9 CLASSIFICATION OF BUILDING INFORMATION – EUROPEAN AND IT SYSTEMS

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Abstract

Growing use of modern communications has resulted in more electronic exchange of information about buildings: with project partners, with product suppliers, through the lifecycle of a building, both nationally and internationally. The organisation of that information is critical to its understanding and efficient usage. With computer systems at each end of the communication, it matters less how items are labelled, but the concepts by which they are organised need to be agreed.

In Denmark, the main classification system used, SfB, is now 50 years old and several other European countries have developed, or proposed, new systems to bring it up to date and take advantage of new forms of data structure. The Centerkontrakt Byggeklassifikation [1] is an industry-wide project to develop a new system. The ITbyg group at DTU is a partner in this and is carrying out research on the needs for, and experience of, classification in Denmark, relating these to new systems in other countries, and the likely influence of future IT systems.

This paper is about classification systems being developed in Holland, Norway, Sweden and the UK, in particular, how these relate to Danish needs and IT systems. It is concerned as much with how new systems can be introduced and promoted among all types of companies in building, as it is with the nature of the systems themselves. It concludes that a widely used, standard specification or cost database, would help introduce new forms of classification. Different conceptual views of the same objects at different stages of the process are needed, and the international standards only provide a general framework. Other groups in the Centerkontrakt are developing tables for elements, schedules of rates and building products, and these should be tested against standards and new, object-oriented data structures.

Keywords: *classification, data structures, reference libraries, object models*

INTERNATIONAL EXPERIENCE

Much attention has been given to new classification systems both nationally and in international groups such as: ISO TC59, ICIS, EPIC and the IAI. A Standing Conference on an Information Framework for Building and Construction meets annually to report on progress in these and other groups, and the last one was held in Oslo in November 2000. However, as well as conforming internationally to allow collaboration with other countries and export of building materials, a new national system must meet local needs and suit the companies which have to be persuaded to use it. For this reason it was decided to focus on countries with some similarity to Denmark, which had introduced, or proposed, new classification systems, and to find out how they were organised and were being, or would be, taken up by users.

A study of building literature and web sites showed that, particularly for product data, there is much diversity within countries and between them. There is a new initiative by the Construction Specifications Institute in the US called the Overall Construction Classification System [2], and this could be significant because of the influence the US has on software development, rather than because their construction industry is similar to that in Europe. The main sources of guidance, which could help to coordinate national systems, are ISO 12006 – 2 [3] and a new ISO PAS 12006 – 3 [4]. There is also the work of EPIC on product classification. Relevant developments in IT include the Industry Foundation Classes [5], which have their own structure, ISO 10303 STEP [6], and various developments in the Internet mark up language, XML.

