

## CONCUR: joining up construction

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## Summary

Recent research in product model related projects has been aimed at developing semantically precise exchange formats. The current industrial need is to build on that with much more focus on the control and management of information within processes. There are also several emerging technologies supported by current research activity, which require industrial path finding implementation. Within the Brite-EuRam project CONCUR, a consortium of European construction interests has worked on industry deployment to demonstrate the application of previous foundation research and present new developments. The paper describes a demonstration of project results.

## 1. Introduction

The Building and Civil Engineering industry is one of the largest in Europe but it is an industry which is organisationally complex and fragmented, with more than 95% of companies being small to medium sized enterprises and operating in a project-centred “virtual enterprise” culture. This is also the case with the larger, multi-disciplined businesses. In the main, the organisation and execution of projects follow very traditional patterns with corresponding traditional information sharing and exchange methods, resulting in faltering and patchy adoption of any new processes, including product related knowledge approaches.

Until recently, there were no significant drivers of industry change. In the last decade however, this situation has begun to change markedly. Clients and facility operators now demand better quality, faster and cheaper built facilities incorporating more complex technology. At the same time, governments have considerably increased the regulatory constraints on safety, waste and energy consumption.

Other industries are facing the challenge of working in dispersed and concurrent business environments by developing integration strategies based on electronic information sharing and exchange using open international standards. Product and Production modelling technology, as featured in ISO-10303 (STEP), UN/EDIFACT and now the International Alliance for Interoperability (IAI) Industry Foundation Classes (IFC), is generally perceived as a key enabler of business integration.

The aim of the CONCUR project is to:

- significantly reduce the cost of tendering,



- speed up the processes supporting tendering,
- improve the accuracy of bids,
- integrate information use,
- integrate the processes and
- support concurrent working.

The project is using commercially available software, has developed an approach for using a web based multi-user environment for storing and exchanging project information, has developed a method of linking Electronic Data Management Systems (EDMS) to Product Data Technology (PDT) databases. The demonstration uses industrial strength information and the partners are stating to deploy the methods on real projects. The project has also contributed to the development of the IAI-IFC open standards.

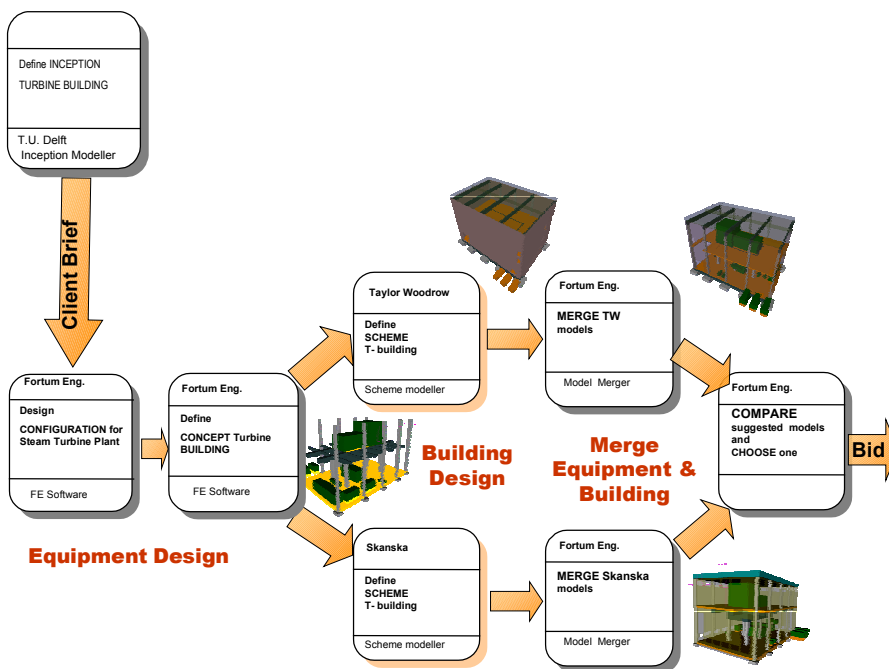
The CONCUR Consortium consists of:

- contractors: Taylor Woodrow, Fortum Engineering and Skanska;
- research and development institutions: VTT and TNO,
- the specification system developer STABU,
- universities: Technical University of Delft and KTH (Royal Institute of Technology, Sweden)

## 2. Business Scenario

The demonstration covers the development of a design and bid for a small turbine house with the emphasis on the building. The industrial partners in the project undertake roles in the demonstration in line with their business specialisation. The business scenario is shown in *figure 1*.

