Asia Construction Information Technology Round Table Meeting

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Beijing, China

Virtual Construction

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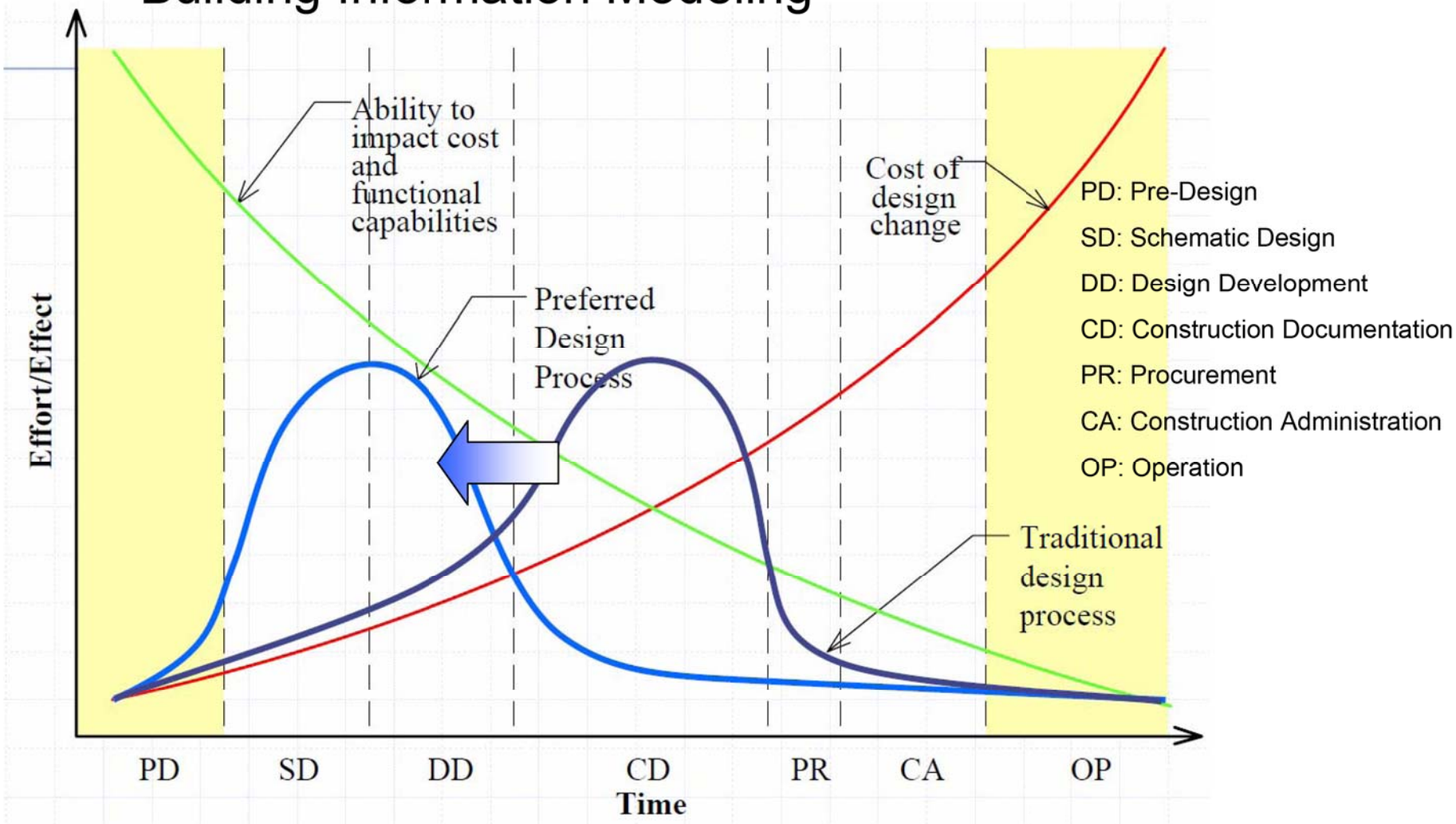
Issues in design and construction

- Only limited sources and amount of information can be available at the design phase.
- Many engineers from different disciplines join the project.
- Many stakeholders including citizens join the project.
- Decisions made during the early design phase can give impact on the project appropriately with low cost, while design changes in later phases tend to make various problems.

