THE ROADMAP PROJECT

The Four Possible Scenarios and Roadmaps to the Future of the Product Models in FM/AEC Industry
Tapio Koivu
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  • technologies
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• Conclusions
Part I, INTRODUCTION

• Data and knowledge for formulating IT-strategies in the FM/AEC industry is scattered, decisions are mostly based on narrow views and result in sub-optimal solutions

• Lots of uncertainty on a number of long-term, non-cyclic trends, such as
  • The adapting of 3D and 4D design and object oriented software to the industry
  • Common standards for interoperability
  • The business processes, role of the facility managers and owners as demanding customers
  • The awareness of life-cycle economics
Purpose

• To give an overview of what is likely to affect the development and use of product models and interoperable software
• To give alternatives for strategy formation
• To challenge existing paradigms
• To help identify alternative R&D agendas
Point-of-Departure

- Pre-studies and research fellowship at CIFE
- Data and knowledge collection:
  - Interviews
  - Delphi survey
  - Literature (state-of-the-art)
  - Seminars
- Identified technologies and trends
  - State-of-the-art report as a basis
About forecasts...

“Forecasts are like self-fulfilling prophecies. If there is consensus on where the action shall be, this is where it will be. It is where the competitive battles will be fought and where the main thrust of research and development will be. It is somewhat like fashion: you can’t go wrong if you are fashionably dressed. Running with the pack gives a sort of safety in numbers, and the knowledge that these areas are dynamic opens up opportunities for innovation”
Scenarios

• “Painting concrete and vivid narratives of the future that hinge on key uncertainties whose outcomes will shape the future environment”
• “Disciplined stories about the future”
• Generates alternatives of how various elements might interact under different assumptions
About making Scenarios

• **Used for providing information on the external environment, future demands and technology interaction for corporate planning**

• **Useful when**
  - macroscopic factors need to be included
  - long-term time frames are required
  - static descriptions of future environments are useful
  - great uncertainty surrounds the problem
  - data are scarce, unavailable or very expensive
  - non-quantative factors must be included

• **Not useful for**
  - very detailed problems
  - middle management decision making
A Roadmap

• **Definition:** Identification of elements, issues, & paths towards a defined goal

• **Scope:**
  • FM/AEC industry globally
  • View: IT/computer modeling

• **Purpose:**
  • coordination
  • prioritization
  • sequencing, giving sense of timeline
  • persuasion, marketing
  • identification of the context/relationships
  • identification of gaps, risks, factors speeding up/slowing down wanted/unwanted development
Technology available for everyone

Technology, by which advantages can be gained

Competitive advantages are seen, but the technology is not yet implemented

Interesting, but the impact is unknown

Identifying technologies

Base

Key

Pacing

Emerging
Emerging technologies

• Model translators
  • New software technology enabling of mapping of a model scema with another model scema (replacing the use of one standardized scema)

• Model servers
  • New software or applications capable of handling the product model so that only changed data need to be transferred or updated with a central data warehouse with a product model

• Technologies embedding model data into physical buildings
  • Virtual product model capable of communicating with the actual building itself and communicating with its physical systems

• Use of all “three levels” of wireless data transfers
  • Getting the best out of “WAN, LAN and PAN” to create “killer applications”

• Embedding product model data to the building production equipment and machinery
  • Measuring or surveying devices using product model data for faster and more precise measurements, building equipment - even robotized ones - using the product model data, etc..
Emerging technologies, cont..

- New optimization, simulation and visualization technologies
  - “Stereoscopic 4D”, true use of “virtual reality goggles” on site on-line with the product model
- New “mediator” technologies, use of the “next generation” internet
  - Technologies enabling use of internet for searching product data directly to models from one application to other automatically
  - Technologies enabling new ways of doing business on expert services (place a bid on structural analysis in the web, someone provides the service over the net, the buyer and service provider never meet)
Pacing technologies

- Parametric, object oriented product libraries
  - Description of building components and products in a format, which enables the use and customizing of the data according to the needs of the project, for example, colors, measures or shapes can be changed and then the product can be inserted to a model.