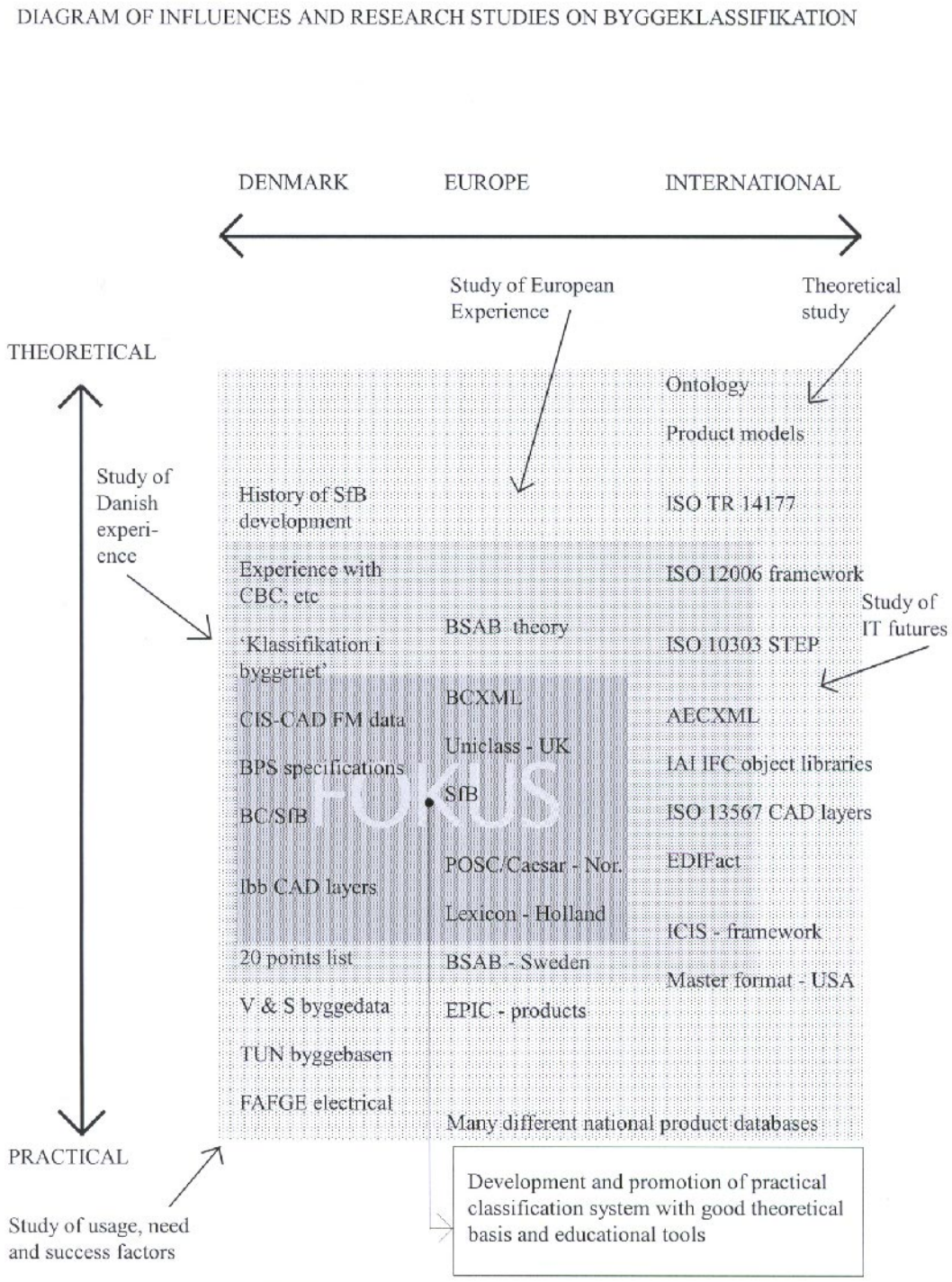

Fig 1. The range of sources studied in the research for the Centerkontrakt Byggeklassifikation

NATIONAL DEVELOPMENTS

The four countries chosen for detailed study were: Holland, Norway, Sweden and the UK. Visits were made to experts in universities, standards bodies or commercial data suppliers, and users in each country. Semi-structured interviews related their experiences and intentions to the needs expressed by a similar section of people in Denmark. Not only were the details of their systems explored, but also the methods used to promote them and exploit IT developments. A seminar was also held by the Teknologisk Institut, which manages the Centerkontrakt, at which presentations were made on the national information systems of Finland, Norway and Sweden. The Standing Conference provided the latest information on international developments.

Holland

Holland has about three times the population of Denmark but its construction industry has many similarities. STABU is a specification for building work used by about 2000 companies. CROW provides similar services for civil engineering. There is a Dutch version of SfB and CAD layer guidelines are based on its element table. The LexiCon development proposes a multi-lingual tool for management of construction terms, describing built objects and their association. It uses an object-oriented approach and built objects are described by: component, function and quantity. This employs the object library method and allows data to be exchanged between different applications using protocols such as STEP and the IFCs.