- A client requiring a power station approaches Fortum Engineering for a solution and bid,
- Fortum act as the principal contractor responsible for the delivery of the complete power station,
- Fortum undertake the design of the of the plant and equipment,
- Taylor Woodrow and Skanska are invited to bid for the design and construction of alternative solutions for the turbine house building,
- Fortum merges each of the competing solutions with the plant and equipment scheme, or alternatives, before choosing the preferred solution,
- Fortum incorporates the successful bid for the turbine house into the bid for power station.



*Fig. 1 Business Scenario process flow*

### 3. Information Flow

The business scenario has been modified to show the information flows and the database systems used by the partners. Fortum, Taylor Woodrow and Skanska have their own internal Information Management Systems (IMS) and there is a web based Project IMS hosted by VTT in Finland. The project IMS consists of the Bentley ProjectWise EDMS system which is the main store for files and models. ProjectWise can interface with the Express Data Manager (EDM) software from EPM Technology of Norway to manipulate and merge objects in product models which are stored in ProjectWise. The models used in the demonstration are exchanged in IAI-IFC v1.5.1 format. The information flows supporting the business scenario are shown in *Figure 2*. Each stage in the process will be described.

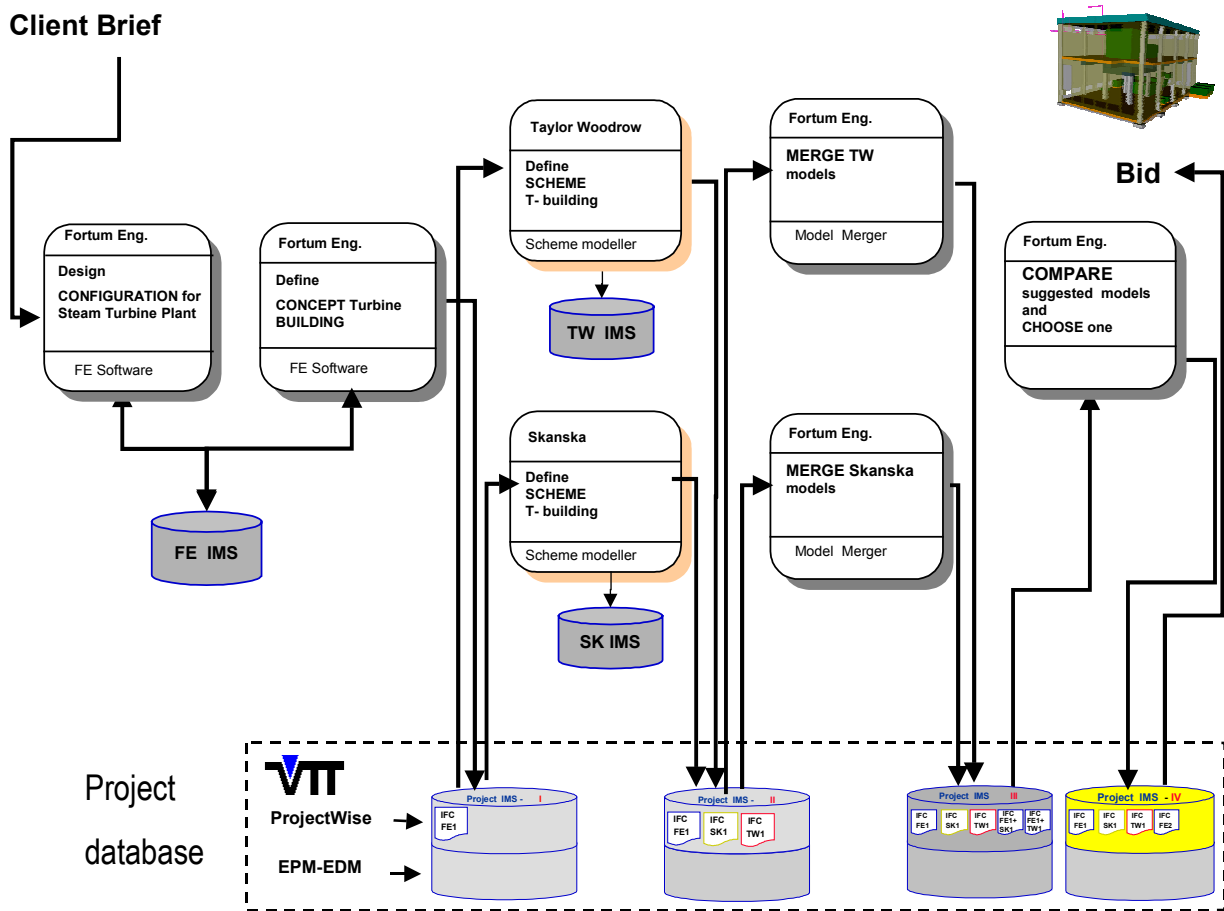


Fig. 2 Business Scenario process flow

#### 3.1 Inception Modelling

Fortum establish and confirm the client brief and prepare the performance specification for the power station. They can use the Inception Modeller software tool, a prototype developed by the Technical University of Delft, to investigate outline solutions and costs for the power station including the turbine house building. The results of this are numerical and used to provide initial guidance to the conceptual design work.

#### 3.2 Equipment Configuration and Design

Fortum configure and design the plant and equipment using a suite of software called PlantPower which has been customised for the purpose. The suite includes:

- “Solvo” for process simulation, energy balance and initial dimensioning;

- A knowledge module holding design rules, design dialogues, plant scope and artificial intelligence facility based on Design++
- A project management module
- An implementation design module for Process and Instrumentation, numerical calculation and layout
- A Communication Module for data exchange and for managing information such as the integrated plant database, ISO and IFCs