- 4D CAD and simulation
  - Combining the element of time to the CAD models, enabling simulation

- Technologies adding intelligence of the product models
  - Self-checking, agents able to independently check the model coherence

- Use of object oriented CAD data for FM solutions
  - Using the information created in the design phase for occupation control, etc. (programs such as the ActiveAsset)

- Mobile technologies
  - Project management and control data to handhelds on sites
  - Wide band wireless -> transfer of pictures, large data sets
Key technologies

- Use of interoperable object oriented software (3D CAD)
- Project extranets featuring project management tools
- Using product libraries over the net
- E-commerce technologies, electronic purchase orders and billing
- Wireless LAN for sites or for a facility
Base technology

- Use of e-mails, point-to-point data transfer
- Use of object oriented CAD, demanding use from other partners
- Data transfer to sites, project extranets, project servers
- Purchase orders through the net
- Document control systems, teamware
- Wireless data transfer
Areas/functions in the need of interoperability

1. Quantity take-off and cost estimating
2. Architectural planning & design, integration with other design functions
3. Product libraries
4. Facilities management, occupancy management, maintenance
5. Development of LCC estimation tools

Source: Delphi Study of this project
What technologies will be important?

TOP 5:
1. Common, standardized product model schemata
2. New internet data exchange or access protocols
3. Model server technology
4. Intelligent agent technology
5. User interfaces

Not in the TOP5:
• 4 D CAD programs
• Graphic visualization technologies
• High-speed, broadband data transfer
• Internet banking and transaction technology
• Surveying technologies (measuring, GPS, ...)
• Wireless communication technologies
• Building automation technologies
• Sensor technology

Source: Delphi Study of this project
Use of product models

• **0-2 years**
  - Scope will be wider
  - More of the existing software packages will be more interoperable

• **3-5 years**
  - Scope will cover most of the information needed in projects
  - Intelligence will emerge (product libraries, simulation, true use of 4D
  - Better accessibility to the data, use of models in FM

• **Over 5 years**
  - More intelligence (model checking)
  - Interaction with building systems, devices and services using mobile connections

Source: Delphi Study of this project
New business??

- **0-2 years**
  - Use of interoperable software within the existing processes

- **3-5 years**
  - Model based design process, designers adding value in new ways
  - Manufacturers able to provide objects, even able to enter assembly markets
  - Market for new middleware solutions emerging

- **Over 5 years**
  - More automation added to FM services
  - Procurement over the internet
  - “Automated” expert services over the internet (checking against codes, etc.)
  - New, intelligent equipment utilizing model data
  - New FM services enabled

- **“Never”**
  - The need for standardized data structures (like IFCs) will cease to exist

Source: Delphi Study of this project
Trends?

- **Proprietary or non-proprietary approach?**
  - Will the vendors believe in the Microsoft model and want to conquer the market or will they base their software development work on open approach allowing users not to depend on one single vendor?

- **Will there be a market for value added services?**
  - Will the industry be able to add value to the end-customer who finally picks up the bill? Will interoperability and product models add to new services which people will pay more or will the orientation be towards cutting costs of the existing process?
  - Will procuring and investing be based on analyzing the economy of the whole life cycle?
Two basic axis

- Added value to the whole life cycle, variety of new products and services, “win-win-win”
- Proprietary, vendor dependent development
- Existing processes, cost minimizing, focus on specific functions
- Non-proprietary, open standards, non-vendor-dependent development
4 Scenarios

Adding value to the user of a building

- Competing camps on vendor-driven platforms
- The cost-effective divide the market
- Value adding service networks emerge
- Optimizing “islands of automation”

Cutting cost
Timing?

In terms of market adoption, we are looking for this point on the time axis.

In terms of product performance, we are looking for this point on the time axis:

Performance

Time

The Technology Adoption Cycle

Innovators
Early Adopters
Early Adopters
Late Adopters
Laggards

the chasm
Identifying different R&D efforts

Risk level, share of public funding

"visionary" projects, result questionable but might turn potential

Risky projects, result foreseen but project might turn into dead end

"Product updates" or productization, results normally to launching activity

Closeness to market
Where will we be in 3, 5 or 10 years?