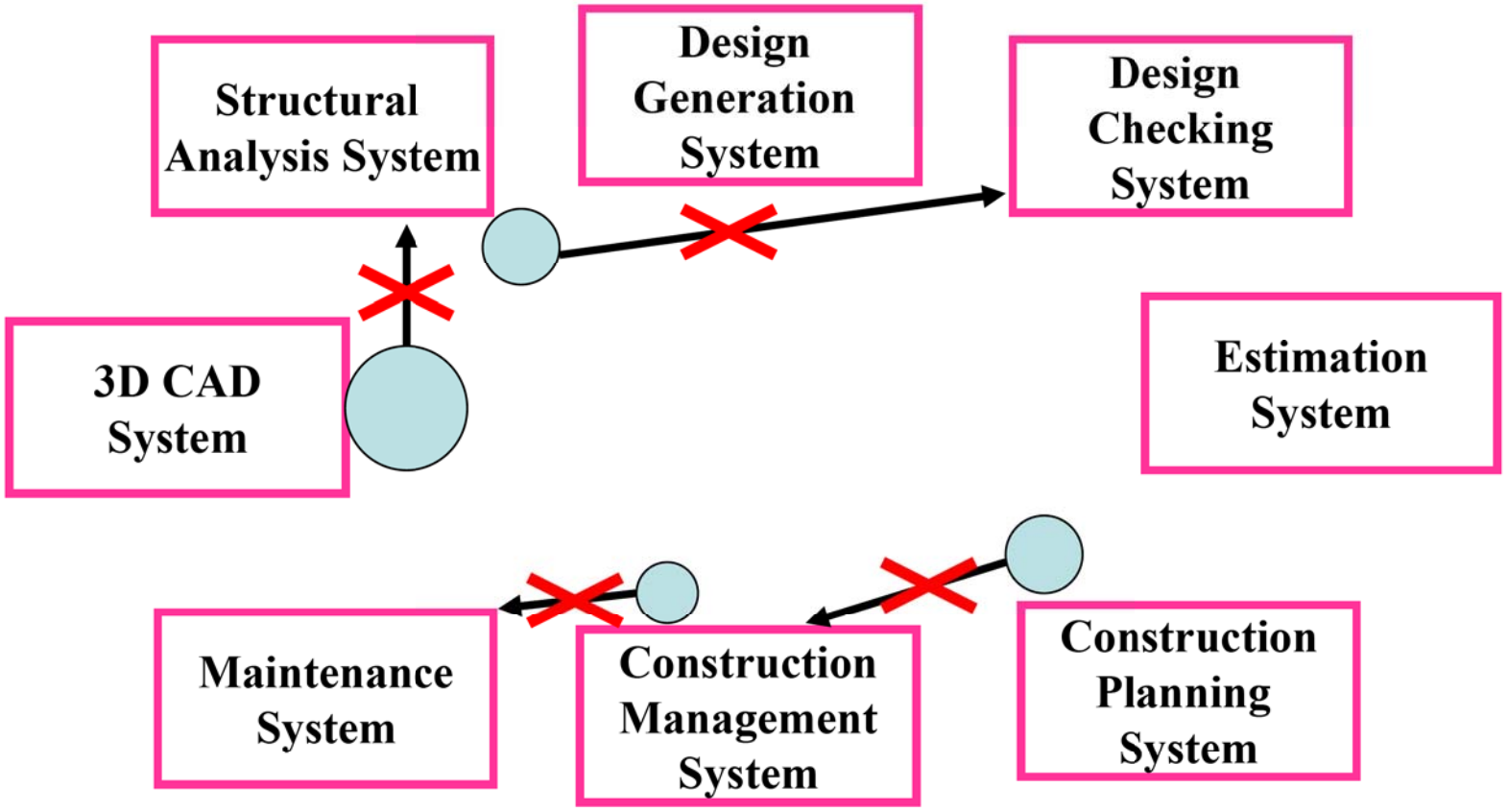
BIM

Building Information Modeling



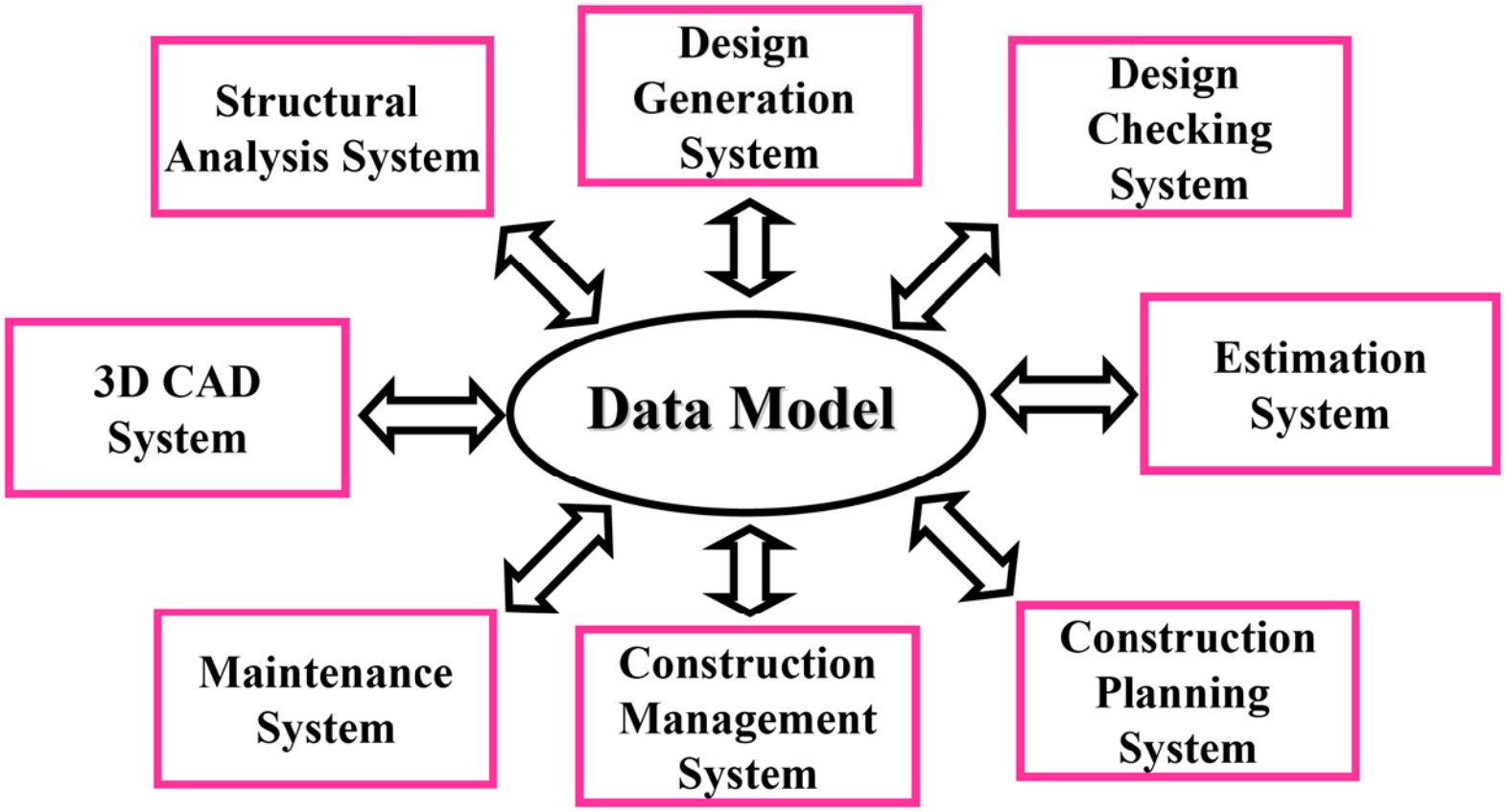
Interoperable Product Model

Engineers use many application systems.

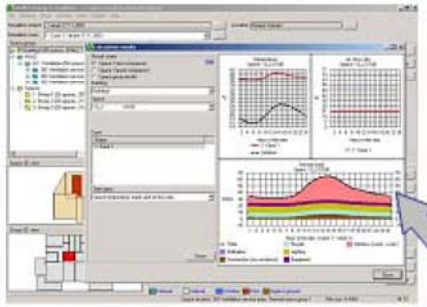


- **Islands of Automation**

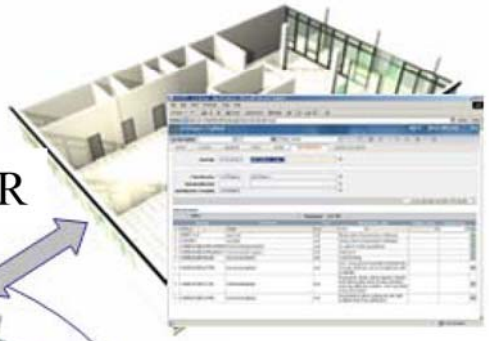
- Data sharing among various systems
- Data input mistakes decrease.