Microstation J is the main software for shape and 3D modelling used by Fortum. Fortum prepare a conceptual layout of the Turbine House which includes the major items of plant, as IAI-IFC objects, and the spacial and functional requirements of the building. They use a company Information Management Sytem (IMS) for storing and exchanging documents and models. The conceptual design information for use by the civil engineering contractors for developing the scheme design is uploaded to the Project IMS as an IFC (*FE1 in Figure 2*).

### 3.3 Civil Engineering Design

The civil engineering companies download the conceptual model and supporting documentation for the Turbine house from the project IMS. They design a scheme and prepare a cost plan and construction programme. In the case of Skanska they use ArchiCad, MS-Project, bespoke software from Solibri and their company internal IMS. It is worth noting that most CAD systems used by construction companies only support mechanical engineering objects as bounding box representations and usually don't export them. The resulting scheme designs are uploaded to the Project Database as IFCs (*SK1 for Skanska and TW1 for Taylor Woodrow in Figure 2*) plus information such as the cost plan and construction programme.

### 3.4 Merging Models

The civil engineering companies have delivered alternative building solutions to the project database which will have the facility to maintain the confidentiality of information where necessary. Fortum Engineering can view both alternative schemes and can merge either with the original conceptual design for the plant and equipment or with an alternative design for the plant and equipment. It is also possible for Fortum to merge models for other parts of the power station into the same model.

Model merging requires the Express Data Manager (EDM) part of the project database. Model merging instructions are assembled via a web based form. The EDM software can also be used to extract individual objects from the Models. The merged models have been loaded into the project database as IFCs (*FE1+SK1 and FE1+TW1 in Figure 2*). After the merging has been completed, the source and merged files are deleted from the EDM.

TNO have developed an easy to use IFC Browser which can be used to view models and extract information relating to objects for use in other applications. For example it can extract concrete volumes for use in estimating systems. It can also be used to apply properties and specifications to the IFC models. Other parts of the project work have developed methods and tools for creating sets of properties, specifications and for manipulating definitions. This work is related to the AEC Lexicon work being lead by STABU of the Netherlands. *Figure 3* includes screen shots from the browser tool which show the plant, equipment and building concept model, the building model and the combined model.

