High Tech Tools to Polish Project Performance: Trends in Design, Construction & Facility Management

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CEOs worry about their firm …

• being marginalized in 5 years
• not having the right skills to compete
• not finding the right people
• not having a migration path to a new business model
• being overtaken by low cost providers
• not being able to meet the investment requirements for new technology
The trouble with our time is that the future is not what it used to be.

Paul Valery
What assets are more valuable than your data and knowledge?

- DBOO - provide value through information
- Extend life-time of design and construction data
- Reduce transaction costs to find, interpret, and display existing data
- Pay attention to data front-ends
- Justify investment in 3D model
Agenda

• Supply and Demand Chains in Construction
• e-commerce
• The role of the Internet
• The role of Information Technology
  – Object models vs. drawing documents
  – Intelligent 3D models
  – 4D models
  – Virtual Reality
• The IT-smart AEC organization
You can’t always get what you want, but if you try sometime, you get what you need
The Matching Game

Producer


Customer

Supply Chain

Demand Chain
The Matching Game

Producer

Distr.
SUB
GC
CM
A & E
Owner

Supplier Chain

Customer

e-Commerce Supports
Integrated Supply & Demand Chains
The Road to Success

Spec / Design

Award

Approval

Detailed Design

Product

Quote

Owner

A & E

GC

CM

SUB

Distr.

Manuf.

time
Improved process through:

- Document management
- Modeling
- e-Commerce
e - Market Places

e-Commerce Platform

Buy-side

Virtual Exchange

Trusted Intermediary

Sell-side
Vision

• Fast, secure data-, picture-, sound-, and video-communication readily available anywhere; fiber for high-quality video and wireless for simple video for households

• Small, fast, high capacity, portable units, capable of interpreting input by voice, handwriting and gestures as well as by keyboard. These units will work with 3D/VR and with several co-residing operating systems.
Vision 2005

- Learning intelligent software agents search for information, organizes information and keeps us informed.
- Secure personal identification and encryption are commonplace; voice recognition, fingerprints etc.
- Smart communicating products and materials everywhere (“distributed intelligence”)
Computer-communications

- Telephone Networks
- Entertainment Networks
- Enterprise Network
- Internet

Interoperability

Single Broadband Digital Network
Network Economy
Source: Business 2.0, June 1999

• Matter – It matters less
• Space – Distance has vanished
• Time – It is collapsing
• People – They are the crown jewels
• Growth – It is accelerated by the network
• Value – It rises exponentially with market share
• Efficiency – The middleman lives, "infomediaries" replace intermediaries
• Markets – Buyers are gaining dramatic new powers and sellers new opportunities
• Transactions – It is a one on one game
• Impulse – Every product is available everywhere
Reasons for Contractor Rework

Materials failure 5%
Human Error 17%
Weather 8%
Insufficient, inappropriate or conflicting information 65%
Poor Workmanship 5%

Source: CSIRO Building, Construction and Engineering, 1998
IT can help

• The major bottlenecks in the AEC industry are information and IT related

• The major opportunities in the AEC industry for increased productivity are information and IT related
IT can help

• The major bottlenecks in the AEC industry are information and IT related.

• The major opportunities in the AEC industry for increased productivity are information and IT related.
Providing Visual Interaction and Access to Your Data

- Decision making involves relating a variety of information.
- Project information exists in many forms and in many locations.
- No single "context" clearly communicates this information and relationships in an effective form.

Where are we working today? Why can't we install the tiles today? What happens if...?
Current Practice

Inflexible 3D model

Project Data
- Local
- Not integrated
Vision 2005

Virtual 3D model
- Flexible
- Integrated with project organization

Project Data
- Worldwide
- Integrated
Interative Mural

Desktop/Webtop

Meeting Notes

Option 1:

Option 2

XML 3D model objects, schedule object, resource, and cost objects

IFC Product Model

translate necessary objects

XML Product Model

XML 3D model objects, schedule object, resource, and cost objects

XML Process Model

XML Cost Model

XML Organizational Model

XML Database

Translate to XML

Integrated Applications

3D Modeler

Construction Method Modeler

Construction Cost Analyzer

VDT

P3

Product Model

Process Model

Cost Model

Organization Model

Process Model
Software Objects

- SUPPLY PIPING
- CONDUIT
- CONTROLS
- DRAINS
- AB100
- EPOXY
- AB200
- EXHAUST
- RETURN PIPING
- VENT PIPING
- TRENCH
- VALVE

- PROJECT
- PROCESS MODEL
- PRODUCT MODEL

- START ACTIVITY
- FINISH ACTIVITY
- ACTIVITY 1
- ACTIVITY 2
- INSTALL PIPING
- ACTIVITY 4
- ACTIVITY 5
- ACTIVITY 6
- ACTIVITY 7
- ACTIVITY 8
- ACTIVITY 9

- LINK

- RELATION TO ACTIVITY OBJECT

- RELATION TO GRAPHICAL OBJECT

- COMPONENT EDITOR

- ACTIVITY 2 in MODEL: RELATION TO ACTIVITY OBJECT

- ACTIVITY 2 in BUILD: RELATION TO BUILD OBJECT

- ACTIVITY 2 in MODEL: RELATION TO ACTIVITY OBJECT
Interactive 4D Production Planning Environment on the Responsive Workbench
Bid Package on the Web

Menu for project views by discipline in 3D design model

Expandable index to specifications
Online Code Compliance Checking

Automated Building Code Checker (ABC)

4.13.6 Maneuvering Clearances at Doors. Minimum maneuvering clearances at doors that are not automatic or power-assisted shall be as shown in Fig. 25. The floor or ground area within the required clearances shall be level and clear.