Adding value to the user of a building

Source: Delphi
Study of this project

<table>
<thead>
<tr>
<th>3</th>
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Proprietary

Non-pro-prietary

Cutting cost
Adding value to the user of a building

Proprietary

Non-proprietary

Cutting cost

3 years
(-1.1, -1.55)

5 years
(0.6, 0.3)

10 years
(2.1, 2.4)

Source: Delphi Study of this project
Other elements

• **Market**
  • High-end and low-end Industry needs
  • Speed of adoption, risk taking
  • Pull or push?
  • How do we cross the chasm?

• **Political and cultural issues**
  • Standards
  • Culture and “net readiness”
  • Coordination of efforts
  • Governmental “imposing”, guidance or enabling measures?

• **Incentives and enablers**
  • Leading role? Who should take it or who is backed up? How?
  • How do we pick also the “high-hanging fruit”?

• **Urgency:**
  • Which are the most burning problems?
Scen1: Value adding service networks emerge

Typical to the scenario:

- Development work initiated by end-user needs and is industry lead, market pull
- Software business is competed and is fast adapting a supportive role
- New potential for value adding services when new challenges face the industry (aging population, demand clean and safe environment..),
- Facility Management profession has developed into value-adding service provider
Typical to Scen1

• Integration of modeling approaches (process, organization, product, …)
• Variety of solutions based on open, industry agreed standards (ranging from building automation systems to life cycle design tools) available
• Use of product model data extended even to building automation or manufacturing devices
• New value propositions and paradigm shape the emergence of solutions and tools
• Construction project modes are dynamically and professionally customized for each according to the market situation and client need, agile contracting networks are able to re-configure themselves without unnecessary transaction costs
How will the market look?

- “Emerging markets” for new expert services or for services during maintenance
- Competition on initial price only is replaced by ability to show best life cycle economy
- The FM professionals are closest to the end of the value chain -> strong role as “wise” customers
- Open data structure standardization enables entry for new software products and services
- Competition is global, project organizations might be set up locally
- Less “fixed roles” for organizations, “virtual contractor” might set up itself for one project and then disappear
Risk characteristics in S1

<table>
<thead>
<tr>
<th>Business Criticality (from the viewpoint of the customers)</th>
<th>High</th>
<th>Low</th>
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</table>
| Vendors/industry                                          | - Re-engineering  
- Leveraging strength  
- Efficiency focused  
- High-risk  | - Cost savings  
- Experience building  
- "Webification"  
- Low-risk  | - New market within existing industry  
- Business models shift  
- New revenue sources  
- Low/moderate risk  |
| Industry/vendors                                          | - Market creation  
- New business model  
- Shift industry dynamics  
- High-risk  | - New market within existing industry  
- Business models shift  
- New revenue sources  
- Low/moderate risk  |
“Killer apps”

- Platforms for “Virtual construction companies” -> way beyond collaboration and bidding tools
- Remote diagnostics and control of a portfolio of facilities, facilities capable of reporting semi-automatically on their own status
- Life cycle economy analysis tool of a product model, life cycle simulation, “virtual life cycle tool”
- Product or building part intelligence in focus, “chip in every light bulb”
Policy options

• Public funding backing up open standards
• Coordination of efforts backed up internationally
  • The role of IAI emphasized
  • Methodologies for “crossing the chasm” developed
• Funding given to the fastest adopters of new technology,
• Taking “collaborative risk” in a network awarded
• Industry, especially Facilities Management in special focus
• Legal issues: Standard contracts re-newed totally, IPR of product models solved
## Value chain & use of technologies

Model server technology serving as a platform,
A family of common model schemas as a basis for the (IFC4.x) software development work,
Standardized exchange protocols (aecXML2010?) in use
Very novel collaboration environments and user interfaces

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<tbody>
<tr>
<td>Intent &amp; concept</td>
<td>Design &amp; pre-const</td>
<td>Delivery config.</td>
<td>Manuf.&amp; assembly</td>
<td>Interfacing user processes</td>
<td>Manag. of user needs</td>
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Mobile Access to site, 3rd gen. Collab. tools
“as built”-models, simulation and visualization of use
Models & bluetooth integrated, Non-traditional processes