### 3.5 Compare Schemes and Prepare bids

Fortum can compare the alternative schemes choose the preferred solution and prepare the power station bid. The final scheme with plant and equipment can be uploaded to the project database (*FE2 in Figure 2*) ready for re-use by the contractors after the power station bid has been accepted by the client.

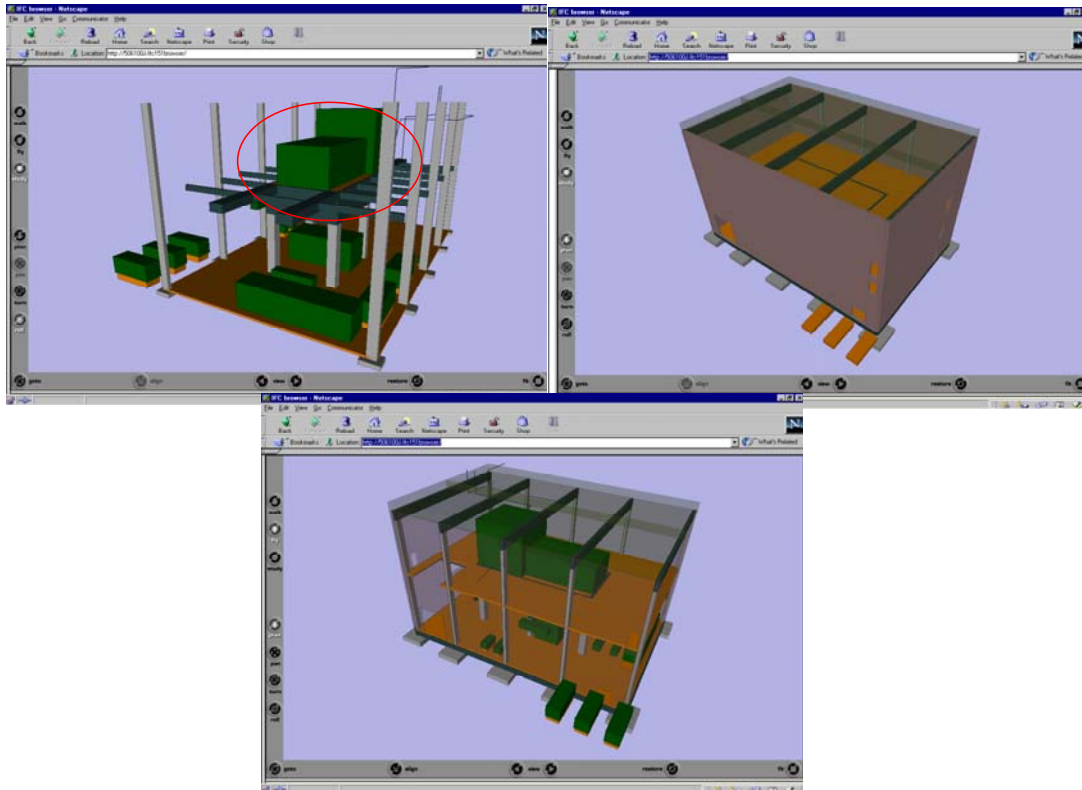


Fig. 3 Merging views from the TNO IFC Browser

#### 4. Information Management System (IMS)

The system has two main sections: a document manager and a model manager. All documents are stored in the project Information Management System's document management service while IFC files can be uploaded into the model manager too.

The main functions are:

- Uploading files from a PC to the document management system over the internet
- Downloading files to a PC from the document management system over the internet
- Ordering the product model server to create models (Merging) based on IFC files in the document management system and display information in lists, 3D (VRML).
- Creating relations between documents in the document management system and specific objects in a model in the product model system.

The project Information Management System has been implemented at a prototype level. It is assumed that companies will have their own IMS systems and only use a project IMS for sharing information, although recent developments have shown that these functions can be combined. The CONCUR IMS has been developed by VTT with specialist help on Model Merging from TNO and EPM Technology.

##### 4.1 Uploading Information

Uploading and downloading documents or models are essentially the same process. Documents are uploaded to the system via a web based metadata-form that has been added as an interface to ProjectWise web client. It is also possible to use FTP. The metadata is according to the CONCUR PDM Schema which is based on IFC2.0 document entities. Files are uploaded with their own metadata.