EXCEPTION: Entry doors to acute care hospital bedrooms for in-patients shall be exempted from the requirement for space at the latch side of the door (see dimension "b" in Fig. 25) if the door is at least 44 in (1120 mm) wide.

4.13.7 Two Doors in Series. The minimum space between two hinged or pivoted doors in series shall be 48 in (1220 mm) plus the width of any door swinging into the space. Doors in series shall swing either in the same direction or in opposite directions.

13. door001: accessibility REQUIRED... DOES NOT COMPLY with accessibility requirements:
   - door001--Maneuvering clearance intrusion by shelf. See Section 4.13.5
   - door001--Need at least 1 to comply with room(a) requirement. See Section 4.13.7

CAD Model

Compliance Checker
Online Performance Simulation

Motion Planner
Wheel chair accessibility
(VRML viewer)
Internet Mediated
Synchronous/Asynchronous
- Collaboration
- Communication

Videoconferencing
- Face-to-Face Meetings
- Meetings in Cyberspace
- Distance Learning Lectures
- Presentations to the Client
4D Visualizations

1. 2/1/00
   - Ride turnover (pink)

2. 6/1/00
   - Laydown areas (yellow)
   - Test & adjust ride (blue)
   - Current section of lagoon under construction (red)

3. 11/1/00
   - Land development (transparent green)

4. 6/1/00
   - Wave machine installation (red)
   - Interior and exterior work on facility (light blue)
   - Lagoon bottom
4D Environments Used on WDI Project

Viewing 4D Models in a Cave, on the desktop, and over the web

Desktop 4D Environment

changes to 3D model

Weptop 4D Environment

VR Cave 4D Environment

Hierarchical 4D Model

relationships between 3D components and activities can be made at any level in the hierarchy
Problems discovered together ...

Design Conflict

15"
… are solved together

Design Solution

9"
Status of Modeling Tools Today

- Parametric Simulation
- 4D non-parametric Ops simulation
- Concept vaporware

- OPERATION & MAINTENANCE
- CONCEPT DEVELOPMENT
- FEASIBILITY
- SCHEMATIC DESIGN
- DESIGN DEVELOPMENT
- CONTRACT DOCUMENTS
- PRODUCTION/CONSTRUCTION
- INSTALLATION/TEST & ADJUST
- RETRO/REHAB
- BLUE SKY

LCC Models

3D Sketching tools

4D non-parametric
Ops simulation

Concept vaporware
Business Processes on the Web

**Typical AEC services:**
- Bidding
- Design analysis;
- Product specification;
- Integrated procurement;
- Field operations;
- Diagnosis, O&M;
- Etc.

**General Services:**
- Shipping;
- Payment;
- Procurement;
- Inventory control;

**Process Automation**
- Viewers;
- Links to product catalogs;
- Document management

**Transaction Automation**
- **Value**

**Information Publication**
- **Complexity**

**Task support**
- **Current**

**Task Integration**
- **Early Adoption**

**Enterprise Integration**
- **Future**
What can you do with Computer Models and the Internet?

<table>
<thead>
<tr>
<th>Business value</th>
<th>Compression of Time</th>
<th>Overcoming Geographic Restrictions</th>
<th>Restructuring Relationships</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Efficiency</strong></td>
<td>Accelerate Processes</td>
<td>Gain Economies of scale</td>
<td>Bypass some Intermediaries</td>
</tr>
<tr>
<td><strong>Effectiveness</strong></td>
<td>Reduce Float Time</td>
<td>Add Global Control</td>
<td>Replicate Scarce Knowledge</td>
</tr>
<tr>
<td><strong>Innovation</strong></td>
<td>Provide Service Excellence</td>
<td>Develop New Markets</td>
<td>Build Networks</td>
</tr>
</tbody>
</table>
The IT-smart AEC organization ...

- makes IT a business-driven line activity, not a technology-driven staff function
- makes IT investments like other investments - on the basis of value
- drives simplicity and flexibility throughout the technology environment
- demands near-term business results from own development efforts and lines up with universities for long-term research
- drives constant productivity improvements
- builds a business-smart IT organization and an IT-smart business organization
Help your CEO and ...

• Do your next project in 3D and 4D
  – use imperfect tools
• Share the results
  – CIFE, CERF provide neutral ground
  – give feedback on “4D Wishlist” at http://randd.disney.com:1492/WISH-List2.HTM
• Go beyond 3D and 4D: try out the building in the computer
  – life cycle modeling
  – operations simulation