



Software Interoperability in the AEC/FM Industry

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Topics of the presentation

- Problems in the current use of IT in the construction industry
- Vera: Information Networking in the Construction Process - a national technology program in Finland
- Activities and current situation in IAI
- Effects to the AEC/FM industry



Problems in the Current Use of IT in the Construction Industry

Software Interoperability
in the AEC/FM Industry

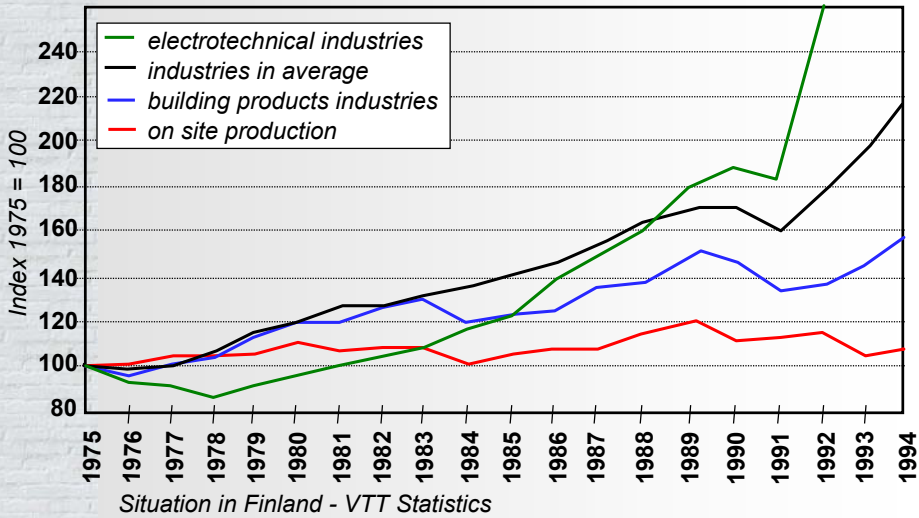


Attitude Problems

- We use IT in most tasks, but we have not yet took the possibilities into efficient use:
 - construction industry is conservative: **“We have been working this way always before, why should we now change something?”**
 - IT has been developed from domain, or even from task perspective, and we produce the information from our own point of view: **“Why should my work give some benefit to the other partners in the project?”**
 - the working methods are mainly the same as before IT: **we have only automated the old tasks**



