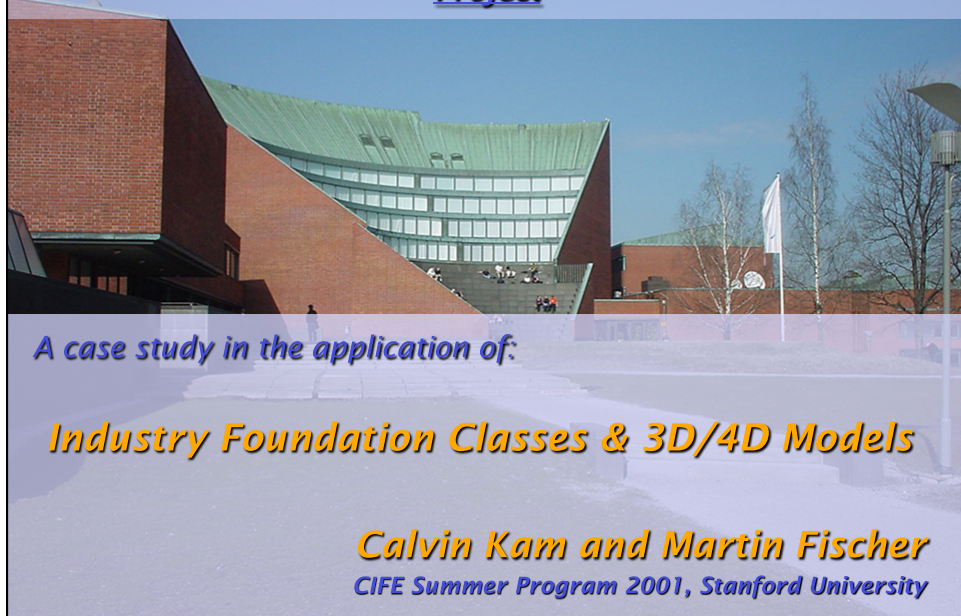


Helsinki University of Technology (HUT-600) Auditorium Project



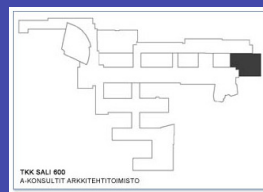
A case study in the application of:

Industry Foundation Classes & 3D/4D Models

Calvin Kam and Martin Fischer
CIFE Summer Program 2001, Stanford University

Project Highlights

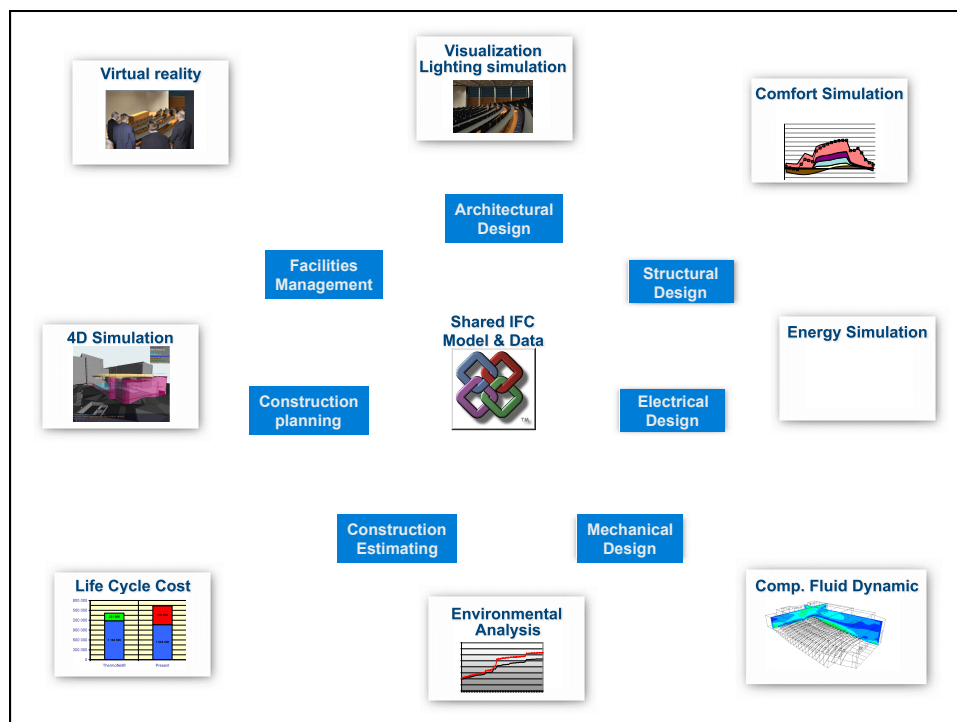
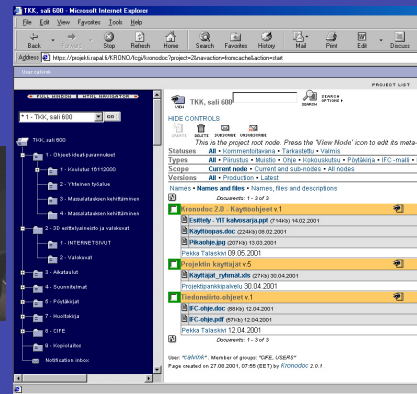
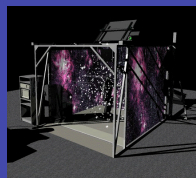
- The new auditorium complex is an addition to the main building (1969) designed by renowned architect Alvar Aalto



