PRODUCT MODELS AND LIFE CYCLE DATA MANAGEMENT IN REAL PROJECTS

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Summary
Building project, with many different players involved, requires open and commonly accepted standard for product model description. Product model based design tools support easy comparisons of design alternatives and optimisation of design solution technical quality. This supports client's decision-making and design target comparisons through the whole building project. Use of product models enable these tasks to meet both schedule and cost requirements of real projects.

Olof Granlund is using product models and interoperable software as the main tool in projects. The use and the realised benefits are illustrated by examples from 3 different real projects: University building, where product models were used already in the very early phases by the whole design team. Office building for research organisation, where product models were used in so called self-reporting building system. Headquarters for international company, where product models were widely used for building performance analysis and visualisations in design phase as well as for facilities management system configuration for operational phase.

1 Introduction
Product model describes building in an intelligent and organized way, which makes it possible to update and reuse information through the whole building process. Building project, with many different players involved, requires open and commonly accepted standard for product model description. An advanced product model schema for building industry is IFC (Industry Foundation Classes), which is developed in international collaboration under co-ordination of IAI (International Alliance for Interoperability). The technical description of product model is important for easy exploitation of the information, but real projects require also always information outside the open product models. However, it is important to follow the main principles of product model based design in all the project work: 3-dimensionality and use of objects with product specific information.

Olof Granlund, building services and facilities management consultant, is using product models and interoperable software as the main tool in projects. The product model based design tools support easy comparisons of design alternatives and optimisation of design solution technical quality. This supports client's decision-making and design target comparisons through the whole building project. Use of product models enable these tasks to meet both schedule and cost requirements of real projects.

2 Product modeling impacts

2.1 Benefits
Biggest beneficiaries from product model based building process are building owners and end-users:

- More efficient and reliable design process.

- The resulted building is better both in terms of performance and life cycle costs through alternative comparisons and life cycle analyses.
- More control to the project by easy-to-understand visualisations and other advanced representation methods, which gives the end-user real possibilities to affect on the end result.
- Information from design phase and updated during construction by as-built data, can be transferred and used also in the operation phase.

Especially building owner's understanding of the benefits and commitment to the use of product models gives a good possibility to affect on the whole building process and on the different team members of building project.

2.2 Building process

Traditional design is suffering lack of alternative analyses. Product model based design process (Figure 1) enables versatile analyses and comparisons, which can happen within the limits of practical project schedules. Simulations, analyses and visualizations support decision-making through the whole building process, both from the point of view of building performance and cost.

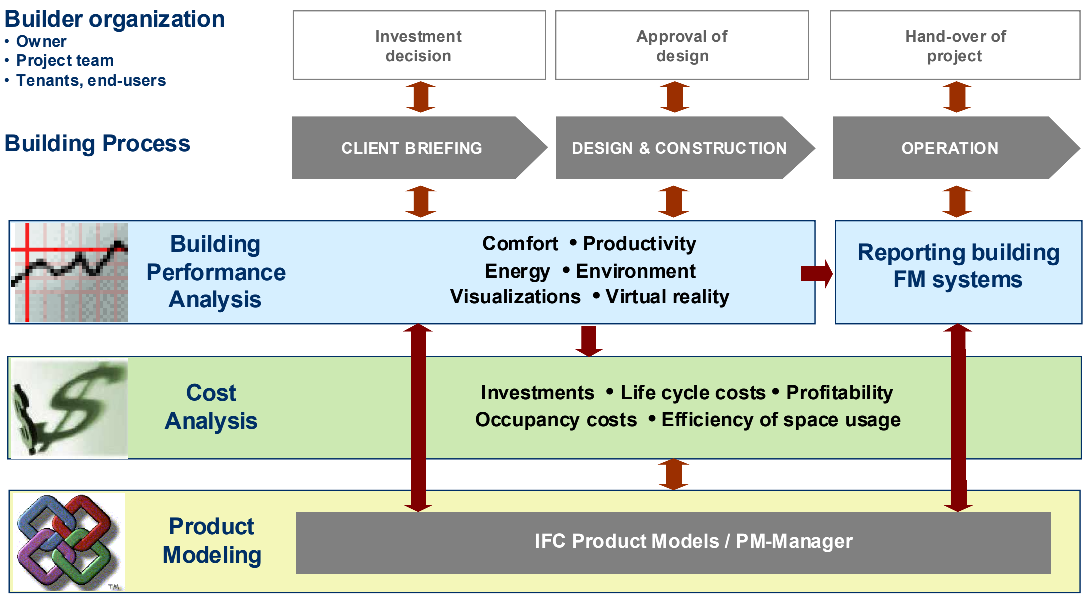

Figure 1. Product model based building process that has been used in several real projects.