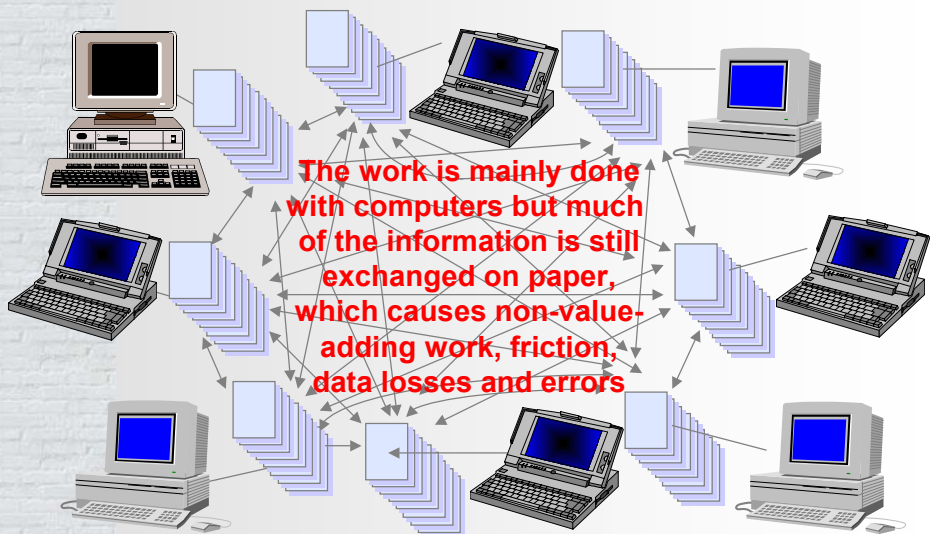
Productivity Increase



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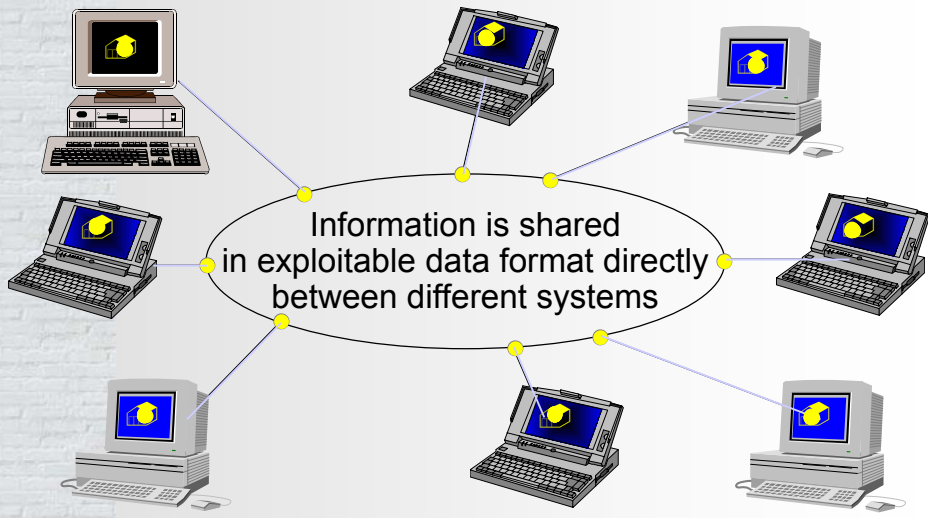
Current Situation



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Goal in the Future



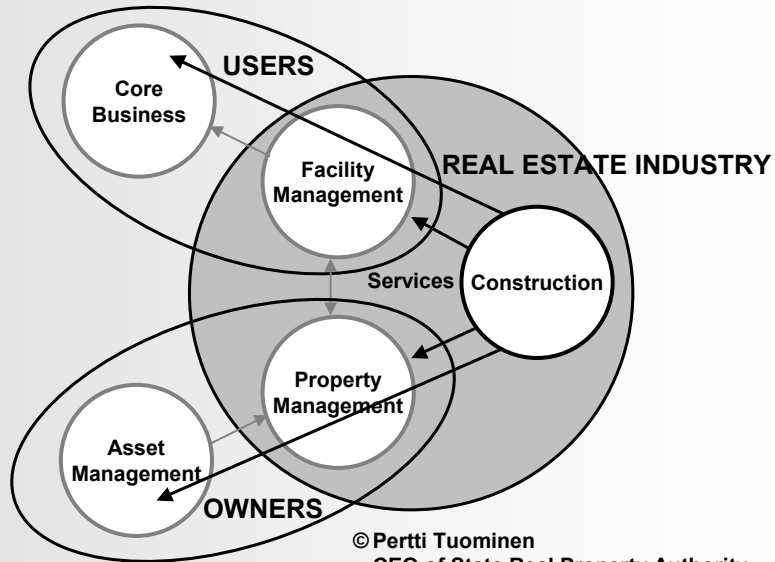
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Driving Force for Changes

- Facility and property management:
 - more complex requirements for buildings
 - more accurate information for FM activities
 - more profit for the investments in buildings
 - inflation does not help as it used to do
 - environmental and life cycle cost issues are coming more and more important
- The need to improve productivity
 - removal of non-value adding work
 - re-use of information
 - better process and information management