Mobile Access to site, 3rd gen. Collab. tools
“as built”-models, simulation and visualization of use
Models & bluetooth integrated, Non-traditional processes
Areas of process re-engineering

Even radically novel delivery modes are formed, the processes align according to end-user needs

- **Model based process**
  - Designers oriented around modeling and objects faster than in S2 or S3
  - Object libraries are in use faster than in S2 or S3

- **Agile, virtual networks**
  - Minimized transaction costs by demolishing bidding as we know it, even eliminating distribution and re-sale
  - Semi-rigid business partnerships form custom delivery processes according to business needs

- **Processes interfacing end-user**
  - Needs specification
  - Selling of optional packages (security, data, automation, etc.)
  - Management of maintenance
Technology Options

- **Platform for model server?**
  - One “universal” model or different partial ones?
  - Peer-to-peer?
- **“IFC Breakthrough”**
  - Balance between implementing and extending scope
- **Integration?**
  - Which functions and how?: Product model-organization-process-actual product and its systems
  - On what level (data bases, transfer protocol, applications)?
  - Who dominates: CAD, ERP or other toolsets?
- **Major advances in value engineering?**
  - Better tools for life cycle economy
  - True understanding of value
  - End-user focus
Technology gaps, yellow zone

Today, we know of opportunities in:
- new types for project collaboration
- Use of intelligent agents to some extent
- Life cycle engineering
- Putting intelligence to objects

We could explore:
- Advanced user interfaces, for example, stereoscopic visualization
- Data mining of project extranets?
- Use of model data to guide building automation
- 5D CAD (3D + time + “what if” -analysis on the model??)
Technology gaps, blue zone

We are now trying out:
• 4D CAD
• Better collaboration tools (iRooms, etc..)
• IFC Data transfer
• Wireless technologies and accessing data better
• Product libraries

We could try apply:
• Model servers
• Wireless tech and “all bandwidths” “2G+2,5G+3G+4,5G”
• Extended collaboration tools
• Parametric building systems or parts
• Ways a IFC compliant product model can provide the right structure for different stages of the process
Technology gaps, red zone

We now have:
- Over 30 IFC certified software packages
- 1-2 pilot construction projects
- Facilities/occupancy managerial software (ArchiFM, Bricsnet)
- 4D solutions
- Digital product catalogues

We also should have:
- Over 100 IFC certified (and quality assured) software packages
- 50 pilots worldwide
- 10 networks of companies hunting for projects where to take advantage of better use of models
- Life cycle ECONOMY tools
- New facility service packages
- Catalogues of objects
Technology roadmaps

Paths for model & system integration
- Mobile access to model data
- Bluetooth & model merger
- ERP and product model merger
- “IFC Breakthrough in its current market”

Paths for modeling technology
- Breakthrough in the use of life cycle data
- Emergence of virtual business networks
- 3G project data banks (including data mining capab.)
- (Virtual) business models based on adding value during whole life cycle

Paths for new service networks

Complexity of the problem

Time

2003 2004 2005 2007 2009 2011
Path to the first breakthrough?

Complexity of the problem

- Pilot projects
- Extended scope
- Model quality assurance in place
- Integration toolkits available
- Integration toolkits in place
- Education and training programs in place
- Agreements on standards and technology linkage
- IPR and Contractual issues solved
- Trade association back-up

Time

2001 2002 2003 2004 2005

“IFC Breakthrough”
Scen2: Speeding up traffic between islands of automation

- **Non-proprietary approach prevailing**
  - Standardization still alive and well
  - Common schemas widely accepted by vendors

- **No efforts in re-engineering, life cycle thinking missing**
  - New business processes or services still missing, vendors align their business according to existing disciplines
  - Life cycle thinking still at its infancy, little added value found from integrating data from design to "down-stream" services

- **Software is looking at improving existing functions**
  - Same transactions but only made faster and more efficient
  - Less paper and printing by better data transfer
  - Somewhat faster lead times by better flow between functions

- **FM industry sees the issue of interoperability as internal to the construction process** (..as long as you keep prices down and deliver on time, everything is ok..)
Islands of Automation in Construction

After the ice period 10,000 years ago the land is still slowly rising and exposing new terrain never before stepped on by man. The challenge is to build bridges between the islands while new islands are constantly appearing.
Typical to S2...

