Collaboration Technology in Design and Construction

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Collaboration Technology in Design, Construction and Facility Management

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New View to the Industry

REAL ESTATE CLUSTER

- Core Business
- Construction
- Services
- Property Management
- Facility Management
- Asset Management
- Owners
- Users

The Finnish Real Estate Cluster

- Produces and maintains the built environment for business, services and living
- Constitutes the main part, 70%, of the Finnish national assets
- Employs more than 500,000 people = 20% of the work force

Total value of the forest $40 billion
Value of built environment $400 billion
Operations $35 billion
Interest $15 billion

Arto Kiviniemi
Technology Programs
- Extensive programs initiated by Tekes and consisting of numerous projects
- Focused on a key technology sector
- Implemented in co-operation by companies and research units
- Companies can participate with their own projects or by joining in common research projects
- Projects and results are partially public, but the results of industrial projects are proprietary

Vera Program Target
The target is to promote the implementation and use of ICT and networks as the enabling technologies to re-engineer the design, construction and FM processes
Vera Schedule and Budget

- Schedule - six years; 1997 - 2002
- Total volume
  - ~45% by Tekes USD 18 million
  - ~55% by the industry USD 21 million
- Total budget USD 39 million
- Current project allocation
  - Research: 38 projects USD 4.5 million
  - Industrial: 97 projects USD 29.0 million
- Total: 135 projects USD 33.5 million
- URL: http://www.tekes.fi/english/vera/

Information Sharing Problem

The work is mainly done with computers but most of the information is still exchanged on paper, which causes non-value-adding work, friction, data losses and errors.
Goal in the Future

Information is shared in exploitable data format directly between different systems

Information Lifecycle - Project View

Real Life Cycle View?

Client’s core business

Pressure to change

Change adaptation

FM services

Building process

Where are the real benefits of ICT?

Design

Construction

"Common Information Language" - IFC
IFC is only a part of the solution

- IFC is an enabling specification; a component for SW development and implementation
- Solution components:
  - Enabling technologies
  - ICT infrastructure
  - Enabling specifications
  - Software applications
  - Processes
  - People

Effects in the Processes?
Design and Engineering Processes

- Shared models can contain complex rules for behavior and relations between objects
  - Easy and cost efficient evaluation and simulation at any project stage
    - requirement management through the process
    - thermal, lighting and performance simulation
    - more accurate cost estimation
    - environmental evaluation...
  - Semi-automated design integration and code checking
- New service areas for architects & engineers
  - LCA/LCC services
  - Information maintenance
  - FM services...

Helsinki University of Technology - HUT600

A case study in the application of:

*Industry Foundation Classes & 3D/4D Models*

*by Senate Properties, Finland*

Calvin Kam and Martin Fischer

http://www.stanford.edu/group/4D/projects/calvin/PM4D.shtml
Virtual Reality

Visualization

Lighting simulation

4D Simulation

Facilities

Management

Shared IFC

Model & Data

Structural

Design

Construction

planning

Electrical

Design

Life Cycle Cost

Construction

Estimating

Mechanical

Design

Environmental

Analysis

Comfort Simulation

Architectural

Design

Energy Simulation

Comp. Fluid Dynamics

HUT600 Design Sketches
Energy Simulation

- Thermal simulation tool for entire building life cycle
- Currently based on DOE 2.1E
- Developed in collaboration with LBNL
- IFC compliant by BSPro link

Comfort Simulation

- Thermal simulation tool for entire building life cycle
- Currently based on DOE 2.1E
- Developed in collaboration with LBNL
- IFC compliant by BSPro link
CFD Simulation

CFD = Computational Fluid Dynamics

- CFX tool by AEA Technology
- Simulation of temperature stratification and air velocities
- Especially for high spaces with high cooling loads
- IFC compliant by BSPro link

HVAC Design

MagiCAD

- 3D CAD tool for HVAC design
- Manufacturers’ product data
- Links to electronic catalogues
Environmental Analysis (LCA)

- Integrated tool for ecological design
- Buildings, technical systems, equipment
- Throughout the design process
- Granlund’s LCA data libraries

Virtual Reality in EVE

- Helsinki University of Technology, HUT
- Visualisation of a modelled space
- A full size virtual environmental room with three walls
- Data link from 3D visualization and lighting simulation

Future:
Visualisation of thermal conditions
Construction Process

- Wide utilization of design data
- Information as a part of the product:
  - building maintenance database based on as-built information will be delivered as a part of the production
  - eCommerce is not just procurement and transactions; product information must be a part of the eCommerce
    - electronic product libraries with direct interface to design and procurement software and building data models ⇒ IFC compliant XML
- Change requires:
  - process and tool development
  - Project management tools
  - 4D CAD: Time schedule combined to 3D...

Construction Planning

- Experiment with IFC import of 3D building geometry
- 4D model integrated with the construction schedule of YIT
- Align 4D view with view from the web camera
- 4D case study in HVAC system with Granlund designers
- There will be case studies in space and facility management
Solibri Model Checker

- First commercial Design Spell Checking product
  - Released at AEC Systems Show, Chicago June 19th 2001
- VR for visual checking
- Any number of constraints to check
  - Best practices, interferences, escape routes
  - Able to download more constraints
  - IFC support, but no IFC’s structural limitations
- User can adjust most constraints
- User can create new constraints
- Communication with HTML/XML reports

Current System Status at YIT

COVE

Quantity Management

PlaNet+ Scheduling

Tender Calculation

Task Management

Project Database

Delivery Management

Procurement Needs

Delivery Database

Supplier register

Quantity & Locations

Time

Cost Knowledge

Standard Solutions

Method Data Base

Supplier register

Current System Status at YIT
Improved Decision Support

Process target is based on the utilization of existing information:
- Functional needs
- Technical solutions
- YIT-House

More information and alternatives supporting decision making
More information available in earlier project stage

Lifecycle Management

- Key people are the clients; building owners and facility managers.
  - they will have the most benefits
  - they can set the requirements
- Better tools for early decision making
  - LCA and LCC tools
  - maintenance simulations
- Better tools for FM/PM
  - better budgeting tools
  - better utilization of resources
  - better management for preventive maintenance
  - lower costs for maintenance
New Business Concepts

- "Drafting" ⇔ information management
  - paper document ⇔ digital information
  - traditional documents ⇔ product models
  - "document" ⇔ a view of the model from a specified angle at a specified moment
- Technical and juridical problems
- Environmental issues are coming more and more important
- Information will be produced for:
  - decision making and production
  - use and maintenance of buildings
- Minimizing the cost ⇔ maximizing the added value through the whole building life cycle

IFC/XML Model Server

- Freeware component by Yoshinobu Adachi
  - Collaboration project of Secom/Japan and VTT/Finland
- More information at:
  - http://cic.vtt.fi/projects/ifcsvr/
Integration of ICT Systems

- LCA/LCC Analysis,
- Energy Simulation
- Environmental and
- Activity Simulation
- etc

- Owner’s & Client’s
- Requirements

- Object Based Design &
- Engineering Software

- Environmental Data

- Manufacturers
- Data

- Production Planning
- & Production

- COVE
- Tender
- Calculation
- Design
- Management
- Project
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