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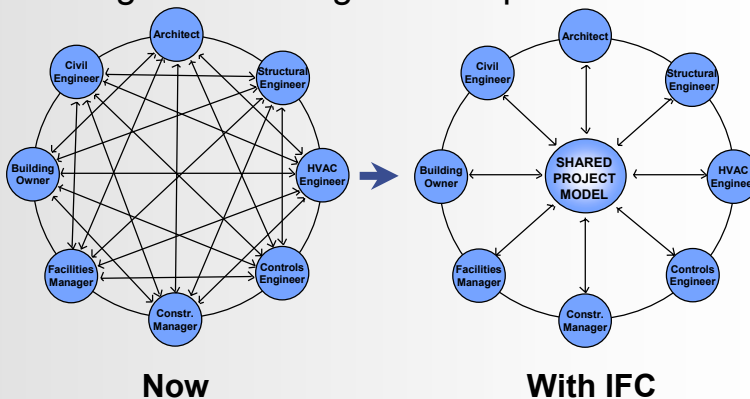


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CEO of State Real Property Authority

- Software technologies
 - product model development - IFC, STEP
 - object oriented software
 - middleware, model servers, data repositories
- Information networks
 - virtual workgroups
 - project data access
 - product data access
 - information management through web
 - Internet commerce

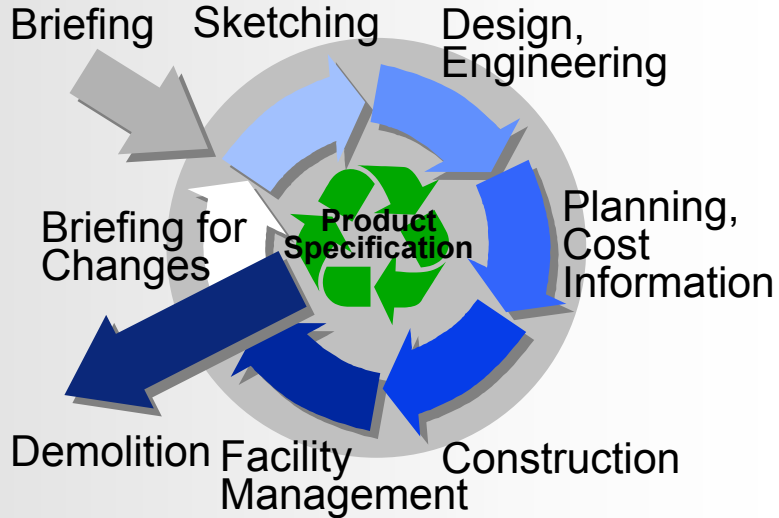
- AEC/FM industry is an information intensive branch:
 - all design and engineering activities
 - procurement and delivery control
 - call for bids, making offers and comparing alternatives
 - contract management
 - cost and utilisation degree control
 - maintenance planning and budgeting
 - technical and security system control in buildings...

- Goal: Continuous maintenance of project data through to building management
- Way: Building information rather than drawing data to integrate disciplines





Information Lifecycle



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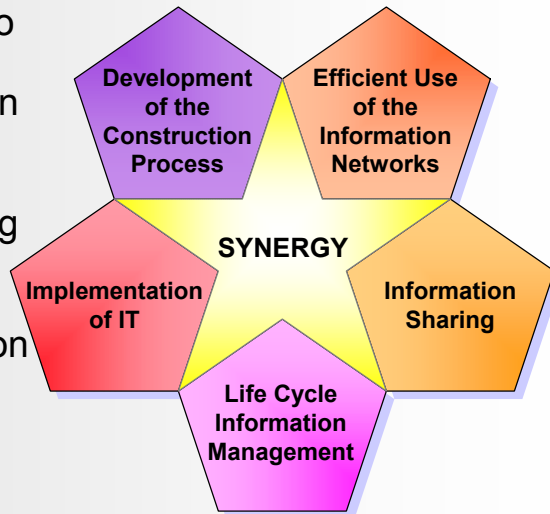
Vera - Information Networking in the Construction Process a National Construction IT Programme

Software Interoperability
in the AEC/FM Industry



Programme Components

The target is to promote the implementation and use of IT and networks as the enabling technologies to re-engineer the construction process



Vera Program

- Schedule - six years; 1997 - 2002
- Volume
 - 40 % by Tekes 70 million Fim (13 million \$)
 - 60 % by the industry 100 million Fim (17 million \$)
 - Total budget 170 million Fim (30 million \$)
- Current situation
 - Research projects: 24 / 12 million Fim (2 million \$)
 - Industrial projects: 56 / 73 million Fim (13 million \$)
 - Total: 80 projects / 85 million Fim (15 Million \$)



Why are we supporting IFC ?