Granlund uses product models in building services design both for input of the building geometry and also for updating the product model by technical data from design tools, such as spatial IAQ design values and 3D model of HVAC and electrical systems. This way other project partners can study technical systems as a part of the building model, e.g. architect can check how technical components affect on the architecture.

3 Real project examples

3.1 Project example 1, university building

The project example 1 is a new university building in Joensuu. This building will be the second phase in the building complex of mainly 2..3 storeys. The first phase was built just recently and has been used about 1 year. Both phases are based on the winning proposal of architecture competition. Phase 1 is a result of totally traditional design process with 2D drawings and documents.

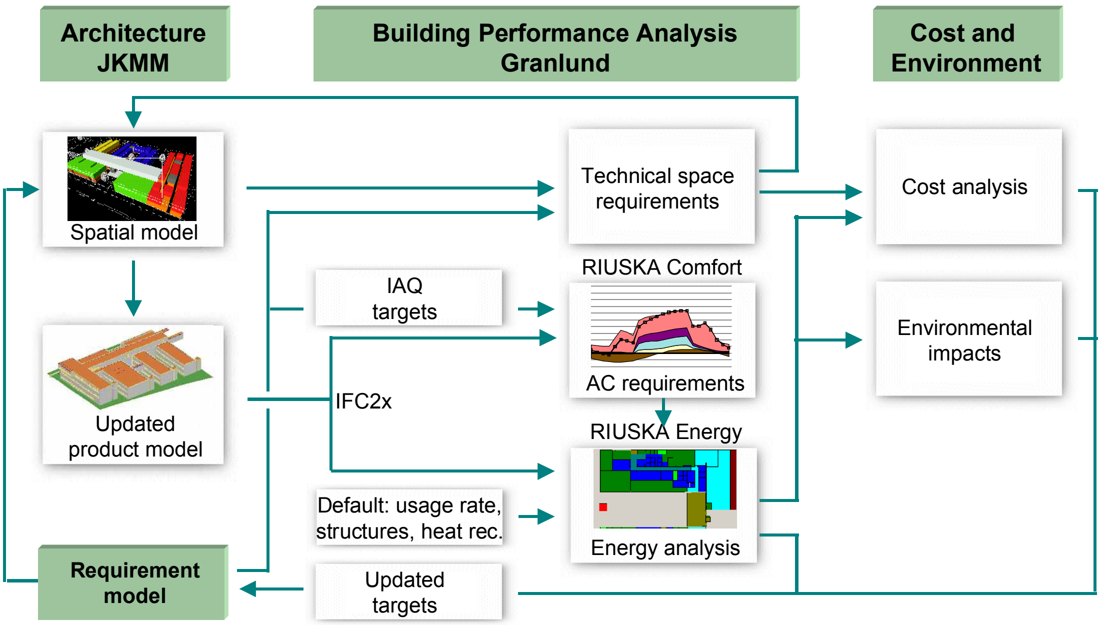

Figure 2. Product model based analyses supported investment decision in this real project of university type of building

In phase 2 product models have been used already in the very early phases by the whole design team. The product model and analysations based on it supported especially client briefing and owner's investment decision.

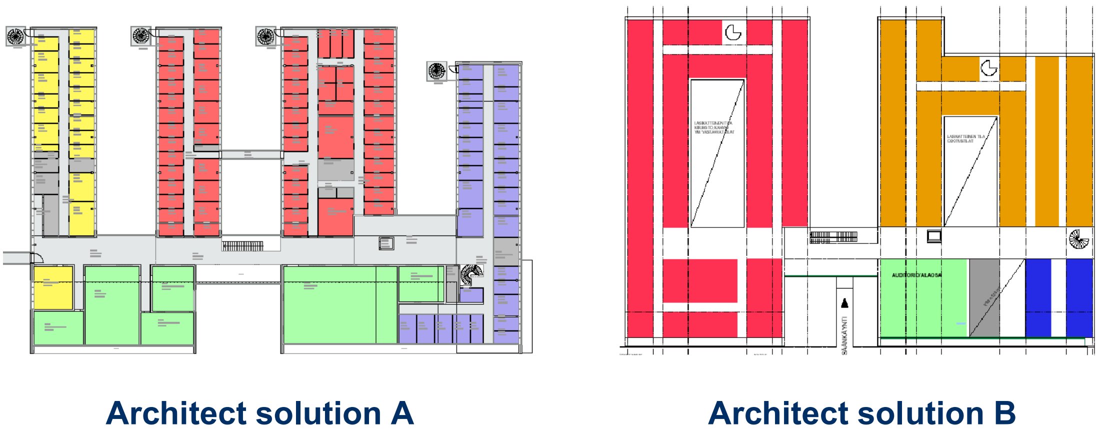

Figure 3. Architect solution was optimized by using versatile energy and cost calculations.

