

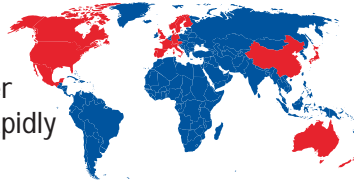
buildingSMART™ Case Studies



Welcome!

BuildingSMART is an international organization which promotes efficient information exchange all along the supply chain in construction and engineering – and right through to facilities management.

We started out in 1995 with a single chapter in North America. Further chapters were rapidly set up in Europe and the Far East, reaching 12 chapters in 2005. China is the latest country to join.



In the early days, our work lay in defining exactly how building information is best exchanged. In practice, this meant understanding what the industry needed and defining the standards or protocols that can be used as a framework for data exchange (creating the Industry Foundation Classes or IFCs – see box).

Firms in architecture, construction and engineering joined us, along with software vendors and progressive construction clients. We used leading experts in the technology – an advanced form of IT – from around the world to help us define and develop the standards.

In 2005, we took a new name – BuildingSMART.

Our work is no longer mainly about creating and advancing the standards for information exchange. That continues, of course, but we want companies to realise what BuildingSMART can do for them and take it up.

So we've assembled a group of case studies, showing how our IFC standards can improve working practices, deliver new efficiencies and save costs.

There's a lot to admire and stimulate new thinking in the case studies.

Enjoy them!

BuildingSMART at a glance

- The first chapter of the International Alliance for Interoperability (IAI) was set up in North America in 1995, followed by the German-speaking chapter in December 1995 and the UK chapter in January 1996.
- Other chapters cover the French-speaking and Nordic countries, Japan, Singapore, Korea, Australasia, Iberia, Italy and China.
- IAI changed its name to BuildingSMART in June 2005 – the emphasis is now on how IFCs make a difference in the real world.
- The BuildingSMART mission is: "To provide a universal basis for process improvement and information sharing in the construction and facilities management industries, using Industry Foundation Classes (IFCs)."

Fast facts about IFCs

- IFCs stand for Industry Foundation Classes
- IFCs define how information is expressed
- They are interoperable – both the originator of the material (eg the designer) and the recipient (eg the constructor) can access the information
- IFCs can be used with any type of software
- IFCs are rich and versatile and contain all sorts of information (eg geometry, location within a building and cost)
- The IFCs are not a separate software product – they can be incorporated in all types of software from different vendors
- Software products incorporating IFCs can put themselves forward for certification

Why do we need to build smart?

- Current work practices often mean slow processes, lost productivity and wasted materials.
- A report by NIST in the US quantified the annual costs of inefficiencies in the capital facilities industry at \$15.8 billion – around 1–2% of the industry's revenue.*
- Sir Michael Latham anticipated that savings of up to 30% of could be realised through better process.**

* *Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry*. August 2004.

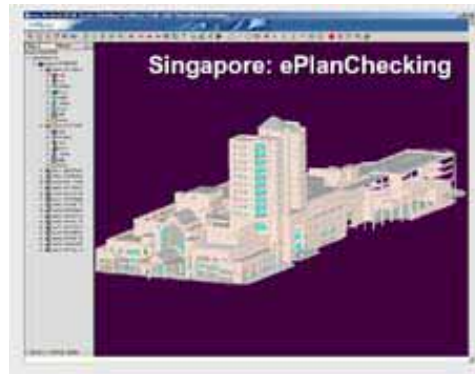
** *Constructing the Team*. 1994.

Singapore: pioneer of e-submission for planning

A swift electronic process for submitting building or planning applications – the e-submission – has been created in Singapore and is already bringing benefits in cost and time reduction.

The Corenet e-submission project (for a Construction and Real Estate Network) provides a single counter or port of call for clients (“one stop”), open 24/7 (“non-stop”). The “one-stop non-stop” resource is already delivering benefits. The average building application has to be submitted five or six times before it is finally approved, so the electronic approach saves a lot in printing and despatch costs. This part of the Corenet project is already up and running.

The second part of Corenet is an artificial intelligence tool called e-PlanChecking, which uses IFCs. It has also been created to check that building plans comply with the various regulations. A third element, e-Info, is creating a central repository of information, which industry can use via a single portal.



‘Transparent and efficient’ – e-submissions in Norway

Norway has collaborated with Singapore to develop an electronic submission system for planning applications.

The goal is for local authorities to offer electronic services in zoning and building matters in order to deliver ‘better, more transparent and efficient’ services. A project known as Byggsøk has been set up jointly by two government ministries and Norway’s National Office of Building Technology and Administration.