- One of the key elements for Vera programme is the information sharing
 - urgent need for a common “software language”
- IAI started at the right time for us
 - incremental development enables immediate implementation
 - IAI is the most active area on the data definition for construction industry
 - same modeling language with STEP ⇒ some areas can expand also to ISO work in the future

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Activities and Current Situation in IAI

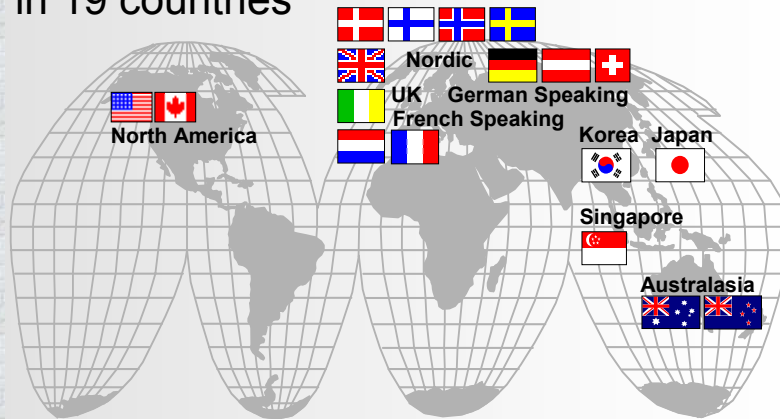
International Alliance for Interoperability

Software Interoperability
in the AEC/FM Industry



IAI membership

- Currently 9 Chapters
- More than 600 member organisations in 19 countries



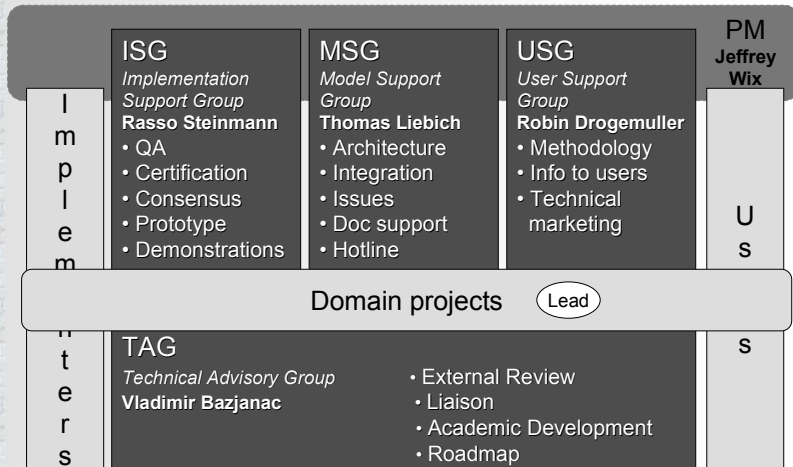
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Current IAI Organisation

International Council / Executive Committee
Chair **Arto Kiviniemi** Chair + 2 / Chapter

International Technical Management
Temporary Chair **Takayori Takamoto** TCs + PM + Leads



