IFC-based Product Model Exchange

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CIFE Summer Program 2001
Stanford University, CA
September 13, 2001
Granlund Today

Figures

- Founded 1960
- Personnel 260
- Export 15%
- Turnover 88 milj. FIM (14 mill. USD)

Activities

- Building services (BS) design
- Facilities management (FM) consulting
- Software development for Design and FM
- Building life cycle data management

Offices

Granlund Kuopio
Granlund Vaasa
Granlund Tampere
Granlund Lahti
Granlund Eesti Tallinn
Granlund Helsinki
The Integrated Building Design and Construction Process

- Performance and cost targets for the building Collaboration
- Continuous maintenance of project data through the whole building life cycle
- Communication between disciplines and project phases
- Re-use of design data
- Use of design and performance analysis models and tools for component and system optimization
- Interoperability between different software
- Internet (Project Management & eBusiness)
- Collaboration and partnership among building owners, architects, engineers, financiers and other key players
Integrated Design Process Tools

Simulation and analysis tools

Comfort Simulation

Energy Simulation

Life cycle analysis LCC / LCA

CFD Simulation

Visualization Lighting simulation

3D model of the building (IFC)

Design, production and FM tools

Architect design

Structural design

HVAC design

Production planning

Facilities management

4D Simulation

Virtual reality

Design, production and FM tools

September 13, 2001
IFC Object Model is "enabling interoperability between AEC/FM applications from different software vendors"

IFC information Axes:
- disciplines involved in AEC/FM processes
- life-cycle stages of AEC/FM projects
- level of detail required
- software applications used

IFC model has to be structured:
- diversification to cope with various information axes
- centralization to harmonize and integrate the various modules
Some possible IFC use cases

- Exchange of basic building model with 3D shape between CAD systems
- Visualisation of building model
- Building design ⇒ Time scheduling
- Building design ⇒ Quantity take-off ⇒ Cost estimation
- Building design ⇒ HVAC design ⇒ Thermal load calculations
- Space and surface temperature calculation ⇒ CFD-modelling
- HVAC design ⇒ Energy code checking
- Building design ⇒ Basic structural design
- Building design ⇒ FM / Maintenance
- Building design ⇒ FM / Occupancy planning
Vision of BS Software Integration

Design
- Systems
- CAD
- Comfort
- Energy
- LCC
- LCA
- Products

Construction
- Systems
- CAD
- Products
- Commissioning
- 4D CAD

Maintenance
- Systems
- Maintenance
- Documents
- Help desk
- Consumption
- Products

MIDDLE WARE TOOL - BSPro ComServer for IFC files

ARCH CAD → IFC → IFC FILE → IFC ➔ Other IFC compliant software

Life cycle data repository for building services
Managing IAQ and Thermal Conditions

- ELECTRICAL ENERGY
- CONDENSING ENERGY
- CHILLER
- EXHAUST AIR
- SUPPLY AIR
- ENERGY STORAGE
- HEAT PRODUCTION
- COOLING PANELS
- LIGHTING
- INTERNAL LOADS
- EXTERNAL LOADS
- WINDOW
- ENVELOP
Life Cycle Data Management

BUILDING SERVICES DESIGN

- Design tools
  - System Design
  - 3D Modeling
  - Simulation
  - LCC
  - LCA
  - CFD
  - Visualization

CAD

3D space model

CONSTRUCTION COMMISSIONING

Building services database

As-built data Commissioning

FACILITIES MANAGEMENT

Technical facilities management

FM Tool

Other facilities management systems

Data exchange links

Building automation
• A middleware tool for exchanging IFC-compliant data
• Easy linking of new and existing software
• Current version handles building geometry and thermal data
• Based on Microsoft’s COM technology

Alternative 1:
IFC compliant architect CAD tools

Alternative 2:
Granlund’s 3D modeler

Alternative 3:
Other IFC compliant 3D modeling tools

Architect CAD

Granlund SMOG

Microsoft Visio 2002

Building geometry and space data (IFC)
Integration of BS Design Tools

PM4D Project / HUT 600 Auditorium Case

Integrated BS Design Tools

- Visualisation & Lighting simulation
- Thermal simulation
- CFD simulation
- BS system design tool
- BS CAD tools
- Virtual reality visualisation (CAVE)
- Facilities management
- Production planning (YIT / COVE)
- 4D simulation (CIFE / SRPA / YIT)

Architect CAD

Drawings (DWG)

Building geometry and space data (IFC)

BSPro link

IFC File "Thermal view"

