Theme:

Title: **A new Danish classification system to meet local needs and link to international & IT developments**

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Abstract: *Denmark is a small country with few large companies in construction, but the industry is well organized, makes advanced use of IT, and is capable of designing and constructing high quality buildings and huge bridges. It was an early user of the SfB building classification system and there are many well-organized sets of data, but it does not have a complete framework for building information meeting new international standards and reflecting developments in IT.*

The Centre Contract Building Classification is a 3 year collaboration project funded by the Building and Industry ministry and managed by the Technological Institute. It will finish at the end of 2002 with proposals for tables of building elements, schedules of rates and building products. The research at DTU was completed at the end of 2001 and looked at international experience and the effects of future IT systems.

While a Danish system must relate to the specific needs and experience of Danish industry, and allow convergence with existing sets of data, it must also relate to international developments to maintain collaboration with other countries and export of building materials. Future IT systems will allow even more sharing of data and members of a project team, wherever they are located, should have a common understanding of the structure of the data they share. Standards such as IFCs for building modeling and ISO 12006-2 for building information, are important and experience from other countries shows that it is necessary to test the Danish proposals against these and set up suitable arrangements for promoting and supporting the new classification. It will also be necessary to educate students and mid-career professionals in the use of a new system.

Keywords: *Classification, IT futures, building elements, standards*

1. Context

Denmark has a population of 5 million and its construction industry had a turnover of 17.5 billion Euros in 1998. It has some very good architects, well known for winning international competitions, many small contractors with a few larger ones owned by Swedish companies, and some large consulting engineers who are the most advanced users of technology.

Usage of IT is generally high and the IT barometer survey [1] showed that 80% of office-based employees have their own PC and email address, and 23% of firms have some experience of project webs. Fig 1. There are high expectations for e-business. Denmark contributed to the early development of SfB, which originated in Sweden, and Bjørn Bindslev developed it into CBC for coordinating elements and prices, but this depended upon a quantity surveying approach that is not usual in Denmark.

Good price book information is available and several trade groups have their own classification systems for the products their members use. There is no complete national specification system, but the BPS system provides type specifications for 80% of building elements. This contrasts with Sweden where the BSAB classification system was developed from SfB and links closely with the widely used AMA specifications [2]. In Holland and Norway there are proposals for libraries of building objects dealing with definition of terms in different languages, and relating to international standards and the Industry Foundation Classes [3].

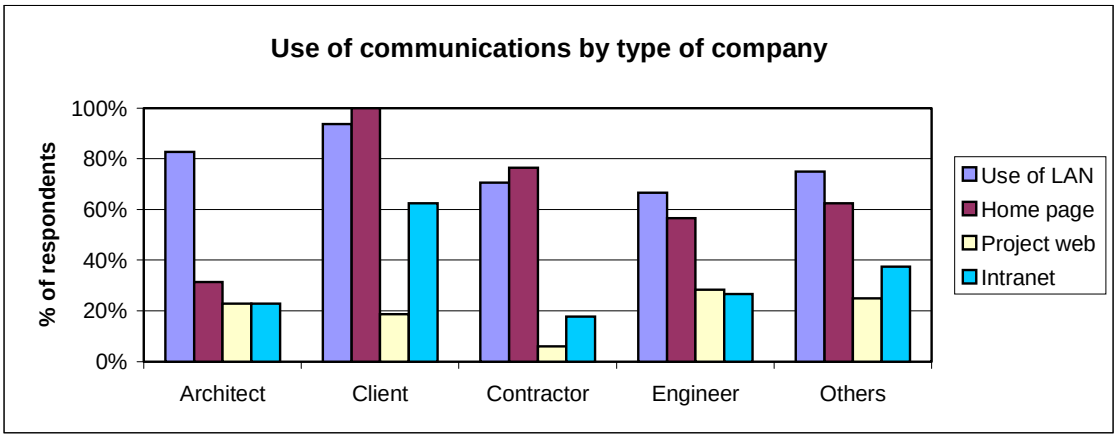

Figure 1. Use of communications by type of company. IT barometer, Denmark. 2001

2. Research objectives

Most of the partners in the Centerkontrakt are practising architects, engineers and contractors, and publishers of building information. They are using their experience to develop proposals that relate to current practice in building. The role of DTU was to take a more theoretical approach, to consider the ontological basis for building information, the international context and future effect of IT systems. The practical urgency to achieve a system that can be promoted to the whole of the Danish industry meant that the research was running parallel with that of groups developing classification tables. The most theoretical aspects are linked to a PhD project that will not be finished until 2004.