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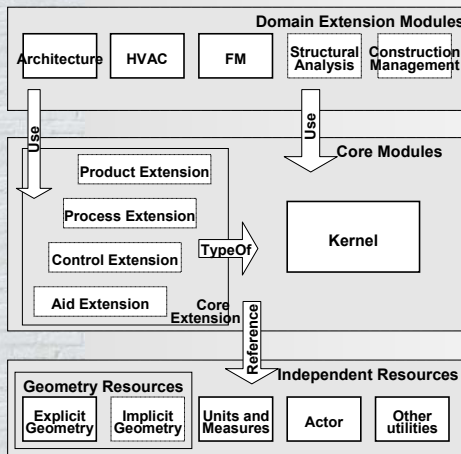
IFC Release History

- IFC R1.0 in January '97
 - Very limited scope, main results:
 - experiences for further IFC development
 - demo implementations from 17 companies
- IFC R1.5 in November '97
 - model architecture improvement with plug-in extensions
- IFC R1.5.1 in September/December '98
 - Development parallel with IFC R2.0 work
 - The first commercial products with IFC support are based on R1.5.1

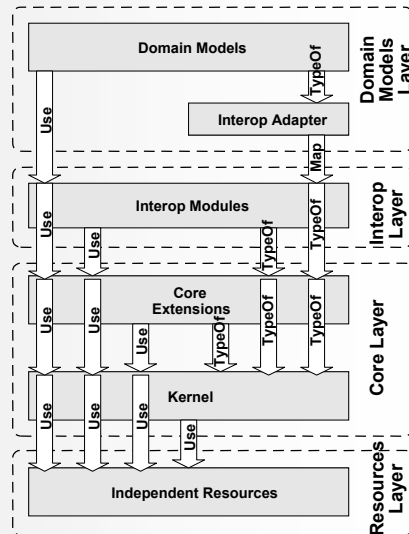
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IFC R1.0 and R1.5 Architecture



IFC R1.0



IFC R1.5

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IFC Release 2.0

- Scope
 - Architecture extensions
 - HVAC systems
 - Code checking
 - Cost estimating
 - FM - Occupant move management, property management
 - General purpose networks
 - External document references
- IFC R2.0 was published in April 1999

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IFC R2.0 Team



Technical Director
Richard See



Yoshinobu Adachi



Robin Drogemuller



Jim Forester



Jiri Hietanen



Juha Hyvärinen



Kari Karstila



Thomas Liebich



Jeffrey Wix

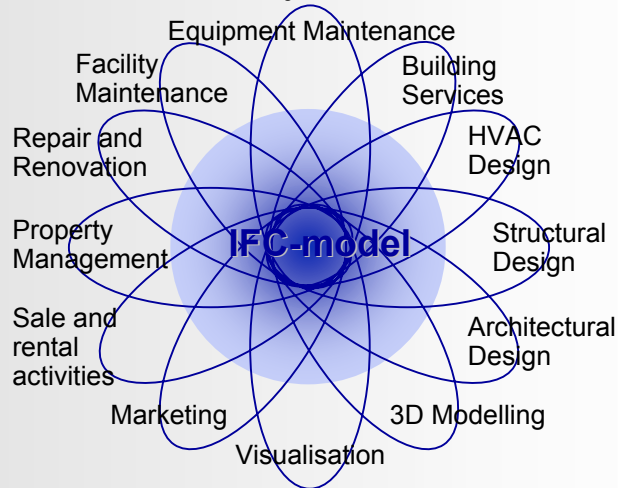


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Coverage of the IFC Model

- Many activities in the building industry and FM tasks, only the basic information



Expected Products - R1.5.1

- Expected products with IFC 1.5.1 support ⇒ 41
- Vendors shipping products with IFC 1.5.1 interface:
 - acadGraph - Alberti for spatial design
 - Autodesk - IFC extension to AutoCAD Architectural Desktop 1 downloadable from web, ADT 2 will include IFC 1.5.1 support
 - NEC - NcadArc, architectural CAD
 - Nemetschek - IFC interface in Allplan FT
 - Olof Granlund - IFC interface to SMOG and Riuska(thermal performance simulation)
- Vendors announced IFC 1.5.1 products early 1999:
 - AIO Group - IFC interface to PointARXi
 - Fujitsu, architectural CAD
 - Graphisoft - IFC extension to ArchiCAD 6.0
 - M&M - RoCAD, HVAC engineering
 - MB Software - low-cost architectural CAD
 - Sofistik - SofiCAD, structural engineering