- 3rd party E-commerce services sold to clients, facility managers, designers of different disciplines, contracting companies and manufacturers,
- Numerous different vendors offering a variety of services, no definite market leaders
- Interoperability still relying on open standardization, IAI is still alive, but other similar efforts compete
- Possibly different standards for production, organizational and geometrical data, very little linkage to building automation or use
- Limited in-house development or development in partnerships except those having a very dominant position
How will the market look?

• “Push” market for new software and services
• The owners are still “bad” customers, vendors agree on platforms and standards without customer involvement
• Large variety of solutions available, no dominant players
• Market structured very much in the same way as now, no emerging new markets
• Little emphasis on life cycle economics, no markets for LCE services
• A lot of co-operation between European and American Vendors, Americans bridging the gap to become more interoperable
Risk characteristics

High
- re-engineering
- leveraging strength
- efficiency focused
- high-risk

Industry
- cost savings
- experience building
- “webification”
- low-risk

Low
- Market creation
- New business model
- Shift industry dynamics
- High-risk

Practice Innovation
- New market within existing industry
- Business models shift
- New revenue sources
- Low/moderate risk

Industry/vendors

Business Criticality (from the viewpoint of the customers)
High
Low

Industry

Low
“Killer apps”

- **Intelligent project extranet**
  - capable of predicting performance of a project
  - capable of project portfolio management -> process improvements and knowledge management enabled
  - capable of some integrity checking
  - on-line access via mobile devices

- **True 4D (simulation) apps**
  - near to full virtual construction
  - integration between some design disciplines

- **2G E-procurement ASPs or bidding tools**
  - Agents searching for best buys
  - Pre-qualifying by expert evaluations over the net

- **Measuring devices capable of using model data**
Policy options

• The resources needed for development work
  • focus on coordination of standard data structures
  • is less in amount than in scen1&4 but more than in scen3
• IAI focuses on survival
• The use of standards is pushed, very little incentives for use
• Level of coordination of efforts adequate among vendors but not really adequate to get industry interested
• Individual companies are rewarded for risk taking instead of groups of companies
• Legal issues need to focus on contracts on how to use the new software and assure quality, IPR of the open platforms addressed
Areas of process re-engineering?

*Focus on incremental changes, no radical re-engineering*

- **Model based design**
  - Some designers oriented around modeling and objects, no real competitive advantage gained
  - Object libraries are in use faster than in S2 or S3

- **Procurement processes**
  - Bidding
  - Pre-qualifying of subs

- **Processes on site**
  - Measuring,
  - Quality control

- **Distributors and resellers evolve intologicistic chain controllers and electronic intermediaries**
## Value chain & use of technologies

<table>
<thead>
<tr>
<th>Scetching tools</th>
<th>Visualization, 3D object models</th>
<th>4D</th>
<th>Project extranets</th>
<th>As-built-model</th>
<th>???</th>
<th>Use</th>
</tr>
</thead>
</table>

- Conceptual Design
- Design
- Project Preparation
- Construction & Procurement
- Handing over
- Use

**Very traditional process structure**

- Standard platforms for different purposes
- Standardized exchange protocols (aecXML2010?)

**Notes:**
- 4D Visualization, 3D object models
- Sketching tools
- Very traditional process structure
Technology options

• **Standardization?**
  - IAI gets its act together, Building specific XML co-operates with IAI fully
  - Pilot projects really open eyes and create a strong pull
  - Breakthrough in adding intelligence to the IFC models?