The first task of the research was to establish the needs and ideas of Danish experts and users for a new system. This indicated some reservations from designers, who feel that standards limit their freedom, and that there were some problems in persuading people to change their systems. Following this study, a selection of European countries was visited to interview: developers of new information systems, information providers and users. This concentrated on recently implemented or proposed systems in Holland, Norway, Sweden and UK [3]. These were linked to developments in building modelling, new languages for exchange such as XML, and all fitted into the outline proposed in ISO 12006 Part 2 [4].

This standard framework for classification of information in building defines three views of a conceptual element: functional element, designed element and work result. Fig 2. These correspond to stages in the design and construction process in which, for example, a wall might have a function of separating two spaces, it would then be designed to be of brick, and producing the result would involve labour, materials and equipment. If a classification system is to be usable throughout a project, it must be capable of handling all these stages.

The final research objective was to ensure that the system proposed would last for many years and be compatible with new developments in IT as far as these could be anticipated.

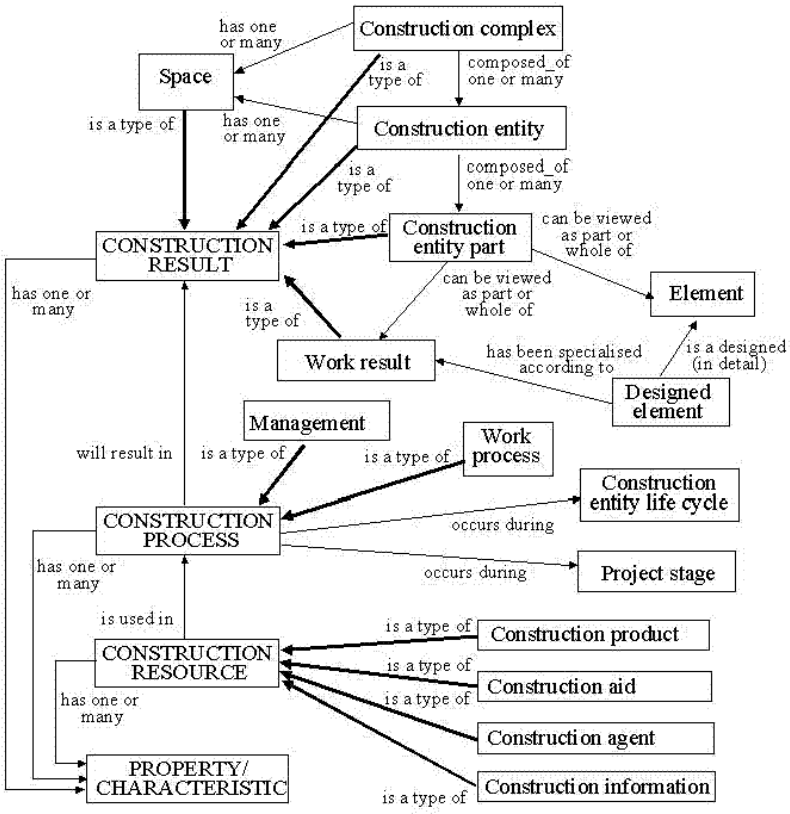

Figure 2. Relationships between results, processes and resources in ISO 12006-2

3. Methodology

There are many techniques for futures studies, but they tend to rely on experts who are enthusiasts for the technologies they are predicting. Experience of studies in the UK such as Technology Foresight and Building IT 2005, has shown that predictions in some areas are over optimistic while, in others, new technologies are not identified. For this reason a new combination of techniques was developed. Four areas of technology relating to building classification were selected and groups of experts convened to look at what would happen in each of these over the next 5 or 10 years, and identify the conditions necessary for success and the barriers which might limit their take up.

- Shared project information
- Building modelling
- Product information
- e-business
- Standard descriptions

The views of the experts were summarised in tables (Fig 3), and from these were developed scenarios in compact form with explanations of the technical terms and any data available on expected future growth. These were sent to a sample of more typical, small and medium sized firms in all areas of construction, and yes/no questions were asked about whether they expected to use the technologies when they became available. The scenarios were sent to 250 firms in five groups and, although the response level was low for particular groups, the data was backed up by the IT barometer survey of 1000 companies carried out a few months earlier.