Expected Products - R2

- Vendors who have announced IFC 2 support
 - AIO Group - PointARXi, architectural CAD
 - Autodesk - Architectural Desktop 3.0 and CAD platform
 - Bentley - MicroStation and CAD platform
 - DOE-PNNL -energy code checking
 - Graphisoft - ArchiCAD
 - LBNL - visualization
 - NEC - NcadArc, architectural CAD
 - Nemetschek - CAD for architects, CAD and FEM for structural engineers, CAD for contractors and FM software
 - Olof Granlund - SMOG and Riuska (thermal performance simulation)
 - Progman - MagiCAD, HVAC CAD
 - Timberline - cost estimation
 - Visio - 2D-CAD
 - YIT - COVE, process management for contractor



IFC Toolboxes and platforms

- Concad: C++ library for read/write IFC files
- CSTB: SDAI platform
 - a generic STEP platform for any EXPRESS schema (late binding)
 - a dedicated IFC toolbox with the IFC schema (early binding)
- MUIGG: Active-IFC
 - Active-X control to retrieve IFC-files
- Nemetschek: late binding data sharing platform (middleware) called o/p/e/n®
- CSIRO: Product modelling tools
- VTT: Promote - IFC browser
 - generates Java classes from any EXPRESS schema and VRML from geometry
 - supports access to distributed models in client/server mode over the Internet



Relation with ISO/STEP

- Liaison status 1997
- MoU in June 1998
- Agreed action items:
 - Joint IAI ITM/STEP meetings
 - Develop links between IFC and Part 225
 - Develop links between IFC and Part 230
 - Joint trial interpretation of elements of IFC Core (as part 106)
 - Collaborate on the CDS and DXF2 drawing exchange developments
 - Review EXPRESS 2 specification
 - Investigate the most appropriate approach to standardisation of IFC
 - IAI documents are publicly available for STEP members



IFC Release R2.x and R3.0

- IFC R2.x
 - model improvements based on early implementation
 - core stabilisation
 - up- and downward compatibility
 - no new functionalities
 - available in December 1999 or March 2000
- IFC R3.0
 - domain project work is continuing
 - modelling starts in the beginning of 2000
 - available in the end of 2000



Current Problems in IAI

- Main problem is the lack of funding and resources
- Most of the resources available for 1999 were spent in IFC R2.0
- Some different views on R2.x
 - extent
 - scope
 - schedule



Evidence of Success

- 3 major & 1 minor releases in 3.5 years
- IFC R2.0 on schedule & under budget
- Integrated AEC/FM information model
 - vocabulary of 400 object types
- Requirements of 16 IFC R3.0 domain projects nearly complete with improved quality
- On-going implementation efforts:
 - 33 vendors have demonstrated software
 - 5 software vendors have R1.5.1 products or extension modules available, 6 more will ship later this year
 - 13 software vendors have announced R2 support
 - 6 toolboxes available
- Increasing visibility on many levels:
 - press, research conferences and papers
 - AEC/FM industry customer awareness



Future Technologies

- First interoperable software generation(s) will be based on data transfer
- Next generations will be based more on data sharing - runtime interoperability
 - middleware
 - model servers
 - data repositories...
- The change to data sharing is not only technical - it is even more cultural
 - new work processes
 - true co-operation in projects
 - education...