Byggsøk is similar to the Singapore Corenet project in the provision of a single information point for planning approval via e-submissions and other planning matters, but it differs in adding the zoning process to the package. It consists of three modules: the electronic information system (local authorities may contribute information to a shared website), a system for zoning proposals and another for planning applications.

Estimates of take-up are realistic: in 2005 a 20% take-up is expected, rising to up to 50% in 2006. Apart from time and cost efficiencies, the new system will mean that information needs only to be registered once and the process will be more user-centred.

Norway and Singapore are far ahead of other countries. “What we have achieved in these two countries is co-operation between industry and government – other countries need to move in the same direction,” says Øivind Rooth, National Office of Building Technology and Administration.

The Aurora project at Joensuu University

Senate Properties, the government property services agency in Finland, has been exploring the benefits of a building information model or BIM in a selection of its projects.

The Aurora project at Joensuu University, Finland, is a mixed-use facility, with teaching space, a regional research centre, offices and a student healthcare centre.



A shared building information model was developed at the outset, at the request of Senate Properties. The architect and contractor were required to work with the model, which was IFC-based.

As work progressed, analysis revealed that the building was too expensive and not energy-efficient. The flexibility offered by the model meant that design change could be easily accommodated. In fact, the whole shape of the building was changed, and the whole facility is now more compact.

The Aurora building is under construction and is due to complete in August 2006.

“Although issues of liability and intellectual property rights remain, we were pleased with the way the model worked,” says Auli Karjalainen, customer manager, Senate Properties/University Premises, who is project manager for the BIM.

“The Aurora project is considered a successful example of a BIM in our part of the world. It is part of our strategy to develop virtual buildings. As one of ten pilots, it is only a small part of our property portfolio, but the prospects for the use of BIMs are good.”

Fire fighting with IFCs

The ongoing benefits of building with IFCs are not confined to FM. Precise knowledge of how a building is constructed – the layout of the rooms, stairs and ducts – could help save lives in an emergency.

“What if the emergency services could send the IFC model, with complete building information, to the emergency vehicle, so that the people in the vehicle could work out their tactical strategy on the way to the scene?” asks Stein Moen, Oslo Municipality.

This is not just a gleam in government’s eye. The fire department in Oslo is already using visualisations from a 3D project model for fire training purposes. Smoke is shown pouring out of the window of a house. As the fire escalates, the smoke bursts into flames and the fire truck arrives. Now the 3D model comes into its own, as it is manipulated to show the interior layout.

There would only be minor benefits in tackling a small domestic fire, but for a large institution, like a hospital, the building model could be a real help.

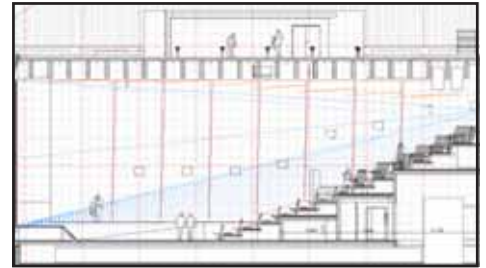
“IFCs open up a lot of opportunities,” concludes Stein Moen.

Cinema design as an object

Small projects can benefit from object technology as much as large ones. The small Norwegian practice, Næss Architects, is involved in a range of work, including schools and cinemas.

For specialist cinema design, a tool has been created, the “cinema designer”. The “designer” is itself an object.

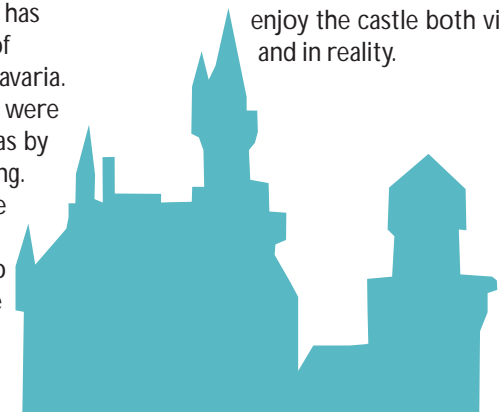
Gunnar Næss, who heads up the practice, is a supporter of object technology. “The technology is there to establish a BIM,” he says. “It’s no more expensive than other systems. Our expectation is that it will allow problems to be discovered sooner and lead to better quality overall.”



Neuschwanstein Castle in Germany

The Bavarian Building Authority, including the CAD-Stelle Bayern, a department of the Building Authority at the University of Munich, has helped create a 3D model of Neuschwanstein Castle in Bavaria. Measurements of the castle were taken by helicopter as well as by internal and external scanning. The purpose of the exercise was to provide a computer-based mapping of damage to allow essential repairs to be done to the façade of the castle. The 3D model, which

uses IFCs, will later be used for FM purposes – and visiting tourists will be able to see the model and enjoy the castle both virtually and in reality.