- This research focuses on exchanging IFC product model data and on leveraging 3D models for visualization and 4D modeling
- Efficient model and data sharing allows the project team to study more design alternatives, complete thorough analyses of life cycle costs and environmental impacts, produce virtual reality models for group decision making, and improve the construction sequence through 4D visualization

Technologies for Construction Pilot

- 3D and 4D visualizations of architectural design alternatives, lighting schemes, and construction schedule
- Rapid analyses of several design alternatives for life-cycle costs, comfort, cost, energy, and environmental impact based on the same IFC-based product model
- CAVE, project extranet

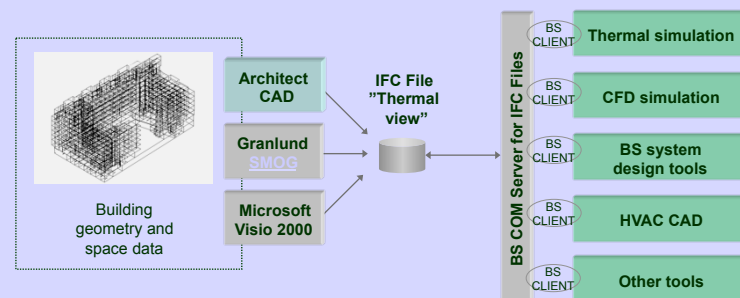


Information Flow

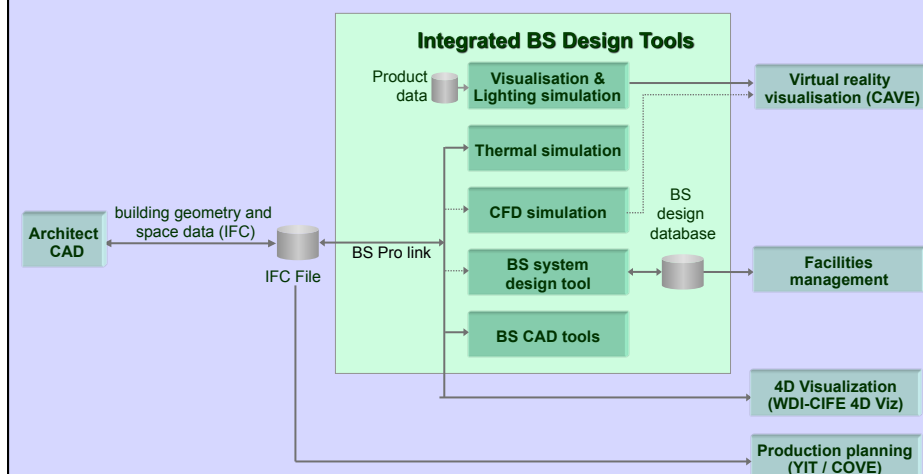
- Granlund has developed BSPro—a middleware tool for exchanging IFC-compliant data

