



Connecting Processes Online: Planning, Building, Maintaining

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ABSTRACT

Both, growing globalization and liberalization of today's markets have increased a weakening of traditional borders between communication media. This applies to the media, as well as to their specific ways of communication themselves. It is more and more apparent that markets and industries are melting together with a significant impact on the climate of competition. The development of the communication technology leads to the establishing of global information networks and hardly any branch dares not to participate in this global competition platform. Under this, the well-known formula of minimizing time and money has gained a next dimension. In this context the amount of data communication between all project participants increased through decentralizing and outsourcing. Thus overview, quality, reliability and mainly 'future-safe' access to all information became more and more important factors in today's competition.

Common development from Framatome ANP and INIT GmbH, both Germany, lead to the implementation of a technical information system (short: ISBA). This contribution presents a global product data model that integrates object orientated Internet-, CAD- and Database technologies. Beside these technical issues the main focus will be given on the range of application and representative use cases will point out the benefits of this new technology.

The ability to access all information online initiates process communication between all faculties involved in the planning, building and maintaining processes. This addresses the demands of suppliers to compete successfully with the new and fast information environment, as well as owners of power plants, which do not only have to maintain all facilities, but even have to assure the quality and reliability of their aging documentation in many cases throughout an increasing lifetime of the plant.

KEY WORDS: online processes, internet, intranet, aging management, process communication, maintenance, planning, building, design, nuclear power plant, product data model, information system.

TARGET

The effective information management more and more influences planning and utilization of all kind of civil and industrial facilities. Clarity, intelligibility, reliability and above all the long-term availability of all the relevant information influence significantly the costs and competitiveness.

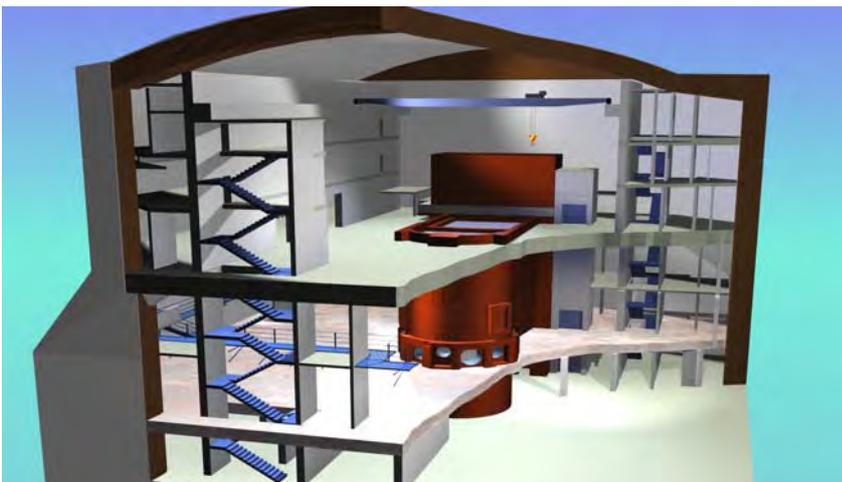


Fig. 1 3D-Model of the Research Reactor of University of Munich Germany FRM II.

Common development of Framatome ANP and INIT GmbH, both Germany, lead to the implementation of a technical information system (short: ISBA) that guaranties overview in vast amounts of data and a permanent online

access to all information over buildings and plants, which are created and must be maintained through the whole lifecycle. The system integrates modern Internet technologies and object orientated 3D- product modeling. ISBA manages all the lifecycle information concerning the planning and design, the construction, the facility management and use, as well as the demolition of the building or plant.

Access - online as well as CAD-based - is given to the following information, for example:

- Geometry model of structures and components,
- Graphical demonstration and illustration of loads and load combinations,
- Structural system of single components,
- Used materials,
- Quantities,
- Processes and progress of erection to support the schedule planning and optimization of construction methods,
- All design documentation and information.