Product data
Visualization and Lighting Simulation

Photorealistic visualizations

Lighting simulations

Links to product data
CFX is a product of AEA Technology
- Simulation of temperature stratification and air velocities
- Especially for high spaces with high cooling loads
- IFC compliant by BSPro link
- Visualization of a certain moment or animation
MagiCAD

- 3D CAD tool for HVAC design
- Manufacturers’ product data
- Links to electronic catalogues
HVAC Design - 3D views from Product Model
3D Product Model of HVAC System

HUT 600 Auditorium Case
Environmental Analysis (LCA)

- Integrated tool for ecological design
- Buildings, technical systems and equipment
- Throughout the design process
- Granlund’s LCA data libraries
“Live”-demonstration description

Architectural Design
3D CAD

Space Modeling
3D CAD

Architectural Design
3D CAD

HVAC - Design
3D CAD

Design Tools

IFC Middleware

Analysis Tools

Internet

Architectural Design
3D CAD

AUTODESK

ADT

OLOF GRANLUND

SMOG

GRAPHISOFT

ArchiCAD

PROGMAN

MagiCAD

BSPro COM-Server for IFC Files

OLOF GRANLUND

IFC File

COVE

YIT

VRML

4D CAD

CIFE

RIUSKA

OLOF GRANLUND

4D -simulation

Cooling load / Energy calculation Tool

Cost and Value Engineering

Virtual Reality Model
 Agenda for the CIFE Workshop session

Martin F. :
• Open the session

Jarmo L. :
• Speaks about COVE

Reijo H. :
• Speaks about model exchange

Antti K. :
• Live demo about the model exchange.

• LUNCH
• Hands-on Session

IFC FILE CREATED BY AN ARCHITECT

CAD SOFTWARE
Show the IFC based building geometry created by an architect

RIUSKA - THERMAL SIMULATION
Import the IFC geometry and perform thermal simulations, export thermal data to IFC

MAGICAD - HVAC DESIGN SOFTWARE
Import the IFC geometry and thermal data, design the air ducting system, export the ducting geometry to IFC

CAD SOFTWARE
Show the IFC geometry now with the air ducting system

COVE
Demonstration
IAI and Development of IFC
Defining IFC (Industry Foundation Classes), a product data model specification describing buildings
First commercial IFC implementations available
9 Chapters, more than 650 member organizations in 20 countries

Mission: To enable software interoperability in the AEC/FM industry.

- AEC/FM industry professionals working with software professionals to define standard exchange specification IFCs, open for implementation and use by all software vendors.
- Design for specification to be extensible, evolving over time, providing global solution.
IAI / IFC, the Big Picture

Building & information life-cycle

Building construction process

IT support & Interoperability

FM

Client

Designers

Suppliers

Constructors

Software + IFC interfaces

AEC Software industry

Implementer A

Implementer B

Implementer Z

IAI

ISG

Implementation expertise

Enabling specification

IFC Specification

Certification procedures

IFC

Modelling expertise

R&D expertise

MSG

TAG

USG & Domain projects

Communication

Business management

Awareness & Resources

Industry Requirements

Software certification

IAI / IFC, the Big Picture
Current Status of IFCs

- Architecture
- Lighting
- Structural Engineering
- Electrical Engineering
- HVAC
- Civil Engineering
- Fire Protection
- Cost Estimating
- Value Engineering
- Procurement
- Construction
- Site Planning
- Programming
- Facilities Management
- Simulation
- Catalogues
- Codes and Standards
- Commissioning
- Lighting
- Electrical
- Simulation
- Codes and Standards
- Commissioning
- Procurement
- Construction
- Site Planning
- Programming
- Facilities Management

Arto Kiviniemi

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### Concepts Supported in the Current IFCs

**Cross industry**
- projects, buildings, building storeys, design grids, constraints (design, building codes, budgets), networks (topology), library links over Internet

**Architectural design**
- spaces, walls, doors, windows, columns, beams, floors, roof slabs, curtain walls, roofs, stairs, ramps, restrooms, elevators, escalators, cabinets, counters, accessories

**HVAC design**
- HVAC equipment (all kinds), ducting and piping systems, thermal load calculations

**Construction Management**
- costs & cost schedules (for quantities and cost estimating), work tasks & work groups (for work planning & scheduling)

**Facilities management**
- furniture, office equipment, occupants, panel systems, asset information, work orders & move plans (for occupancy planning / move management)