Architect created first spatial model in 3D format, which was also an easy-to-understand tool to discuss with the end user about space requirements and layout. This spatial model was completed with rough information about main structures (walls, windows, doors) and transferred to building services and cost consultants. Building-owner established very tight cost, energy and environmental targets for the building and the architecture solution was further developed based on energy and life cycle cost analysis.

The first architect layout with narrow wings resulted large envelope area compared to the floor area. The next version used inner courts with glazed ceilings as a solution for decreasing the envelope area. Certain operations like library and waiting center were well suited for that kind of areas. And still the architecture expressed the same visions as in the original architecture competition. This way both the energy and cost efficiency became better, although energy did not yet meet the target value. Energy efficiency was then further developed by optimizing insulation level of the envelope.

Investment decision was made after analyses and so it was more knowledge based than traditionally. Now the updated challenging but realistic target values work as a good starting point for the actual design phase. When compared to the phase 1, the resulted energy target for phase 2 is about half of that. And all this by investment costs within limits of original targets. The design will start on summer 2004 and continue the wide use of product models.

3.2 Project example 2, office building for research organisation

The project example 2 is a new office building for governmental research organisation in Helsinki. In this building the design was made totally by traditional methods. The building-owner and the end-user wanted anyway to guarantine both cost and energy efficiency as well as comfortable indoor environment, why product modeling and related analyses were done separately by special consultants. To also assure targeted operation, client wanted to invest in so called self-reporting building system, which can use the product model information like 3D geometry and analysis results.

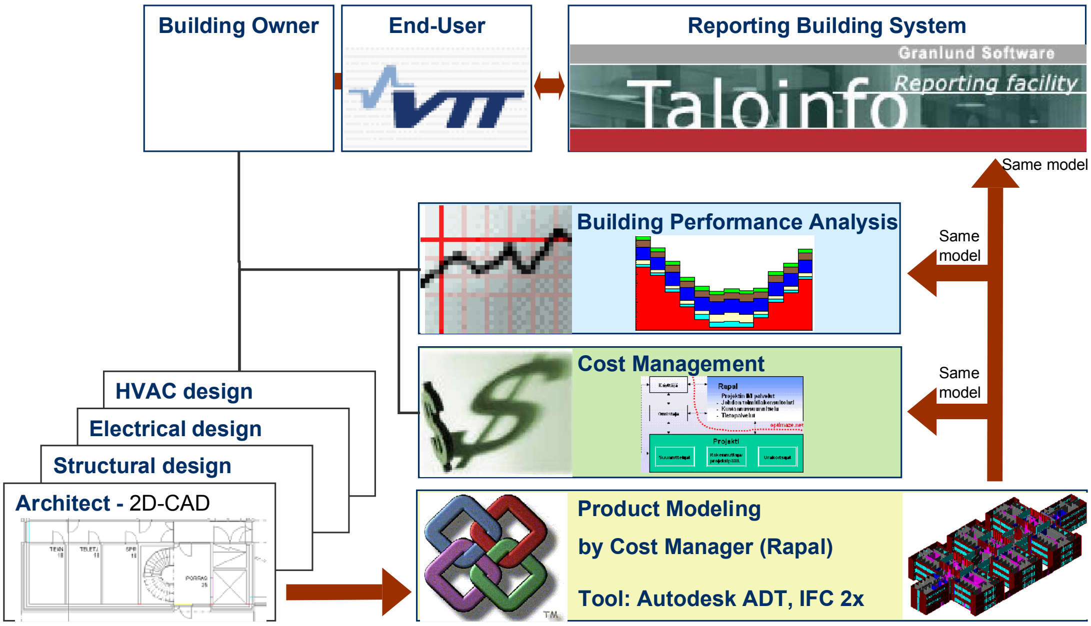

Figure 4. Traditional design and separate product model based services were combined in this real project of office type of building

The self-reporting building system is new information system for easy and visual building reporting. It is used to monitor and analyze building operations from several different points of view: indoor conditions, energy-efficiency, environmental impacts and life-cycle cost. It collects automatically data from different building technical systems such as building automation, access control, energy metering and facility management. It creates new level of reporting by combining existing data from several different sources, e.g. hourly electricity consumption from energy metering system can be compared to occupancy data from access control system.