• **Technological improvements?**
  - The use of agents
  - Design packages near true simulation
  - Data transfer to sites improved

• **Preferences in focus:**
  - IT and tool integration oriented
  - Creation of new software and extending old ones
  - Measures of success: improvements in data flow -> productivity gains, cost and time savings
Technology gaps, yellow zone

Today, we know of opportunities in:
• new types for bidding tools
• Use of intelligent agents
• Putting intelligence to objects

We could explore:
• Advanced user interfaces, for example, stereoscopic visualization
• Data mining of project extranets?
• Use of model data for measuring on site
• 5D CAD (3D + time + “what if” -analysis on the model??)
Technology gaps, blue zone

We are now trying out:
- Pre-qualifying of subs in bidding solutions
- Electronic billing
- IFC data transfer of geometric and other properties of a building
- IFC data transfer from design to quantity take-off and cost estimating

We could try apply:
- Advanced environment for bidding (more online, war-room like)
- aecXML data transfer
- IFC data transfer with extension to scheduling
- Data transfer between model and measuring devices or manufacturing equipment
Technology gaps to red zone

We have now:
- Project extranets (Buzzsaw)
- Bidding ASPs (Buildpoint)
- 30+ IFC Certified software packages
- 1-3 pilots testing IFC data transfer
- Performance simulation
- Commercial 4D packages
- Electronic catalogues, “spec helpers”

We should have:
- Code checking software
- Extended performance simulation of facilities
- Extensions to project extranets
- Object catalogues with integrated specs
Technology roadmaps

Paths for common data stds

Complementing standard acceptance

IFC general acceptance

Standard interaction agreement

Project extranet using objects

IFC compliant scheduling tool

Merger of model stds

Project extranets using model server

Paths for new software, solutions and extensions

Time

Level of technology

2002 2003 2004 2005 2006 2007
Scen3: The cost effective divide the market

- Proprietary approach adapted
- Point-to-point interoperability at max
  - No true B2B or “win-win-win” -approach
  - Interoperability only if agreed with two parties
- Strong vendors able to dominate the market
  - Small ones comply with the major ones and use their tools
- Minor changes in the business processes
  - The current processes are made leaner, more efficient and cost effective, focus on individual companies
  - No signs of improvements in the industry fragmentation
  - No Life-cycle approach
- Some new service providers (as long as depending on the strongest platforms)
Typical to S3

“Use whatever you want internally, as long as you can deliver in .xyz format”

- The owners do not see the value in information content
- 2-3 families of products have their de facto -standards
  - Autodesk, Bentley in the US, Graphisoft, Nemenechek in Europe?
  - Small companies come up with extensions based on the above
- No Life Cycle tools emerging
- Exiting things might be tested, if they serve the existing market
  - For example, mobile data transfer of directly of .dwg
- Owners still not really interested in added value of data, pre-requisite might be compliance to software A, B or C
How will the market look?

- No new markets emerging, technology push
- Vendors reacting to market needs and follow what industry needs
- Few very dominant vendors divide the slowly and steadily growing software market
- Big differences between the use of software in Europe, Japan in the US
- Few very large companies own businesses in other countries, industry fragmentation keeps action very local
- Large companies rely on 2 - 3 major vendors and their in-house development
Risk characteristics

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- leveraging strength  
- efficiency focused  
- high-risk       | - Market creation  
- New business model  
- Shift industry dynamics  
- High-risk       | |
| High                                                     | - cost savings  
- experience building  
- “webification”  
- low-risk       | - New market within existing industry  
- Business models shift  
- New revenue sources  
- Low/moderate risk | |

Practice Innovation

High

Low
Killer apps

• “Full service CAD -packages”
  • “AutoCAD with everything on it”
  • Packages tailored according to the role in the process, for example, life cycle management tools - if you need them!
  • Intelligent Project extranets, as long as they follow vendors’ standard

• More advanced project management tools with mobile use
  • Primavera, etc..