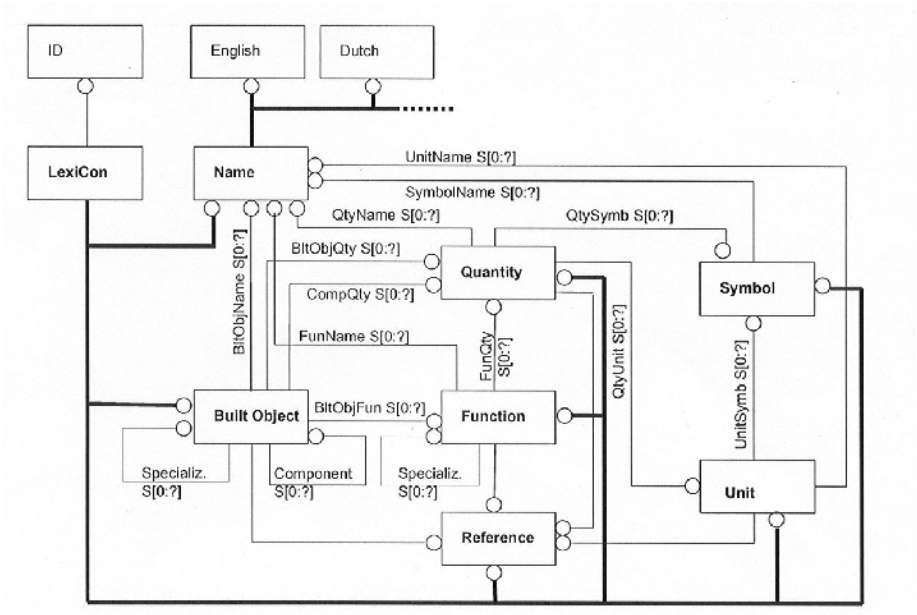

Fig 2. Diagram of the LexiCon system in the Express data modelling language

LexiCon has not been launched yet, but would be introduced as a new classification for the STABU work descriptions and through software developers providing new tools for the building industry. One of these tools, being developed in the EU e-Construct project, is bc-XML [7], another multi-lingual tool for business transactions on the Internet. The Dutch are very aware of the need to work in languages other than their own, and they have also separated building and civil engineering data.

Norway

Norway has the same population as Denmark but is outside the EU and has a widely used standard specification system NS 3420 [8], developed by Norwegian Building Standards. The BARBI project [9] started from trying to define a new classification system but it eventually proposed an object-oriented reference library based on experience of STEP in the process industry through POSC/Caesar. This makes it possible to separate the functional, physical, activity and characteristic aspects of an object, so that it can be used for all phases of a project. Reuse of objects to create new objects allows different classification tables to relate to one library. The library will now be populated with building objects to test the system.

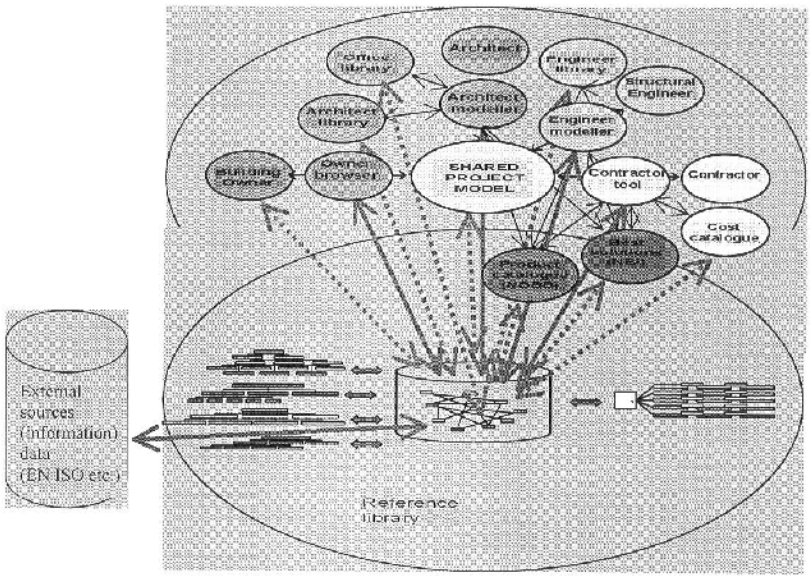

Fig 3. Diagram from BARBI on a reference library for members of the building team

Both Holland and Norway had experience of new systems, in building modelling and facilities management respectively, being launched before the market was ready for them. They will make sure that their new building information systems, incorporating classification, are developed with their construction industries, and are promoted through their established specifications, when the market is ready for them.

Sweden

Sweden has about twice the population of Denmark and has a long tradition of standardisation. SfB was originally developed there but was further developed to meet the needs of contractors as well as designers about 30 years ago and became the BSAB system. It became quickly established through the organisation that owned all the public buildings

adopting it. It has recently been revised as BSAB 96. The system has a good theoretical basis, developed at Lund University, and is supported by the publications and development effort of the Svensk Byggtjanst. It provides the most convincing experience of what can be done to integrate standard work description, such as the AMA, with new classification tables.
There are also projects demonstrating how BSAB relates to ISO 12006 – 2 and the IFC models [10]. However the Swedes are realistic about the need for the IFCs to incorporate some additional concepts from ISO 12006 – 2 and meet local requirements. There is also a demonstration of how BSAB could relate to XML.