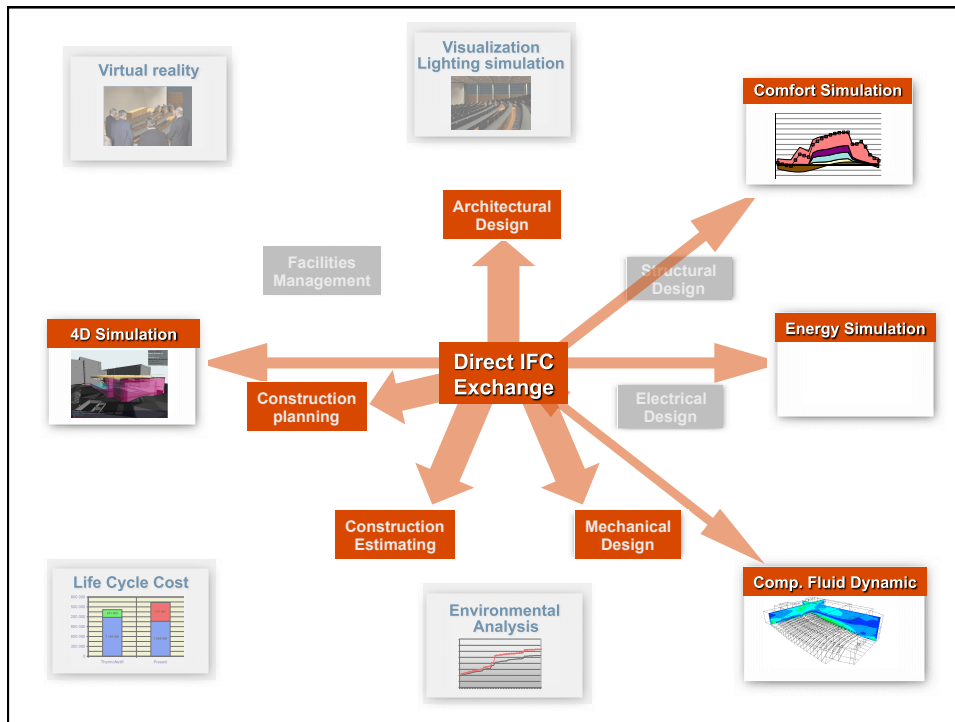


- Current version handles building geometry and thermal data



Information Flow





Architectural Design



- the architects used photomontages to illustrate how design alternatives fit into the existing site context

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Electrical Design

- Granlund designers use VIVA for lighting design and selection



- VIVA is a database which gathers lighting products by different manufacturers

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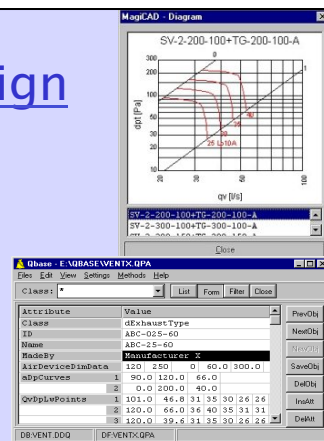
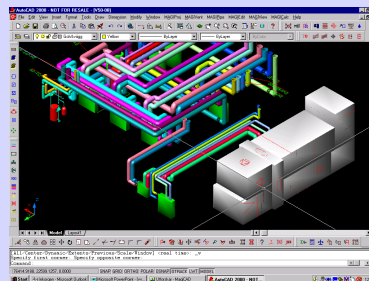
Mechanical Design