• Trading portals for the users of CAD-package X
  • If you are a user of Autodesk, welcome to the club and get a great bonus!
  • Product libraries follow the brand and vendor
  • Streamlined traditional processes and fast service, revenue to the vendor/service provider from each transaction

• Point-to-point transfer
  • Translating parts of a schema to another and taking care of interoperability - if demanded
Policy options

- The resources needed for development work
  - a structures
  - are minimal externally, internally used according to no common standard
- IAI focuses on survival
- The use of standards is pushed, very little incentives for use
- Level of coordination of efforts adequate among vendors but not really adequate to get industry interested
- Individual companies are rewarded for risk taking instead of groups of companies
- Legal issues focus on how to avoid litigation when using software in projects, standard contracts untouched, no-one cares for IPR
Areas for re-engineering

“The less changes in the industry, the happier the vendors are”

• Model based design processes
  • Virtual design teams
  • Full scale use of object oriented product libraries
  • 3D sketching

• Bidding and procuring is streamlined but not radically changed

• Facility Managers and building owners make use of as-built data
Technology options?

- No coordinated actions needed
- **Standardization:**
  - IAI can go, vendor standards rule
- **Technological advances:**
  - Mostly done by vendors, (Bentley picks up XML schemas, Autodesk have theirs, etc.)
- **Preferences in topics:**
  - IT & tool-oriented
  - Mapping and translating instead of data transfer based on common schemas or standards
  - Creating extensions to existing software
  - Measuring success by cost or time savings
Value chain & use of technologies

- .DGN, .DXF etc. Used for integration
  Document based systems

Scetching tools, Visualization
Conceptual Design

Control & change manag. of documents
Design

Construct-ibility analysis
Project Preparation

Project extranets & collaboration tools
Construction & procurement

Visual tools for maintenance training
Handing over

FM/ERP?
Use

Very traditional process structure
Technology gaps, yellow zone

Today we know of the potential in:

• mapping and translating
• new types of collaboration tools

We could explore:

• New types of user interfaces
• Advanced user interfaces, for example, stereoscopic visualization
• Data mining of project extranets
• Transfer and mining of data (document based) with wider access
Technology gaps, blue zone

We are now trying out:
• Pre-qualifying of subs in bidding solutions
• Electronic billing
• To create new extensions to different data systems
• Data access to site with mobile devices

We could try apply:
• “Trust building” tools
• Data access and transfer with mobile devices for almost on-line control
• “Full service” software in pilot projects
Technology gaps, red zone

We now have:
- Companies providing tools capable to cover most needs of the design processes
- Project extranet services
- Cool visualization tools

We could explore:
- More integrated project extranet services
- How to make existing packages include cost estimating, quantity take-off
Technology paths

- The Autodesk path
  - Autodesk full service package
  - Autodesk 4D extension
  - Model Translator breakthrough
  - Neat little thing for structural engineer
  - Extension to very cool area
- The Bentley path
  - Extension to cost estimation
  - “Any data for WAP”
  - Extension to a sexy area

Complexity of the problem

Time

- 2003
- 2004
- 2005
- 2007
- 2009
- 2011
Scen4: New services and business networks

- Business networks emerging, “owners of data” rule the projects
- Dominant platforms and vendors dictate the rules
- Lots of small different solutions sold to companies with strong in-house IT-staff trying to integrate (in-house scemata)
  - Vendors develop according to co-operation with industry
  - Solutions range from building automation to middleware
- Networks of companies compete against networks
  - Networks come up with new service or product concepts difficult to copy
- “IFCs” die, people focus on big vendors
Typical to S4

- The AEC Systems 2005 summit has three major camps under which the stands are organized
- Owners and the industry is divided into these camps
- The big building owners have teamed up with vendors to produce better tools for life cycle engineering and economy
- Designers teaming up accordingly
How will the market look?

- New markets can be created by big players
- Only big operators will be able to purchase sophisticated and specialized tools
- Industry leaders commit to two major packages
- The software market leader buys out no. 2
- Joint development venture between leading software companies and industry
- The market will become polarized, big alliances compete globally and act locally, small companies look for small potatoes
## Risk characteristics