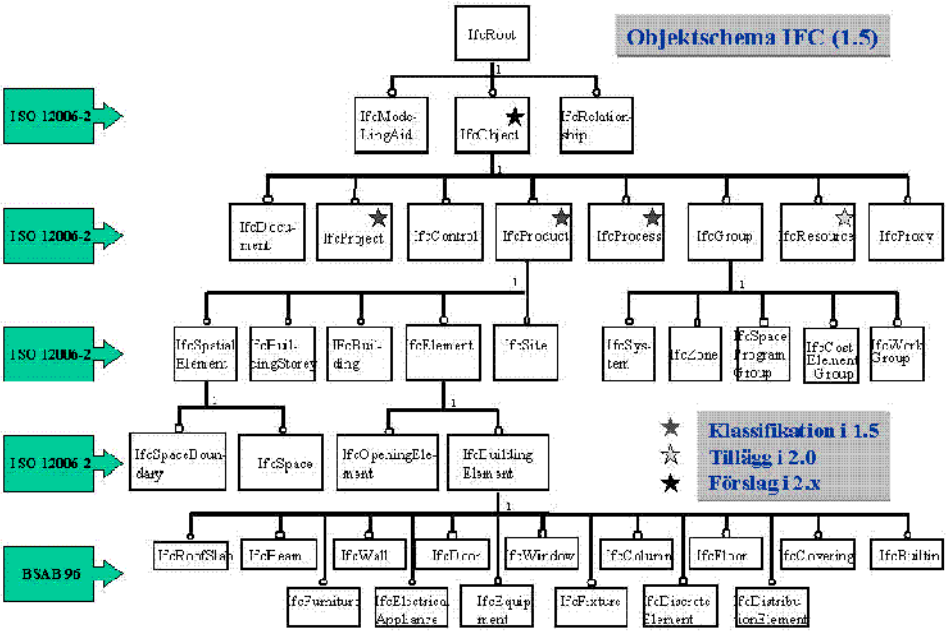

Fig 4. IFC classes related to ISO 12006-2 and BSAB. Report A15. IT bygg och fastighet.

Sweden provides an important precedent for Denmark, although there are differences of attitude towards standardisation. A project to test the Centerkontrakt proposals for classification tables against ISO 12006 – 2 and IFCs, similar to that carried out with BSAB, is proposed in Denmark.

United Kingdom

The UK has greater differences from Denmark having about ten times its population. However there has always been much exchange of information between the two countries and the larger size of UK construction industry firms allows them to try out new processes which are of relevance to changes now being tried in Denmark. The main organisations providing standard building data are companies owned by the Royal Institute of British Architects. NBS Services publishes the National Building Specification, which is widely used, and has developed a new classification system, Uniclass, to integrate CI/SfB with other classification systems used in the UK, in a series of faceted tables. As in Holland, these separate building from civil engineering elements. RIBA Information Services publishes the Product Selector which is currently classified by CI/SfB but there are plans to add Uniclass and EPIC indexes.

The size of the UK industry, and the differences between the professions, have resulted in several different classification systems: CI/SfB, mainly used by designers and for product literature, Common Arrangement, organised by work sections in a previous attempt to unify classification, and the Standard Method of Measurement used by Quantity Surveyors for bills of quantities. Uniclass aims to integrate these but has not been widely promoted yet. Some trials are under way and those involved said that they hoped it would help them integrate their UK offices with branches in other countries. Other users believe that classification tables are less important now with the ability to search by keywords or full text. However there will probably need to be some structure for such searches if different users are to find the same data and organise it in a common manner.

COMMON EXPERIENCE

Although there are differences of approach in each of the countries studied, there are some common factors that would equally apply in Denmark. The content of the classification tables and their terminology, are of relatively little importance and will inevitably differ between countries. They need to use local languages and link with existing systems that are established in each country.

The fundamental concepts which most of the countries visited are following, are those in ISO 12006 – 2 particularly its three views of building objects as: **functional elements** becoming **designed elements** then **work results**. This reflects the processes of design - when an element, such as a wall, will be given a function as a space divider, detailed design – when structural and material attributes are added, and construction – when the resources needed to produce it will be added. This concept is fully established in BSAB, is part of the proposals for LexiCon and POSC/Caesar, but Uniclass does not have a table for designed elements.