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Effects to the AEC/FM Industry

Software Interoperability
in the AEC/FM Industry



Design and Engineering Processes

- "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
 - these views will be produced from the data by the actor who needs it
 - technical and juridical problems
- Information will be produced for:
 - decision making and production
 - use and maintenance of buildings



Design and Engineering Processes

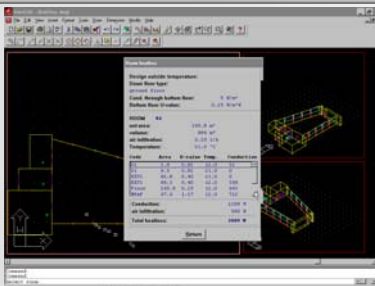
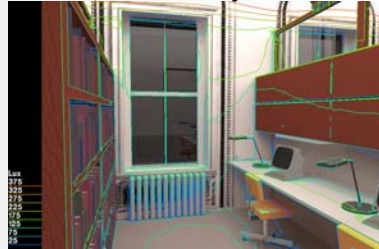
- Models can contain complex rules for behaviour and relations between objects
 - (semi)automated design integration and code checking
 - easy and cost efficient evaluation and simulation at any project stage
 - thermal, lighting and performance simulation
 - more accurate cost estimation
- New service areas for designers/engineers
 - LCC analyses
 - information maintenance
 - FM services...



Viva - a lighting design and simulation tool by Olof Granlund



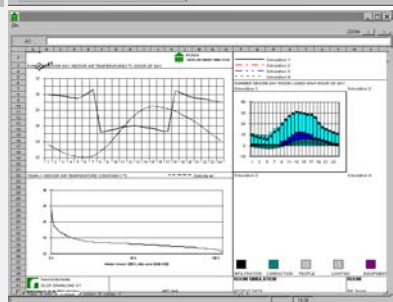
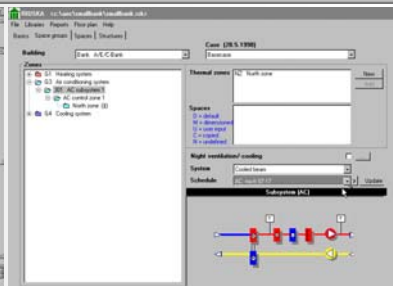
IFC R2.0 SI-1: Photo Accurate Visualisation, Vladimir Bazjanac/LBNL



SMOG

(Space Modeler of Olof Granlund)

- use of IFC building objects
- based on the DOE simulation engine
- IFC R1.5.1 version available
- IFC R2.0 in development





Construction Process

- information as a part of the product:
 - building maintenance database based on as-built information
 - product information as a part of the electronic procurement and commerce
 - electronic product libraries with direct interface to design and procurement software and building data models
 - EDI support also to product information exchange and management
- change will not happen if the lowest price is the only selection criteria



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
 - lifecycle cost and maintenance simulations
- Better tools for FM/PM
 - less unused spaces
 - better management for preventive maintenance
 - better budgeting and lower costs for maintenance



Some Studies of Potential Savings

- Germany
 - savings of US\$ 1 billion/year just by improving the quality of DXF data
 - hypothesis: work decrease of 50% in the receiving company
 - in USA this would equal to US\$ 3 billion
 - *Wolfgang Haas 1998*
- Finland
 - potential savings of 7% in the construction costs by efficient IT use
 - this did not include any savings which could come by reducing errors with better information management
 - *Enkovaara & Heikkonen 1998*
- AEC3 (several countries)
 - removal of information re-keying would enable savings of 16% in the construction
 - *Thomas Liebich & Jeffrey Wix 1999*

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Cost savings through innovation

Brian Atkin, Professor, KTH, Stockholm

- Introduce value management - save 18%
- Hold value engineering workshops - save 9%
- Use IT extensively - save 12%
- Introduce partnering - save 11%
- Provide clear incentives for performance - save 7%
- And there is more...
- Add all of these and other measures together and you end up with a 143% cost saving!

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Cost savings through innovation

Brian Atkin, Professor, KTH, Stockholm

- So, why are buildings not free?
- Because you cannot tinker around with parts of a process in isolation and hope to make a dramatic difference overall.
- An integrated process is just that.
- Playing around with part of the problem won't do - building bigger mouse traps is not enough.

- The future is clear enough and we can have it - if we want it!