<table>
<thead>
<tr>
<th>High Business Criticality (from the viewpoint of the customers)</th>
<th>Low Business Criticality (from the viewpoint of the customers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- re-engineering</td>
<td>- cost savings</td>
</tr>
<tr>
<td>- leveraging strength</td>
<td>- experience building</td>
</tr>
<tr>
<td>- efficiency focused</td>
<td>- “webification”</td>
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<tr>
<td>- high-risk</td>
<td>- low-risk</td>
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<tr>
<td>- Market creation</td>
<td>- New market within existing industry</td>
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<tr>
<td>- New business model</td>
<td>- Business models shift</td>
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<tr>
<td>- Shift industry dynamics</td>
<td>- New revenue sources</td>
</tr>
<tr>
<td>- High-risk</td>
<td>- Low/moderate risk</td>
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</tbody>
</table>

### Practice Innovation

- New revenue sources
- Low/moderate risk
“Killer apps”

- “Full service” software packages covering the whole life cycle
- Database mapping software
- FM portfolio management tools (unlikely to be model based, though)
- Automated, object oriented design processes specific to service
- Product libraries for different industry alliances and their e-business efforts
Policy options

“Big is beautiful”

- Back-up vendor-industry partnerships, let strongest survive
- No coordinated standard efforts unless industry driven
- Breakthrough in value adding from the owner perspective needed
  - Better tools for life cycle economy optimization
  - True understanding of value in the early phases of the project needed
  - End-user focus -> the tenant is served, not the owner
### Value chain & use of technologies

**Very sophisticated vendor specific platforms extending even to building automation**

Intelligent agents, translators & mapping programs

<table>
<thead>
<tr>
<th>“Intent“ models</th>
<th>Semi-automated design tools</th>
<th>Simulation for constructability</th>
<th>Vendor specific product libraries</th>
<th>Simulation for use</th>
<th>Stds per vendor for building automation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intent &amp; concept</td>
<td>Design &amp; pre-const</td>
<td>Delivery config.</td>
<td>Manuf.&amp; assembly</td>
<td>Interfacing user processes</td>
<td>Manag. of user needs</td>
</tr>
</tbody>
</table>

Customer oriented process
Technology options

• Very little coordinated actions needed

• Standardization:
  • IAI can go, vendor standards rule

• Technological advances:
  • Mostly done by vendors, (Bentley picks up XML schemas, Autodesk have theirs, etc.)
  • Interesting to see how ERP and CAD vendors compete or cooperate

• Preferences in topics:
  • IT & tool -oriented
  • Mapping and translating instead of data transfer based on common schemas or standards
  • Creating extensions to existing software
  • Measuring success by cost or time savings
Technology gaps, yellow zone

We know of opportunities in:
• Mapping and translating technologies (from one data schema or data base to an other)

We could explore:
• Use of agents in for various purposes in existing project data banks or product data models
• Use of automated data flow, for example, semi-automated design processes
Technology gaps, blue zone

We are now trying out:
- 2D to 3D “expanding”
- Enterprise software for streamlining existing processes

We could try apply:
- putting more intelligence to CAD software packages
- Integrating ERP and engineering software
- Services to compliment project extranet, such knowledge capture, performance measuring of projects, etc
Technology gaps to red zone

We have now:
- Comprehensive, good software packages like Microstation, AutoCAD
- Software for automated design for some areas
- ERP packages
- Project extranets

We could have:
- even more comprehensive products including structural analysis, cost estimating and quantity take-off, FM functions, etc....
- ERP suited for construction projects
- Project extranets with better services
Technology paths

Complexity of the problem

Path for industry-CAD vendor alliance using “model based” strategy

- Mobile access to model data
- Extended scope of proprietary models
- Collaboration tools with extended service

Path for industry-ERP vendor alliance using “document based” strategy

- Data mining of extranets
- Integration with building automation systems
- Model server for the alliance
- Integration to Facility portfolio management
- Data mining
Conclusions

• Nearly everyone wants the industry to adopt value adding and non-proprietary approaches
  • Areas of where scope of interoperability will be wider can be seen today
  • Lot of unknown potential in FM and building automation
  • The design process and professions are in a turning point
• So, is the problem even technological anymore? A profound cultural change or a shift in paradigm is needed.
• If so, where is the true business driver? Who will be able to take the risks necessary to put the pieces of the business processes in a different order and make more money like no-one ever made in this industry?