RANGE OF APPLICATION

Planning and Design, Project Management

A building or plant arises with its design. It will be built, used, rehabilitated and finally demolished. During the lifecycle of a facility there will be plenty of information generated. Those are for example the design and other documentation for the planning permission, the documents for use and reuse, 3D building model with specific structures and units like floors and rooms, definition and attribution of HVAC facilities, definition and attribution of objects of inventory, documents for specific facility management units including relevant contracts. In optimal case this information will be generated while designing a new building. In practice, however, this information will be often generated afterwards for an existing building. The existing information will then be gathered in a building model. This model builds up the guideline for the forthcoming information processes.

Experiences with ISBA shows that CAD- systems can be effectively used as a creative basis for the implementation of technical information systems. In this case the CAD- system will not only be used for modeling of structures but also for visualization of all technical design documents and processes. Because the entire 3D- model will be saved in an external database the structures and all the associated information can be transferred to another visualization and multimedia environments, as well (see fig. 2).

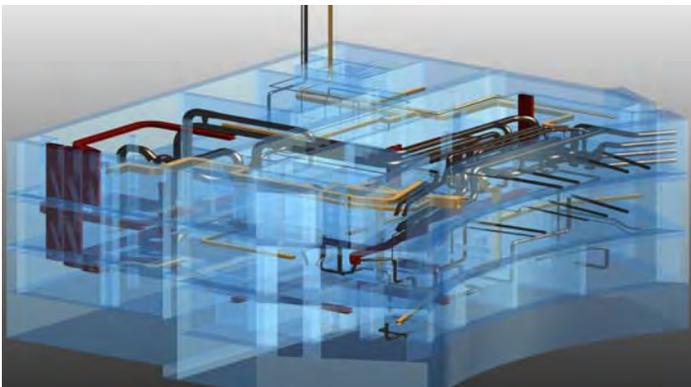


Fig. 2 Visualization of European Pressurized Water Reactor EPR.

Each of the project participants is able to check or modify the latest versions of project documentation. This is possible due to the Internet access to ISBA at any time and anywhere. With help of access control the specific information and latest changes in planning are available for authorized persons only or for public use. All the information can be integrated within a workflow. Through information queries several kind of lists, like “unfinished tasks”, “my tasks” and “to do till certain date”, can be easily generated. At the end of the project phase a complete project documentation has been gathered.

Document Management

One of the greatest advantages of the information system is the effective management of documents and drawings. By clicking a structural part or a component with mouse the information concerning this structure can be seen. The loads as well as the design documents can be saved object orientatedly. Additionally the design chronology can be followed. With help of a viewer the information can be directly accessed in Internet browser. Alternatively it is possible to check the documents out and save them on the client computer in order to modify them. Logically another user

Internet Communication

The integration of global resources and sub-contractors as virtual teams is a strategic target in many companies. The realization of a location independent and rapid access to the current project data is more important than ever. With the help of CAD-independent and graphically interactive Internet platforms (Fig. 3) that integrates all the elements and results of planning such an online project communication can be carried out.

The detail design of structures can be managed and controlled in stages with agreements, suppositions, changes and versions, which chronology can be followed up. Source information like design parameters, structural systems, loadings, selected profiles and connections are online and timely available for all the participants (multi-user) as well as integrated with the CAD-applications. The change management is provided cost efficiently on an Internet platform.

The presentation of due dates and current status of erection including the time schedule is graphically interactive and can be easily used for comparison analyses. At the same time the documentation of correspondence, information for the delivery control and agreements can be followed up.

As a result of using Internet technologies the number of errors and misunderstandings are reduced. Furthermore the management of a project in all its phases can be carried out more effectively. The entire lifecycle of the building or a plant can be managed properly.

TECHNOLOGY

Object Orientated Product Data Modeling

Integrated information processing demands for a permanent availability and even exchangeability of all design data. This covers not only static analysis, design and construction, but covers as well all authorization and change processes, as build procedures and versions and the planning chronology. This is especially true for the planning of considerably big plants. This requires the implementation of a global product data model, which includes the above-mentioned information up to the correspondingly required details. This heterogeneous pool of information needs a flexible modeling technology, which is given by the objectorientation.