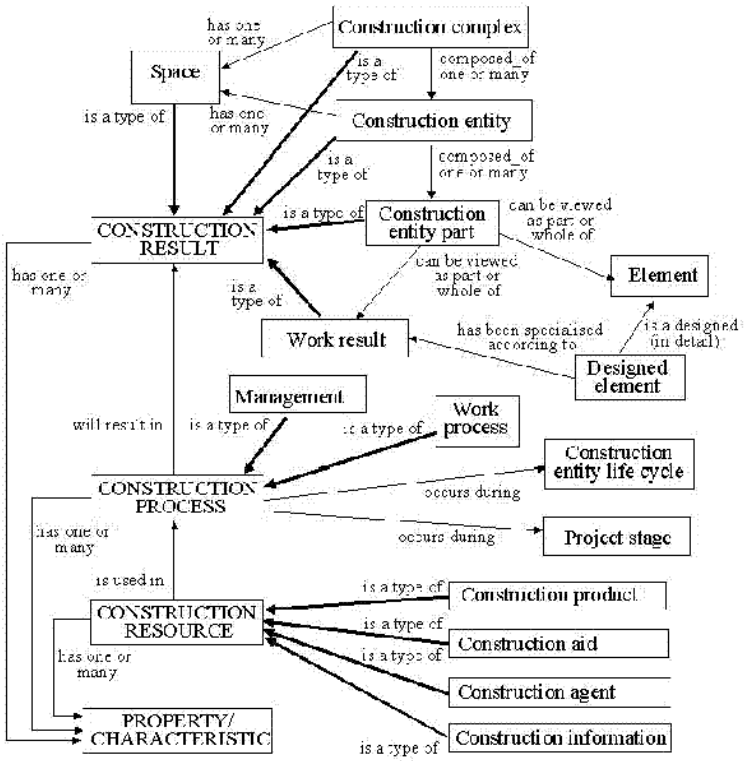

Fig 5 Diagram from ISO 12006 – 2 of the concepts of different views of building objects.

Another similarity between the countries, more relevant to promoting a new classification system, is that they all have well established standard specifications and these are, or will be, used to introduce new classification systems to their users. Denmark does not have such a system, although the Byggecentrum has recently extended its BPS type specifications. The large consulting engineers have their own and use them for competitive advantage.

Denmark has a history of developing classification systems, such as CBC used successfully by Bjorn Bindslev in the 60s and 70s. These never became adopted by a large part of the building industry and there is a fear, in some quarters, that standardisation limits design freedom. This is rather like saying that the alphabet limits literary expression. Any system should be open ended and allow extensions and new technologies to be incorporated. There are particular types of building the elements of which will always be hard to classify, Frank Gehry's Bilbao Guggenheim museum for example, where it is difficult to separate walls from roofs or to describe a typical wall section. No information system should try to include these landmark buildings but, with growing rationalisation and prefabrication, more typical buildings will benefit from a higher level of standardisation. In Denmark, where building is more expensive than in most other parts of Europe, there is a concern, expressed in a recent Task force report [11], that building productivity must be increased. It is in conjunction with new processes for design and construction that better classification systems should be able to contribute to providing better value.

EXPERIENCE RELATED TO DENMARK

The need for classification

Information technology is changing the way in which building data is exchanged and accessed and there has been much discussion of whether this increases or decreases the importance of classification systems. It certainly makes it possible to transfer the terminology between different members of the project team or different languages. A user in the UK felt that full text search and keywords make classification obsolete, but data needs to be organised somehow and it is very convenient if the supplier and user of the data can use the same structure. The coding need never be seen by those using computer systems and could be in a simple numerical form. Some versions of SfB are regarded as unsuitable for computer use since they use different types of character – upper & lower case letters, numbers and brackets.

If keywords are used, as is typical for searching the Internet, they need to have some structure, and this structure should relate to that which is most widely known in the construction industry or that of a widely used set of data, such as a standard specification. It is unfortunate that Denmark does not have a complete and widely used national specification since the other countries studied are building, or intend to build, their new classification systems on top of specification systems. If classification is to become a more useful tool it should allow flexibility and be thought of as a means of accessing data through different sets of views. The concept of ISO 12006-2 [3] which views the same entity as a Functional Element, Designed Element or Work Result, is fundamental and one of the few common concepts in the new proposals in the countries visited.