US Navy and DARPA turn to IFCs to help with ‘protective measures’

In recognition of the fact that the world is a more volatile and dangerous place, the US Navy have developed tools to assess the vulnerability of existing and new building stock to a variety of threats. As key buildings across the US, both naval and non-naval, come up for refurbishment and rebuilding, protective measures are being introduced.

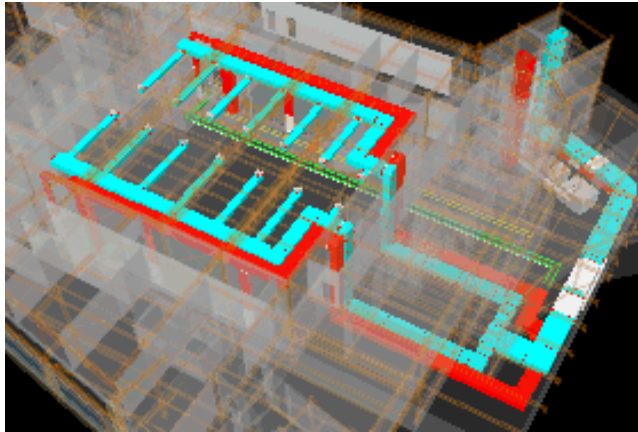
To predict the spread of biological and chemical agents, they are now using IFC-based building models, including fabric and HVAC systems. Appropriate protective measures are being added and their efficiency checked. Finally the updated building model is available for visualisation and costing.

This is no ‘gleam-in-the-eye’ project – the tools are being prepared for early use. A simpler and ‘unrestricted’ version of the software should be available for public download shortly, allowing sophisticated air-quality analysis of building. The project partners are the US Navy’s Naval Surface Warfare Centre near Washington, DARPA (Defense Advanced Research Projects Agency), the Florida State Energy Commission, and AEC3.



Digbeth College of Further Education, Birmingham, UK

The largest gap in the chain of building information occurs between the design/construction of a building and handover to those who will be responsible for operation and maintenance. It was against this background that the lfc-mBomb project – lfc Model Based Operation and Maintenance of Buildings – was conceived. The project aimed at devising a method that would allow a seamless flow of information to pass from design and construction to operation and maintenance – and decommissioning and demolition if need be.



The project brought together representatives of the construction and IT industries to develop an information process framework, test cases and complex software interfaces. Digbeth College served as one of the test cases, with the project team concentrating on the HVAC (heating, ventilating and air conditioning) services. With its maze of concealed ducts and channels, this is an area where problems are often hard to solve during maintenance.

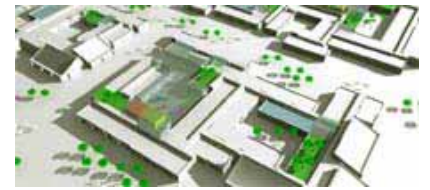
The project provided a proof of concept that improved information flows can be made a reality, with demonstrated benefits of clash avoidance, improved handover of information to the FM manager, speed and flexibility. The reuse of design and construction data during the FM period is a powerful benefit that building owners everywhere are seeking. The innovation was to use IFC-compliant software applications and an object model server that held the building model and enabled software applications to share the information. "Instead of taking months to populate the FM system by hand, as in the past, the job can now be done in a matter of days," says David Leonard, of Taylor Woodrow Construction, who led the project. "One thing is clear – the lfc-mBomb system makes data last longer."

In April 2005, the mBomb project won a commendation from the Chartered Institute of Building, UK, for its contribution to innovation in the construction industry.

The Danes do digital construction

Denmark is determined to increase take-up of collaborative ways of working using IFC 3D models.

To this end, the Danish National Agency for Enterprise and Construction has launched an implementation programme, Digital Construction (Det Digitale Byggeri), to promote the use of ICT in building and construction.