- MagiCAD is a 3D CAD tool for HVAC design

MagiCAD
Progman Oy



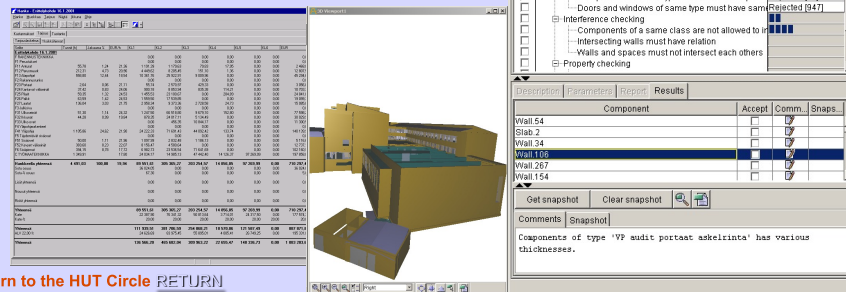
- the selection of HVAC components is linked to the electronic product catalogues from different manufacturers



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Construction Estimating

- COVE (COst and Value Engineering)
YIT's proprietary cost estimating and production planning system
- IFC-compliant
- performs "Design Spell Check",
automatic construction cost estimating

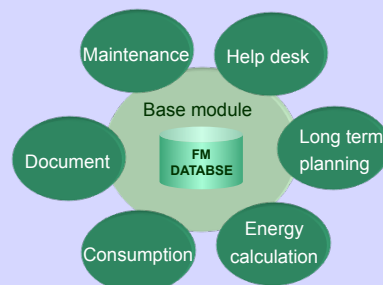


Facility Management

- Granlund has developed a facility management database that is compliant with its design database



- during design, the design team was able to retrieve accurate life cycle maintenance and operating cost data
- during this Fall, the team will begin with the service and management specification
- designers and facility managers will coordinate to transfer data



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Lighting Simulation

- photorealistic study with Lightscape
- lighting simulations and daylighting studies
- links to virtual reality CAVE

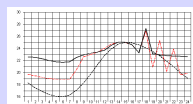
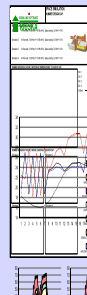
Lightscape



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Comfort Simulation

- RIUSKA—IFC-compliant simulation tool
- imports 3D geometry in IFC format
- determines thermal conditions based on site location, building volume, and internal heating/cooling load
- suggests cooling/heating requirements and air velocities



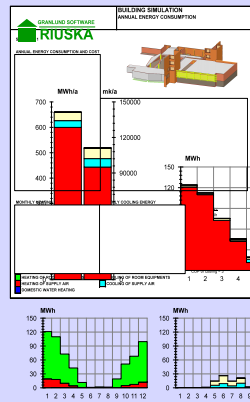
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Energy Simulation

- RIUSKA—IFC-compliant simulation tool



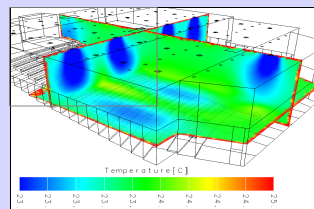
- estimates heating and cooling energy consumption by HVAC system
- accounts for changes in monthly thermal conditions and estimates energy cost



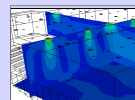
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Computational Fluid Dynamics

- the auditorium has a large volume with high thermal loads
- CFX tool by AEA Technology
- IFC-compliant by Granlund's link—BS Pro
- simulates temperature stratification and air velocities of a proposed HVAC design based on thermal loads generated by RIUSKA