Relevance of projects in different countries

Of the countries visited, all had established information systems for building, mainly consisting of national specifications, and they have organisations devoted to developing and supporting these. All had proposals for updating their SfB systems and, in the case of Sweden, this had been done many years ago. Their success in exploiting BSAB is the most complete and should be an important precedent for Denmark. They have a very rigid method using a detailed classification structure that makes some obvious improvements on SfB, and they are mapping this onto ISO 12006-2 and the IFCs. A more flexible method, which might suit Denmark better, is in the UK where Uniclass was published 3 years ago to conform to ISO 12006-2 and to integrate a number of existing tables including SfB Table 1 and the Common Arrangement of Work Sections. This has not been promoted hard and some of the building databases there can be accessed by several different classification systems.

The alternative approach to the detailed classification tables used in Sweden and the UK, is the reference library method proposed in new systems being developed in Holland and Norway. This is being reflected in ISO 12006-3 [4], recently approved as a Publicly Available Specification (PAS), based on Lexicon and proposed by ICIS. Their inspiration is forward looking and derives from the greater experience of the process industry through POSC/Caesar. This can lead to excess complexity and the process industry is more focussed on operation than design and construction. The Dutch are involved in the e-Construct project and looking to a multi-language version of bc-XML to handle the well-organised process models for building they already have.

Other countries, which have particular relevance to Denmark, are Finland, which is close in size and appears successful with Building 90 and various IFC related projects, and the US with OCCS, although aimed at a very different industry structure. Product data seems to be totally diverse and could only be controlled by a dominant information broker in each country. EPIC has proposals for standardising the classification of this. Of the countries visited, Sweden has the best supporting organisation for its classification systems and much experience, while the UK has a more flexible but, so far, less effective approach. Holland and Norway are probably the most ambitious and very aware of the need to be international and compatible with the latest technology.

The international dimension

A major question is to what extent Denmark should meet its own national needs and to what extent it should conform to international practices. The minimum standard to observe is ISO 12006-2 [3] which only defines the headings of the tables, and the relationship between them. ISO PAS 12006-3 [4] is more controversial but proposes a framework for object-oriented exchange and an Express based terminology for this. De facto standards are quite as important and the IFCs are the best hope for modelling buildings at present, with the BLIS [12] project for software interoperability showing how many firms are producing software. XML offers an Internet based language for exchange of all sorts of commercial and technical messages.

How will Denmark's economy be served by a new building information system? The larger consultants do much work abroad and, in the UK, the reason for several firms adopting Uniclass was that it would help their offices abroad to conform to local information systems. Exports of building materials are also important but product manufacturers have tended to present their data in their own way or to meet the requirements of any database that might help promote their products. Most international standards, such as that for CAD layers, ISO 13567, recognise the need for local flavours. There is a high level of classifying concepts in ISO 12006-2, and that is the minimum to which Denmark should conform. Getting the construction industry to move on from the current systems it knows to something more useful with new technology, is the most difficult problem of all, and local preferences and experience have to be incorporated in the way these were expressed in the first of DTU's series of research reports.

Technical differences of approach

The traditional approach to classification is to have a strictly hierarchical list of standard elements that may need to be reclassified between the design, costing and construction stages. A more recent approach is for classification tables to be seen as just a means for accessing building objects to suit different purposes. A wall is a Functional Element separating two spaces – a brick wall 22.5 cm thick is a Designed Element, and 10 sq m of facing brick and associated materials and labour is a Work Result. These are different views of the same object with added attributes as the design process proceeds. The Reference Library method recognises the development as part of a process that needs to be modelled to establish relationships between the objects and their attributes. This is an idea towards which STEP and IFCs have been working, but it is dependent on implementation by software suppliers. They often have slightly different objectives and it will take some time for a coordinated library of international building objects to be developed, and even longer for these to meet the needs of smaller information suppliers and building firms.

The growth of Project Webs, which need better ways of organising project data than they currently offer, and the eventual move to standard forms of 3D model, may help project teams to share their knowledge and some of the smaller suppliers and subcontractors to get involved. Much of this information is about building geometry and the Centerkontrakt is mainly driven from the bottom up, by the need to link building elements with price book data and product databases. The growth of e-business may force better data structures on the building industry but, rather than rush into the ad hoc data structures that are currently available, Danish industry should wait for the results of the Centerkontrakt.