Technologies	*Up to 5 yrs*	*5 years ahead*	*10 years ahead*	*Conditions*	*Barriers*
E-BIDDING TENDERING **E-bidding**	Electronic tendering within a year		Electronic tenders on all projects Producers take part in design - simpler bidding with less work	Contract law Frame conditions Digital signatures	Digital signatures Company admin New roles/liabilities
Value chain	Use and support of systems in the present value chain		New value chain, not including wholesaler or dealer.		Producers want to keep value chain, will not offend clients.
E-BUSINESS **Product service and advice**	Large suppliers offer tools and advice on products	Large suppliers/ companies put guidance on Internet	Small companies give installation advice on the net. Servicing of products is often included in the package eg servicing of electrical systems		
Knowledge business	Distance learning Commercial learning communities for exchange of experience and business		Focus changes from technology to people. New technology supports this digitally	The industry should admit that it is a knowledge industry	Knowledge has a cost. Too little development by companies.
Mobile technology	Better access to information In critical situations, mobiles can be used to solve problems or buy components.				Successful e-business needs more data in a bid and planning for what's needed when.
SUPPORT FOR BUSINESS **Cost control**	Continuous updating and pricing	Integration of storage, design & cost	System for just in time building and work on the site, eg with reporting of tasks.		Various suppliers of systems can hinder integration
Teaching knowledge and e-organisation	More project & less company oriented. Loyalty to the project results in more knowledge of it		Big dinosaurs will use many small companies as partners since they are more innovative. Middle size firms will disappear.	Holistic management. Partnering creates more knowledge.	Various systems can hinder reducing skill levels and therefore hierarchies.

Figure 3. Summary of e-business workshop developed into scenario for the IT futures study

4. Results of the IT futures study

Architects and engineers were asked the same set of questions and the combined analysis of their responses showed that they were optimistic about take up of such technologies as: object-oriented design, project web, electronic specifications and new classification systems. Fig 4.

Building owners and managers provided fewer responses and showed little interest in 3D models, which they maintain are unnecessary for facility management. They were keen on electronic tendering and on the use of building classification by their consultants.

Contractors were interested in getting fast Internet on mobile devices but did not expect this to include useful graphics for 10 years.

Building materials producers were fully aware of the possibilities of supplying information on their products electronically and, in 5 years, some expected to build data into their products. They felt unable to accept 3D data from consultants in place of drawings and prefer to use their own classification systems.

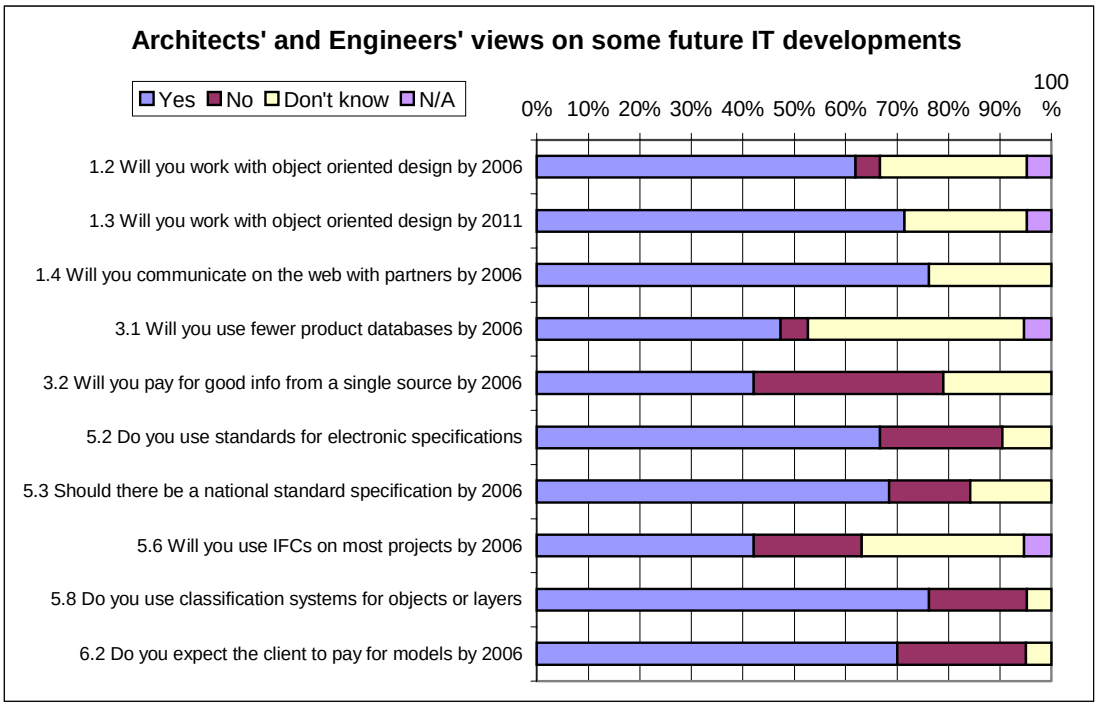

Figure 4. Responses to selected questions on the scenarios from architects and engineers

It is a matter for concern that different groups in the industry have different needs and opinions but, with more sharing of project data through project webs, and the possibility of adding more structure to the form in which data is held in these, there may be more pressure on all those involved to classify their data within a common framework. The key to this development is the client and greater use of partnering. This is only just starting in Denmark but, studies of some housing projects on which partnering was tried over 5-7 years, showed that project web experience was gained on these, but with greater use by designers than by contractors or suppliers [5]. More research experience on this is reported by Jan Andresen and Susanne Hartvig in their paper [6].