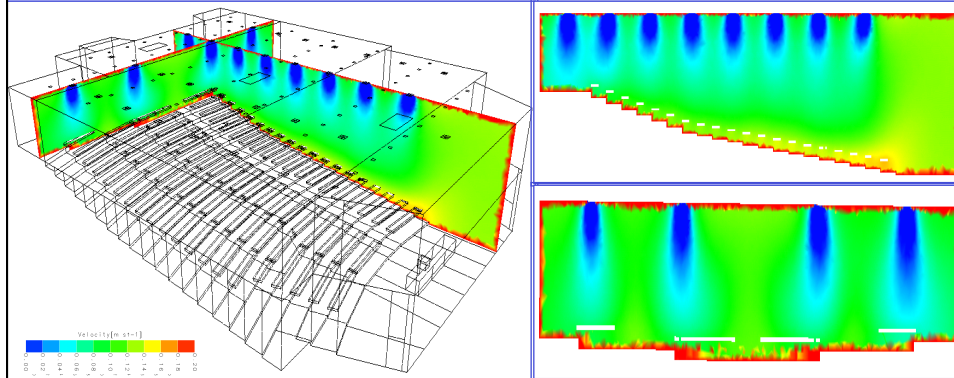


Temperature



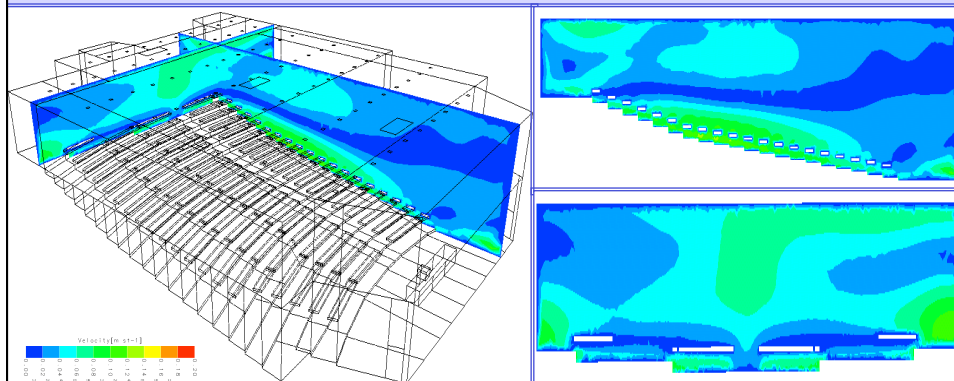
Velocity

Mixed System



- The mixed system shoots conditioned air from the ceiling
- It has a more conventional and simpler design but heat is trapped along the boundary in the auditorium

Displacement System



- The displacement system supplies from beneath and cools the occupants more efficiently
- It requires an underfloor HVAC distribution system

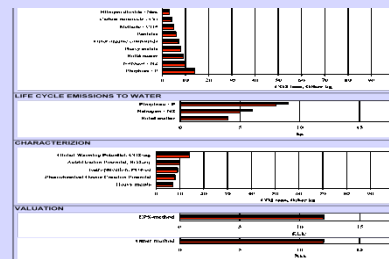
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Environmental Analysis

- BSLCA—an integrated tool and life cycle database for sustainable design



- incorporates building geometry, MEP systems, equipments, and energy consumption throughout the building life cycle
- assesses the impacts of emission from building components to air and water



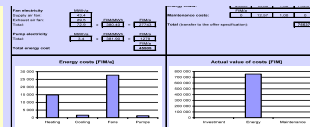
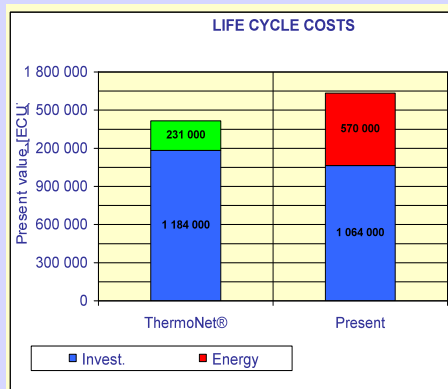
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Life Cycle Cost

- life cycle cost analysis tool for building services design, system comparisons, and flexibility studies