Specific technologies

The next stage of the research will look at future developments up to 10 years ahead and try to predict whether they will be taken up in construction or not. However, from the visits made, meetings attended and papers collected, some of the most relevant technology for the next five years is already known. Object-oriented product and process models are well studied and the standards and object libraries are gradually developing. Meanwhile the industry continues to use conventional 2D representation and to be more concerned with document management and exchange than with common project models. The classification structure to be proposed should work in this traditional environment as well as anticipating when software products and standards will really make 3D data normal for their systems. The link between geometric data, potentially conforming to IFCs, and price books is very significant for Denmark but it currently limits the ability to reanalyse cost data. Widely used price book data, such as that published by V&S byggedata, could form an established base for Danish classification. The role of the Byggecentrum, which now own V&S and the BPS specification, and publishes SfB, could be very important if it can take on a similar role to the Svensk Byggtjanst. It would have to work closely with Danish companies with their own specifications, and it is important that the same structure is used for these and for product data.

XML is another very significant technology for the next few years, being based upon a UN standard, eb-XML, which should stimulate Electronic Data Interchange. Aec-XML is proposed by Bentley Systems as a basis for publishing the IFCs, and the bc-XML being developed at TNO takes that technology further and introduces language independence. It is hoped that the IAI will adopt the best flavour of XML and that this will allow local classification systems to be used to access common libraries of building objects. Mapping to the IFCs is an approach that has been taken with BSAB, Fig 6, and this demonstrates its feasibility. A similar project is likely to be undertaken in Denmark with the proposals coming out of the building element group in the Centerkontrakt to show how to link cost and product data with the ISO 12006-2 structure.

