simple and well suited to computerised databases and WWW interfacing to be customised to our needs (Dubois *et al.* 1998).

- **Basic principles for data structuring:** information related to products and materials is represented using similarly complete sets of data, all of them together constituting the material and product database, using the following concepts, separated in abstract data type (ADT) and concrete fact (CF):

- **object** (ADT): item selected on a « column »: highest level of hierarchy;
- **constituent** (CF):1st level detailed information about the object;
- **meta-segment** (ADT): set of information of the same nature related to a constituent;
- **segment** (CF): subdivision of the meta-segment: table of data, definitions, figures;
- **meta-element** (ADT): collection of information of the same kind;
- **element** (CF): item of information.

The SYDOX methodology can deal with a special gateway concept used to connect heterogeneous data sets (Dubois and Fraou 1998). In the present project, different ontologies have to be interfaced. In fact, the mapping of the description of concrete elements (composition) with its related properties (description, regulation, safety measures, standards, etc.) is achieved through a standard ordered hierarchical graph whose nodes are either primitive or reference properties (environment, etc.) and formal properties (certification, etc.).