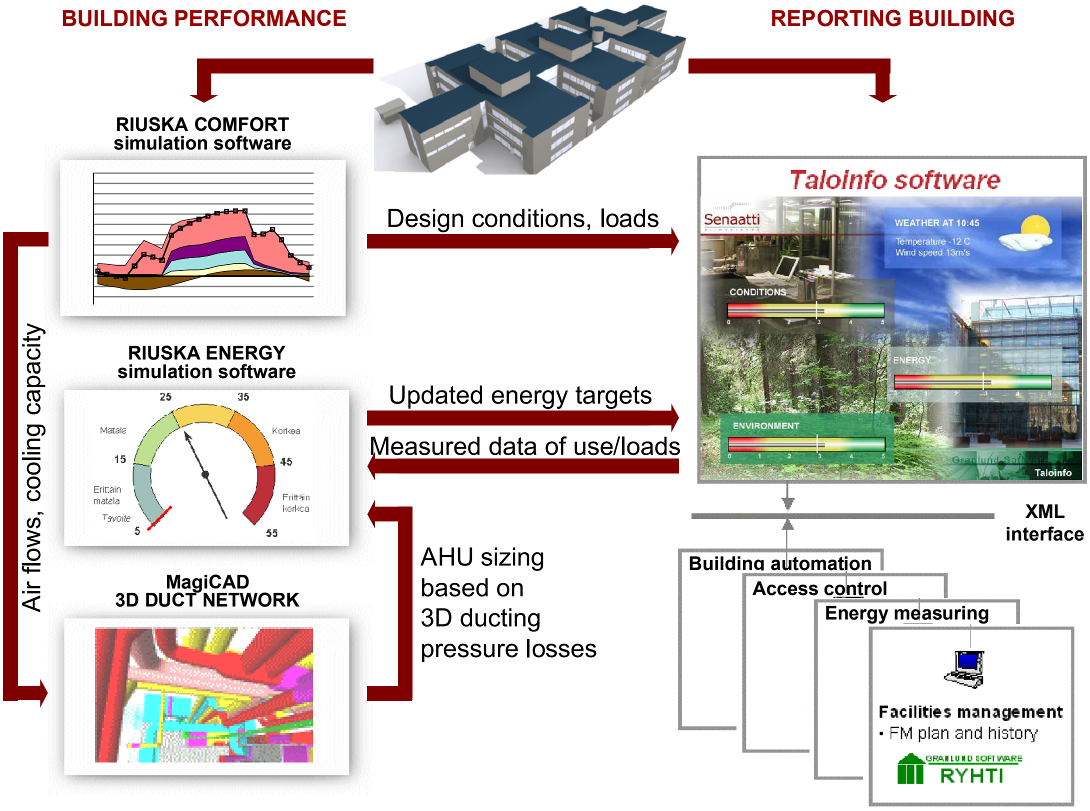

Figure 5. The self-reporting building system brings product models to building operation.

This is the second pilot building for self-reporting building system. Based on experiences from the first pilot project, the product model is used more widely. It imports from product model building geometry, spatial information and comfort and energy targets. The system includes also total energy simulation model of the building, which allows automated target updates according to changes in occupancy or loads. This is the first step towards continuous commissioning. The project is now in construction phase and configuration of the self-reporting system is started.

3.3 Project example 3, headquarters for international company

The project example 3 is new Scandinavian headquarters for international medical company, where product models were widely used for building performance analyses and visualisations in design phase as well as for facilities management (FM) system configuration in operational phase.

The building services designer also created the 3D geometry model, because architect didn't use any product model based tools. This extra work was saved many times by using the same model in energy, CFD and environmental analysis as well as in sizing of heating, cooling and ducting.

The product models from design phase were transferred also to facilities management system. The geometry model was used in the intranet based FM system for occupant requests, cleaning area information and company phone book system. It also supported access to technical FM system, where technical product data from design was linked to spatial information from the geometry model.