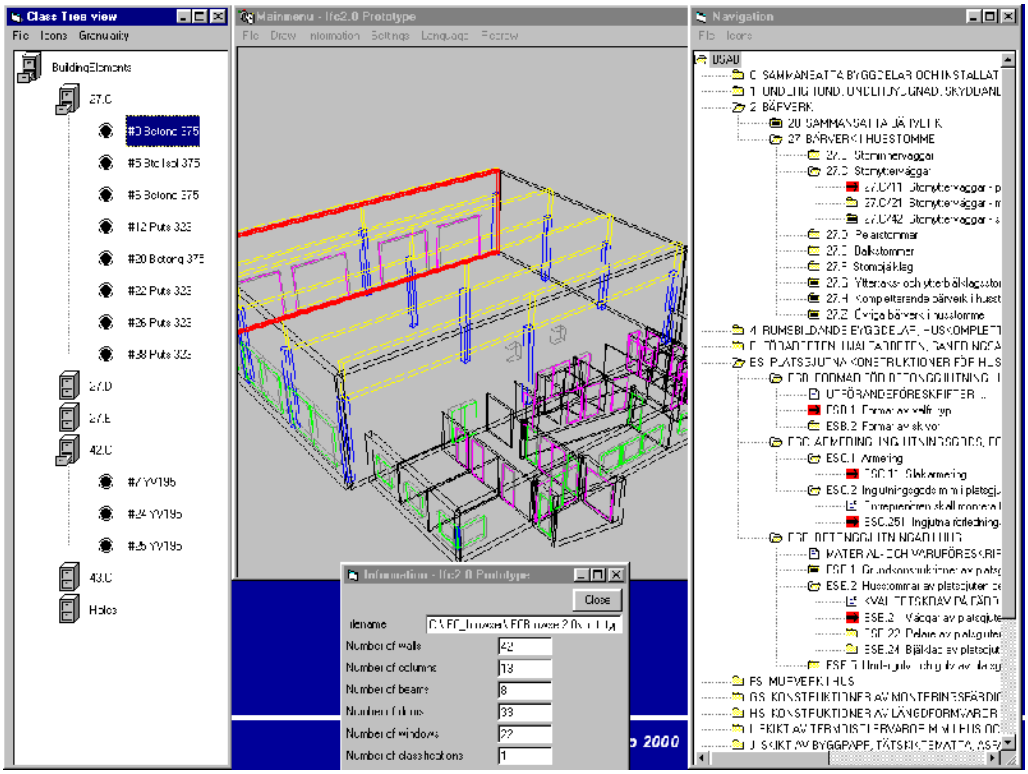

Fig 6. The BSAB test project showing BSAB elements on right and IFC classes

Success factors and promotion

Another aspect of introducing new standards that was explored in the discussions both in Denmark and the other countries, were the factors that have made the introduction of new methods into the construction industry successful or unsuccessful. From the Danish experts and users interviewed it was clear that simple systems, with an obligation by the client to use them, and clear forms of presentation and tools to aid their use, were desirable. The 20 Points List [13] for urban renewal is a successful example of this. However only publicly financed building is likely to have this degree of client involvement at present, but it is hoped that the Danish clients' group, Byggherreforeningen, will introduce this to the larger private clients. Architects and others need to be reassured that classification does not limit design choice and that it is only a means of access to data. It is not enough to publish classification tables. There must be a good theory linking all types of data used in building and an organisation that can support this, provide tools such as databases, and ensure the availability of product libraries.

Lessons from other countries include: the importance of starting from a set of data that is widely used, such as a national specification, involving major clients and, perhaps, putting a price on the classification system to show its value, while allowing others to adopt it for nothing. Advanced systems cannot be sold directly to the end user, they must be delivered via information brokers and software houses for inclusion in their service or systems. An information structure can be thought of as a brand since it needs promotion, and SfB is a rather old, but widely known, brand name. What Denmark needs is a new brand for classification and the Centerkontrakt should deliver this in 2002.

CONCLUSIONS

Integration with the other Centerkontrakt groups

The next stage is for the input from other countries and from recent publications to be considered alongside the work of the other project groups on building elements, schedules of rates and product data, to see where the ideas presented here fit in with their own proposals and where there are serious differences. The most fundamental document is ISO 12006-2, which is only a very general framework for classification tables, but its terminology should be used if only to be able to maintain the dialogue with other countries. ISO PAS 12006-3 adds some further terminology presented in the Express language, and this should be examined more critically in conjunction with the technology implied by the reference library approach. Partners not familiar with the BSAB system and the recent documents on linking it to IFCs and XML, should study these and consider how Denmark could learn from this experience.

Testing of the draft proposals

If the Industry Foundation Classes are expected to become widely adopted in Denmark, and the next phase of the research will try to estimate how soon this will happen, then testing of a prototype classification system should be carried out, using similar methods to those used for BSAB. This would establish the possibility for its use with advanced modelling systems and indicate where problems might lie. At the same time it should not be forgotten that most building information, although produced by computer, is published in conventional form and the proposed classification system should also work in a more traditional environment. This method of use could be tested in Document Management systems and Project Webs that still work with conventional documents.

Links to related information and organisations

The other countries studied all based, or will base, their new classification systems on some existing and widely used set of data. It was generally a standard specification and Byggecentrum is working on additional parts of the BPS specification and can now provide type specifications for about 80% of building work. This is not used as widely as in other countries at present and other sources of building data, such as the V&S Byggedata price books, are another possible starting point on which to promote new classification. It is fortunate that these sources are now both owned by the Danish Building Centre, which also publishes SfB. This organisation, as a partner in the Centerkontrakt, would seem to be a possible one to provide the essential support and development of a range of information services. They are also developing a building product portal and, if this could be integrated as well, the possibility of a fully coordinated set of building data for Denmark might be achievable. It would have to be well supported by other firms, and commercially viable, for such a comprehensive service to be sustainable. A recent report from the Danish Byggepolitisk Task Force ‘Byggeriets Fremtid’ [11] proposed among other things, the formation of a Centre for Building IT, organisation and competence. One of its roles could be to guide and support implementation of classification proposals both in teaching and in developments by software companies.

Further technical and futures studies

The technical differences between the different national systems and the influence of new IT systems will require more study. This is part of the next phase of the research and scenarios will be devised by groups of experts advising DTU, then tested on representative groups from all parts of the Danish building industry. This method should provide the best possible views of future developments but will not be dominated by the enthusiasm of experts, since the real test of whether, or when, these developments are likely to be widely used will be in the hands of the people who will have to be persuaded to use them. The classification system proposed should be capable of lasting for many years, if not as long as SfB has, but it should be flexible and suitable for smaller firms of all types, some of which may never adopt leading technology.

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