The IMS receives the file and uses the "IMS Servlet A" to connect to the ProjectWise database and store the file in the appropriate project folder. The database stores both the documents and the metadata. The approach is shown in figure 4.

## 4.2 Model Merging

Within CONCUR merging is understood to be updating which means the addition, deletion or change of part of an existing model. The user gives a merging command via a merge form which is an interface to the ProjectWise web client. This command instructs which models to merge, how to merge them and what to do with the merged model. The models need to be populations of the same schema.

In the Project IMS the “IMS Servlet B” extracts the models from projectWise sends them with the merging instructions to the EPM Technology Express Data Manager (EDM) where they are merged and then delivers the merged result back to ProjectWise. The approach is shown in *Figure 5*.

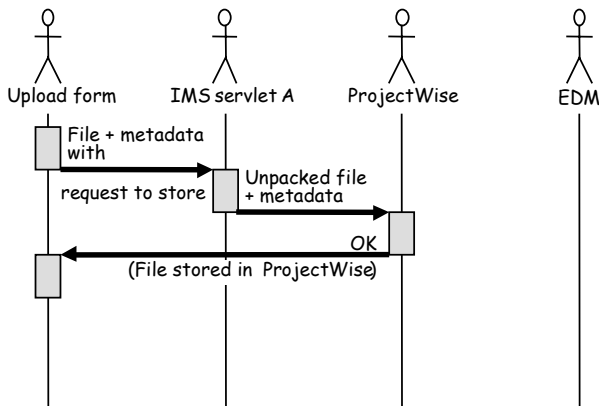


Fig. 4 IMS Uploading Approach

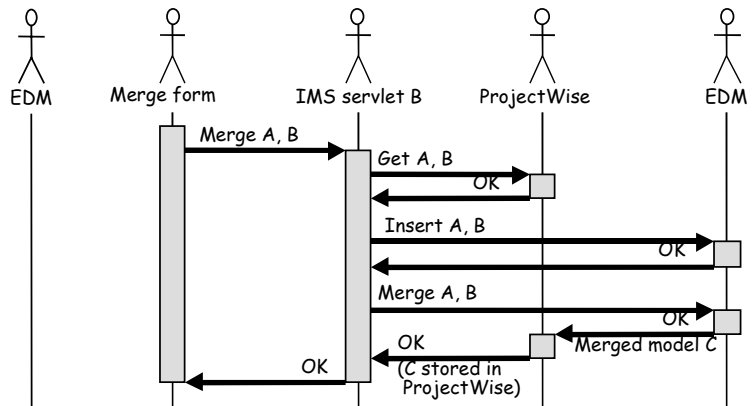


Fig. 5 IMS Model Merging Approach

## 5. Conclusions

### 5.1 Technical Results

CONCUR partners have contributed to and encouraged the development of IFCs. The project has provided a testbed for the advanced use of IFCs and demonstrated their early application. The IFCs were originally intended for information exchange but CONCUR has extended their use to information storage.

From a project point of view, cost and time are not yet supported by these models and also, the frequent upgrading of revisions has led to incompatibilities between software products. The current IAI strategy will eliminate this because upgrades are planned to be much less frequent. One of the industrial partners has developed a close relationship with CAD vendors and has helped them by testing their IFC translators.

IFCs and their translators are still immature and vendor uptake is approximately 12 months behind developments. However, there is increasing vendor interest and a number of smaller companies are very enthusiastic and see IFCs as an opportunity.

### 5.2 Industrial results

CONCUR has shown that it is possible to use open standard product models to integrate design activities across companies and industrial sectors and reduce the time to tender. Fortum Engineering are already using the approaches developed and Skanska and Taylor Woodrow are both committed to using modelling in the business and are in the early stages of deployment. The CONCUR project has demonstrated the effectiveness of web based information exchange environments and how they can be used with more advanced use of PDT. The model merging is limited in its use and the legal issues have not been addressed however, it is a first step and shows the feasibility of the approach.

The project has provided technical guidance to a number of the more adventurous commercial software vendors who are adopting some of the ideas.