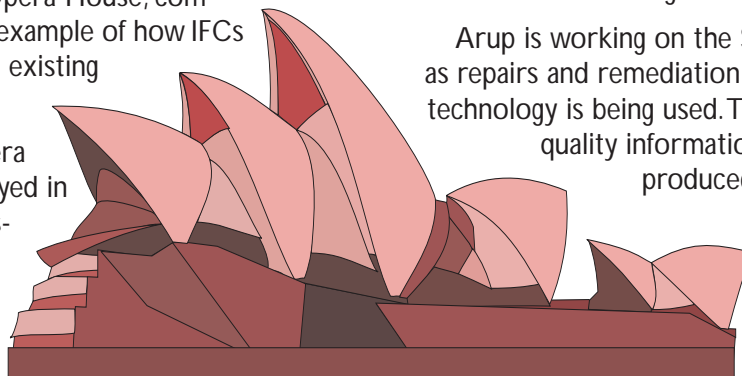
Joint venture B3D, consisting of Ålborg University, design professionals Rambøll and Arkitema, and contractor/developer NCC, has prepared a document, *Clients' requirements for 3D models*, taking the public-sector client through the whole business of the 3D model, its uses and benefits. The concise edition is an excellent example of how to put across complex ideas in an attractive, accessible form.

"It is the client's responsibility to demand the use of 3D models," says the guide. "And the consultant's responsibility to meet those demands."

Sydney Opera House

It's not just new buildings that can benefit from IFCs. The iconic Sydney Opera House, completed 30 years ago, is an example of how IFCs can be introduced into an existing building.

The podium of the opera house was carefully surveyed in the early 60s and good 'as-built' information was



recorded. Elsewhere in the building, 'as-constructed' information is lacking.

Arup is working on the Sydney Opera House, and as repairs and remediation are being done, object technology is being used. This means that high-quality information on the structure can be produced to assist ongoing facilities management.

Hospital project in Norway realises value through an IFC approach

Development of the new Akershus University Hospital, near Oslo, is harnessing IFC software to achieve a range of aims. The primary purpose in creating the IFC-based object model was for planning purposes and to set up object libraries. The hospital has over 1,000 unique rooms in which 50,000 articles are deployed. Of these, 20,000 were drawn in CAD. With work on a scale like this, the object libraries have proved a key tool.

Secondly, responding to political demands for lower operational costs, the IFC project model helped bring down operational and whole-life costs. A new 3D model was completed in only three months. This speed of work was possible thanks to the IFC model approach. Quantities are taken off the model. Information will be transferred from the model to the FM system.

Thirdly, the new entrance building is being used for comprehensive testing of IFCs on a project. The building, which contains an auditorium and canteen, can be tackled discretely, and this part of the project will use IFC software to look at, among other things, energy consumption, indoor climate, environmental impacts and fire hazard.



The project includes the integration of different applications and information. Thanks to the integration, an astonishing flaw in the design was uncovered: 57 rooms which required a water connection had not been provided with one. Better to discover this at the design stage than during construction!

The hospital will be in full operation in 2008. Despite some technical problems – such as the complex facades and the lack of objects from manufacturers – the use of IFCs has been central to the progress of the hospital project.

Automatic estimator in Australia

A new estimating tool is being developed by Australian research organisation CSIRO (Commonwealth Science and Industrial Research Organisation) and its project partners to assist the process of cost estimating and planning. The estimator software prepares bills of quantities in accordance with the Australian Standard Method of Measurement, drawing on a 3D model that has been created using IFC data. The use of IFCs is essential to the process – they are the enabling technology. The estimator tool will also use a database of rates for the costs.

The research project has produced an early demonstration, showing a dynamic visualisation of a building, together with individual cost items. The potential of this tool, once it is up and running and commercially available, is vast. The presence on the project of the large Australian property and construction consultants

Rider Hunt – their credits include the Sydney Opera House and Sydney Olympics facilities – is testament to the promise of the automatic estimator in real-world applications.



The US Coast Guard: a case study in sharing data

The US Coast Guard is a multi-mission organisation responsible for 95,000 miles of coastline and over 8,000 buildings and structures. It is part way through a sweeping programme of process change that will create closer links between facilities and operations.

“We set up a Shore Facility Capital Asset Management initiative or SFCAM,” explains David Hammond, senior programme manager, Office of Civil Engineering, US Coast Guard. “We selected 20% of our staff to look at certain functions and make changes, creating a virtual organisation in order to do so.”

One part of the initiative is to ensure that present and future facilities are aligned to the requirements to ensure homeland safety and security. Facility assessments are being carried out and funding re-allocated. “We are making real change – real quick,” adds Hammond.

Underpinning this massive change programme is the use of information-rich 3D CAD models. Links with GIS software are also being explored, and the contribution made by IFCs is much valued by the Coast Guard. “It is standards like the IFCs that have really made this possible... the beauty of IFCs is the ability to use the data many times.”

And 3D is just the start of things. Prospects like adding in a fourth dimension, that of time, and a fifth, that of finance, are looming.

David Hammond’s recommendation to anyone embarking on a change programme is to embrace change actively. His “confessions of a change agent” conclude with the advice: “Hold to the vision ... manage chaos.”