The presented product data model, here, is defined in a substantial class library. Classes are the basic elements of objectorientated programming. Each class is a user defined data type, which serves as a template for each specific object (instance) that is created by the class.

Modeling the Structural Components

Modeling of the structural components considers their particular function how they are supporting the entire building (walls, slabs, beams, columns, etc.) and has to consider the adequate information access due to usual divisions of buildings (building, level, room, etc.). Fig. 4 shows an representative example of a reactor building.

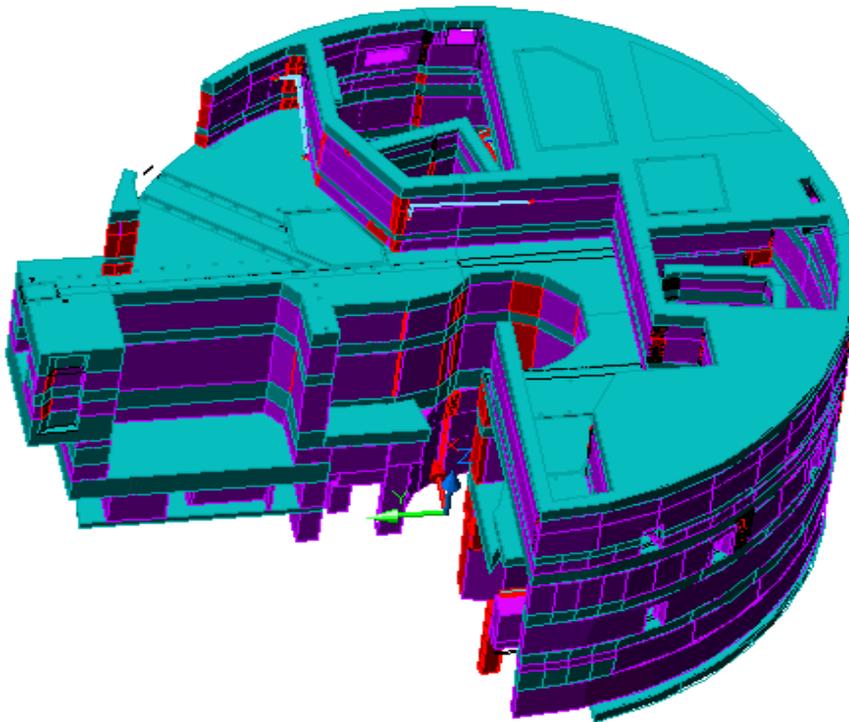


Fig. 4 3D-Model of a Reactor Building.

By means of hierarchies the product data model uses all possibilities of heredity: information and behavior are bequeathed from the upper classes to the subsequent classes. Increasing the bequeath depth goes along with detailing the special class properties and fulfills the demand for appropriate degree of information content. (e.g. the information requirement is different during the basic design phase compared to the detail design phase).

Modeling of Forces and Load Combinations

The loads, which have to be considered, are usually categorized into dead loads, service loads and special loads. Especially the last two categories describe situations, which do not act simultaneously. Thus the product data model describes rules and relations between the loads, which allow deriving automatically all possible combinations.

Up today it is common to produce load plans (2D) and reports for special loads. Using product data modeling it is now possible to collect group of loads under certain conditions and to attach them to the physical structural members or their idealized static system. They can then be produced as load plans in the desired form: in (traditional) 2D-load plans as well as in 3D 'load models', indicating precise position and direction of loads. Interfaces to existing static and dynamic analysis tools support the technical design process and reduces sources of errors or miss communication.

CAD and Database Systems

The international IT market tends definitely towards objectorientated commercial products. E.g. AutoCAD is an objectorientated CAD system, and has objectorientated programmable interfaces (ARX). ISBA extends AutoCAD and uses consequently its objectorientated features. As a database the objectorientated database system (OODBMS) Objectivity [3] is used. CAD and OODBMS are synchronized through the Technical Informationssystem at any time.