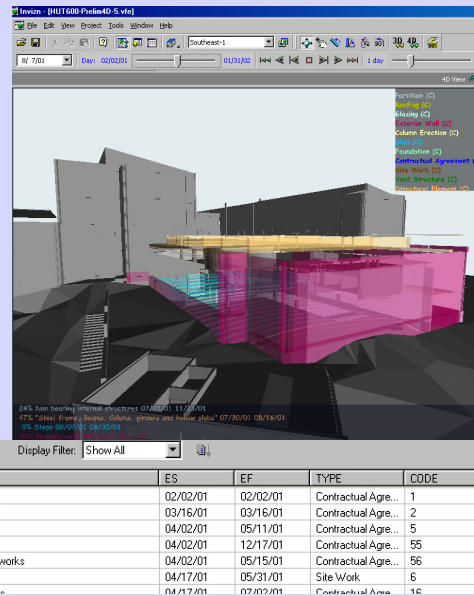
- it leverages facility management data from previous projects to provide cost comparisons during the design phase



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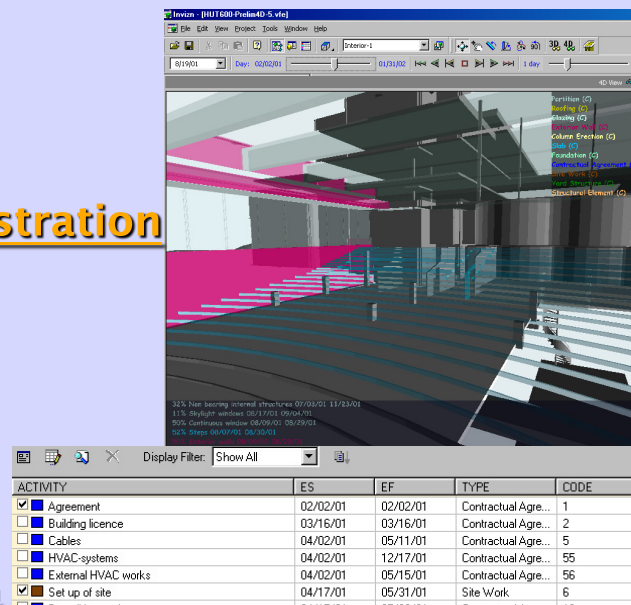
Construction Planning

- experiment with IFC import of 3D building geometry
- the 4D model integrates the construction schedule from YIT
- align 4D view with view from the webcam
- 4D case study in HVAC system with Granlund designers
- during this Fall, there will be 4D case studies in space and facility management



4D Simulation

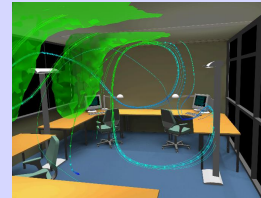
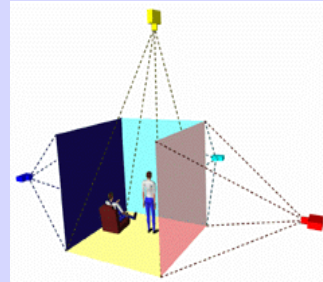
4D Demonstration



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Virtual Reality

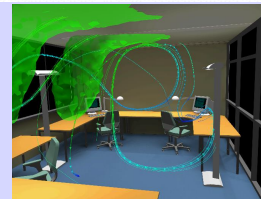
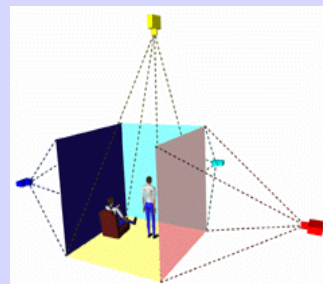
- 3m x 3m (~10ft x 10ft) CAVE room with 3 rear-projectors and 1 top-projector in the Computer Science Dept. at Helsinki University of Technology
- VR navigation by 3D stereoscopic eyeglass equipped with a motion sensor
- end-users navigate through the auditorium and MEP systems in the interstitial space



Virtual Reality

End-users were able to provide valuable inputs during the schematic phase:

- location of the first row
- view from the back rows and the sloping of the lecture hall
- lighting schemes during presentation
- aisle locations



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