5. The proposed building element table

This is still in draft form and the sub-categories have not been defined, nor has it been linked to the schedules of rates or product data development work. The latest information will be provided when this paper is presented. The table is simple and relates quite closely to SfB Table 1, of which there is wide experience in Denmark. Most elements are divided into function, and primary and secondary parts, reflecting some of the concepts in ISO 12006-2 [4]. One of the objectives is to reduce ambiguity, particularly at the building site.

The table is currently undergoing testing and further development but, to relate to international experience, it should follow the Swedish work on BSAB by being tested on sets of building data that can be interchanged with IFCs [7] and presented in XML. Fig 5 shows the whole domain covered by ISO 12006-2 with the main Danish building elements related to this, and the IFC release 2 model architecture [8]. The proposed classification system for Denmark only covers a part of the whole field of information about buildings, but it is the element tables, linked to schedules of rates and product data, that are most critical for productivity and co-ordination throughout the building process.

COMPARISON OF: INDUSTRY FOUNDATION CLASSES, ISO 12006 -2, AND CENTERKONTRAKT CLASSIFICATION BYG.DTU Jan 2002

IFC RELEASE 2 MODEL ARCHITECTURE

DOMAINS

Architecture	**Construction Management**	**HVAC**	**FM**
Interoperability			
Spatial elements	**Building elements**	**HVAC elements**	
Core Layer			
Extensions to the Kernel:			
Control, Modelling, Process, Product, Project management			
Resource layer	Representation		
Classification	Actors		
Date/time	Document		
Geometry	Utility		
Material	Product		
Property	Cost		

ISO DIS 12006 – 2. FRAMEWORK FOR CLASSIFICATION OF INFORMATION

Building Construction

Construction complex

Construction entity

Construction entity part

Element (functional)

Designed element

Work section result

Construction result

Construction process

Management, Process, Stage

Construction resources

Construction actor

Construction information

Construction aid

Construction product

Property/characteristic

DRAFT TABLE OF ELEMENTS Sept 2001

Construction	**Services**	**Equipment**	**Units**
Primary / Secondary			Site
BYGNINGSDELE – element table			Units

Construction	**Pipes/Ducts**	**Electrical**	**Equipment**
Site	Site	Site	Site
Structure	Drainage	Fire protect	Information
Ext walls	Water	High voltage	Furniture
Roofs	Gases	Low voltage	Sports
Ext. access	Cooling	Communicatn	Tech equipt.
Floor const	Heating	Safety	Decoration
Int. walls	Ventilation	Automation	
Int. access		Mechanical	
		Elect. distribution	

BYGGEPRODUKTER – building product data

PRISKURANTER – schedules of rates

6. Conclusions

The IT futures research has mainly confirmed the direction in which technology is moving, towards more sharing of information, even with mobile devices on site. This emphasises the need for a common framework, and the most difficult task facing the Centre Contract partners is to promote the eventual system and get it into wide use. This will involve a number of tasks:

- Testing the proposals for compatibility with ISO 12006-2 and Industry Foundation Classes
- Ensuring that data can be transferred from the systems already used in Denmark. Translation tools may be necessary
- Owners of existing sets of product data should consider cross-referencing to the new system and eventually transferring to it.
- Integrating the classification system with related systems such as the IBB CAD layering guidelines [9] and use of XML for EDI.
- Developing a web search engine categorising information according to the new classification tables.

Alongside this is the need to set up commercial support for the system and to develop it as a brand. SfB, although based on the name of a forgotten Swedish committee, is a brand which is widely known and has lasted for 50 years. Its replacement in Sweden, BSAB, is supported by the building centre, Svensk Byggtjanst, which provides a commercially viable service and keeps it up to date with new technology. The Danish building centre, Byggecentrum [10], is one organisation that could provide a similar service since it already owns a publisher of schedules of rates, has product information and owns an internet portal. It would need to provide publications, a web site and a help desk. The education group in the project is waiting for the final results before recommending the educational support necessary. This might consist of distance learning modules which would be used by universities and by companies for continuing education.

The Danish Centre Contract includes representatives of most types of group in Danish building, and its recommendations should result in an up-to-date system which some of the larger Danish firms are already committed to use. Their influence, via the growing use of partnering and project webs, should encourage smaller firms and product suppliers to adopt the new system, provided it is promoted and well supported. There will be new technologies which are hard to anticipate, and which will influence the way classification is used, but most of the developers of these would welcome a national framework provided it also meets international standards. The greatest effect of new technology, with its ability to communicate any type of digital data to any location, is to increase the need for a common framework for all data used in building.

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