**Building codes**
- energy code checking, occupant escape from fire, handicapped access to buildings
IFC Releases

• Software products supporting R1.5.1 available, first certified in May 2000
• Support for R2.0 being implemented in software, certification of 12 products in May, 2001
• IFC 2x specification being finalised and published in October 2000
  – Providing a stable core specification, a "platform" for future extensions
• IFC 2x implementation ongoing within ISG, pre-products late 2001, first certifications in May, 2002
• Release 3 projects to extend IFC 2x running, specifications expected in 2001
Active IFC - Implementers

Certified Products:

- Autodesk (ADT) IFC 1.5.1
- Claire project (IFC Viewer) IFC 2.0
- Data Design System (E-, HVAC-, Construction Partner) IFC 1.5.1
- Graphisoft (ArchiCAD) IFC 1.5.1 and IFC 2.0
- Han Dataport (Elite NT Architect) IFC 1.5.1
- Olof Granlund Oy (BSPro, Riuska) IFC 1.5.1 and IFC 2.0
- LBNL (BSClient for Energy+) IFC 2.0
- Microsoft (Visio 2002 Professional) IFC 2.0
- Nemetschek (Allplan) IFC 1.5.1
- PNNL (COMcheck-EZ) IFC 2.0
- Skanska (Facets) IFC 2.0
- Solibri (Model Checker) IFC 2.0
- Tomberline (PECAD) IFC 2.0
- TOPS (IFC to VRML Converter) IFC 2.0
- YIT (COVE) IFC 2.0
- Eurostep (IFC Toolbox) IFC 2.0
**Key implementers**

- Autodesk (CAD)
- Bentley System (CAD)
- Graphisoft (CAD)
- Nemetschek (CAD)
  + Olof Granlund (M+E)
- Data Design Systems (M+E)
- Han Dataport (Architecture)
- Vizelia (FM)
- Nova Sprint (Code checking)

**Milestones**

- pre-products at ACS 2001 (Frankfurt - November)
- Certification - May 2002
- products from mid 2002

**Current status**

- first sample files (for co-ordination view) ready
IFC and XML - One possible interpretation

Complex information structures

Flat information structures

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& Kari Karstila/Eurostep
BS-8 Project

• IAI Project: Building Services project number 8
• Completion of the IFC HVAC extension schemata
  • HVAC equipment
  • HVAC systems
  • Controls
  • Connectivity

• Participation
  • Seven organizations in five countries

• Support
  • Governments (Australia, EU, Finland and U.S. - federal and state)
  • Private sector (Finnish and French)
BS-8 Project Goals

- Extend IFC schemata to support the modeling and simulation of HVAC components and systems
- Support the use of various building simulation tools
- Import information from upstream applications in *.ifc or XML format
  - Building geometry
  - General and performance specifications of materials
  - General and performance specifications of equipment and furnishings
- Export information to downstream applications in *.ifc or XML format
  - Other HVAC applications
  - Cost estimating applications
  - Commissioning and building operations/maintenance software
  - Code-checking applications
  - Software that serves utility companies
  - Many other types of applications

Vladimir Bazjanac, LBNL
Processes Supported by BS-8

- Fully supported process: Building energy performance simulation
- Implicitly supported processes
  1. Dynamic load estimation
  2. HVAC design
  3. HVAC equipment selection
  4. Measurement and verification (HVAC view)
  5. Building performance metrics (HVAC view)
  6. HVAC system and equipment commissioning
  7. HVAC system and equipment retrofit
  8. HVAC system and equipment physical layout
  9. HVAC system and equipment product data (catalogues, external data bases)
BS-8 Project IAI Schedule

2000
IFC 2.0
Development
Implementation - First commercial applications

2001
IFC 2x
Development
Review
Document
Implementation - First commercial applications

2002
Certification

2003
IFC 3.0
Project preparation & schemata development
Integration & documentation

BS-8
Schemata development
Review & Integration & testing implementation

Vladimir Bazjanac, LBNL
BS-8 Info Exchange

• Project web site:
  http://eetd.lbl.gov/btd/iai/bs8
  • file depository
  • issues/resolution log
  • up-to-date project information

• Project contact:

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## More Info About Integrated Design Tools

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<td><a href="http://iaiweb.lbl.gov">http://iaiweb.lbl.gov</a></td>
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<td>BLIS - web site</td>
<td><a href="http://www.blis-project.org">http://www.blis-project.org</a></td>
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<td>IFC - certified commercial software tools</td>
<td><a href="http://www.bauwesen.fh-muenchen.de/iai/ImplementationOverview.htm">http://www.bauwesen.fh-muenchen.de/iai/ImplementationOverview.htm</a></td>
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