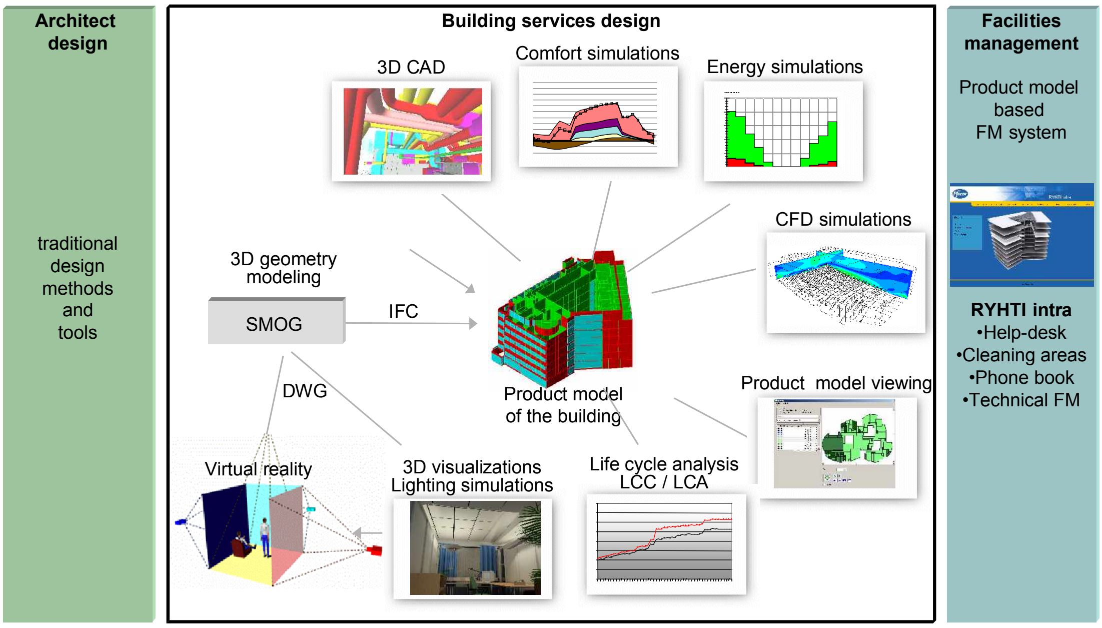

Figure 6. Building services consultant made the 3D geometry model for versatile analysis, visualisation and facilities management purposes in this real project of headquarter type of building

One example from the different building performance analyses in this project are CFD simulations for comfort analysis, where the use of product models made it possible to meet the real project schedule requirements. CFD used the geometry data and also boundary conditions of air devices from manufacturer’s product selection tool.

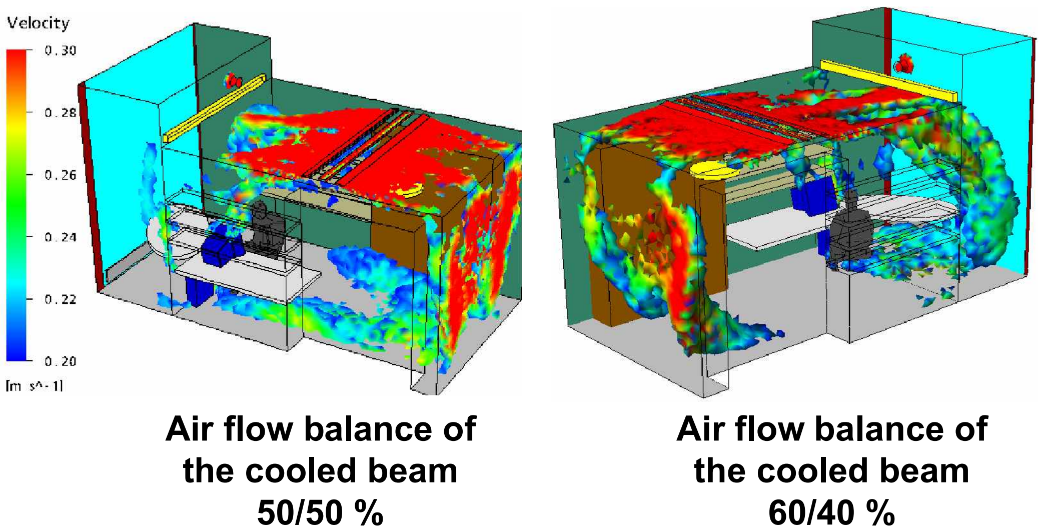

Figure 7. CFD simulations supported air flow balancing of active cooled beam in an office room, where 60/40% solution (right) resulted better indoor conditions from the point of view of risk for draught

4 Discussion

Experiences from several product model based real projects show that there is not only one correct way to use product models. On the contrary many different kind of concepts for product model usage resulted real benefits in projects. The challenge for future development is the management of data updates through the whole building process and especially during operation.