At a great extend the implementation of ISBA was driven under the demand to use a 3D volume model. The capabilities of today's hardware (PCs) allows 3D handling without serious limits. Even the available tools have the power to model arbitrary 3d bodies without loss of time or capacity. The advantages are obvious. They are (among others):

- True and faithful image of the reality
- Unambiguous directions of loads (no more conservative load assumptions)
- Clear exchange of information
- Extraction/establishing of submodels according buildings, levels or rooms.
- All the possibilities for visualization (virtual reality)
- Aids for orientation and navigation
- Automated collision tests

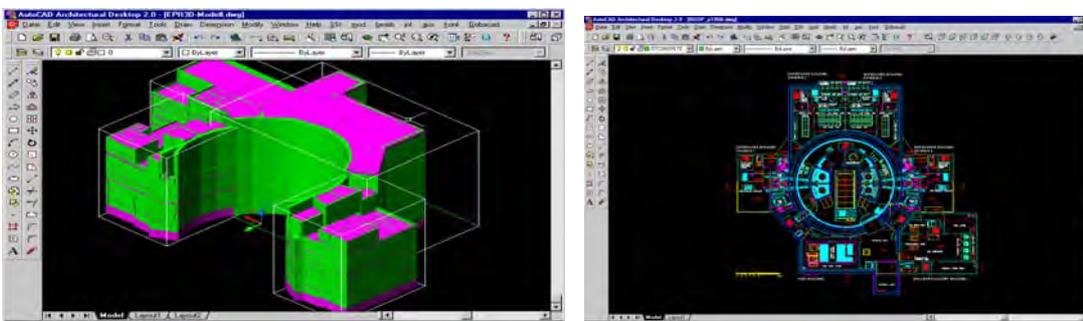


Fig. 5 3D-Model und automatisch generated 2D-drawings of EPR.

Fig. 5 shows a 3D model of EPR and a 2D drawing, which was automatically derived from the 3D model. Fig. 5 may give a first impression about quantity and the complexity of the geometry, but one should keep in mind: this is a usual structure in the realm of nuclear power plant. Under control of the Technical Informationssystem the 3D model is designed with the CAD system. Depending on the current context (designing a wall, slab or a load, etc.) additional information is generated during the design steps, it is associated to the structural component and in the same time stored in the database. The database is self filling through the design phase and the generated information is steadily available for queries (diagrams, reports, submodels, ..) and process communication.

Internet Technology

Objectorientation is coming more and more into the fields of internet applications, and XML is getting more and more a 'quasi standard' of efficient internet applications. The openness and scalability of browsers and groupware applications proves to be highly beneficial when partial solutions shall be combined to a general solution. It is possible to create internet based process solutions among commercial available software components.

The strategies to construct open and integrating internet solutions are many and diverse. The described architecture here is based on objectorientation and (thin) client server structure. It focuses on the requirements of the areas Technical

Informationssysteme, Project Management and Facility Management. The core of the participating systems is the usage of a dynamic object manager, to define application specific objects. These may be objects of the civil structure (rooms, walls, slabs, openings), objects of specific crafts (heating, climate, piping) and even objects of the project coordination (deadlines, milestones, documents, claim management)

Any number and type of attributes may be attached to each object. It is possible to arrange the attributes by topics (headlines). An elaborated administration of user rights grants or permits access on the attribute level. The ability to create own object behavior is given as well as the ability to create own object hierarchies. This object orientated approach allows the formulation of fast and comfortable search queries across the entire system.

CONCLUSION

Technical Informationssysteme are based on object orientated technologies. They synchronize the simultaneous application of Internet, CAD and database systems on the basis of object orientated product data modeling.

The ever increasing possibilities of communication and visualization lets the (design-) world grow together. The collaboration of all participants in the design, construction and maintenance processes is getting closer and it is not more bound to regional borders.

Seeking and getting of internal and external services, coordination over new communication media, will have its effect in all ranges of the engineering praxis. Object orientated Technical Information Systems have the potential to fulfill these requirements.

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