BIM integrates applications

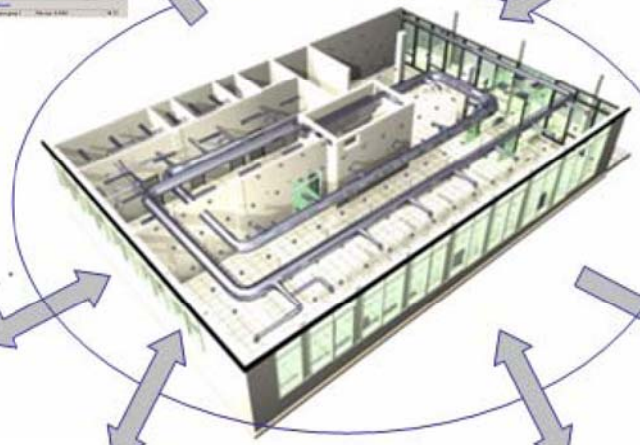


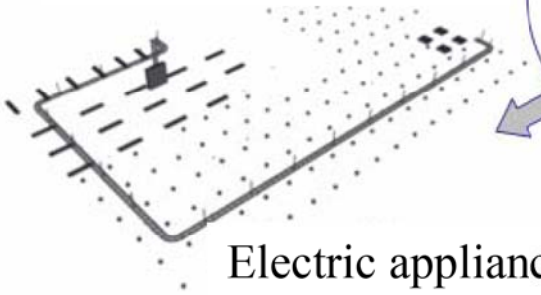
CG, VR



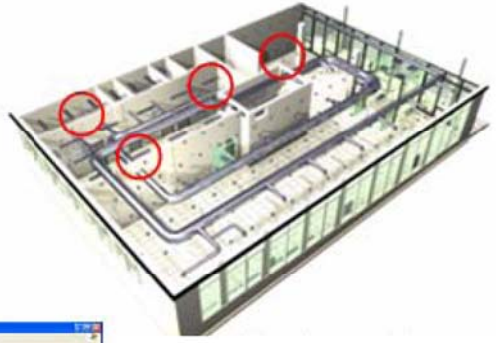
Operation & FM

Energy, Structure,
LCC, 4D, 5D,
Simulations





Electric appliance



Conflict Checking
(Architecture, Structures,
HVAC)

HVAC

Cost Estimation

Source : IAI, AEC3 (TLC)

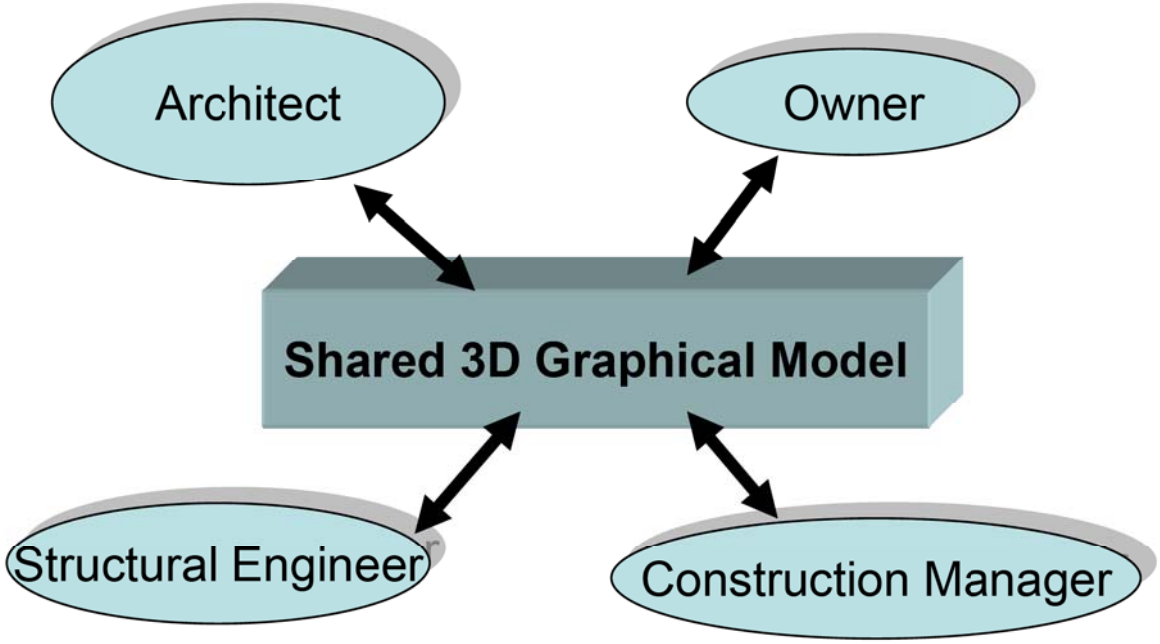
Efforts for CAD and Product Model Standards

- 1970s
  - IGES (Initial Graphics Exchange Specification)
- 1980s
  - US: PDES (Product Data Exchange Standard)
  - Europe: ISO, TC184, SC4, ISO-10303, STEP (Standard for the Exchange of Product Model Data)
  - ISO was slow in development of AEC product model.
- 1994
  - Autodesk started IAI (Industry Alliance for Interoperability).
- 1997
  - IAI became an International Alliance for Interoperability.
  - IFC (Industry Foundation Classes): Building product model
- 2005
  - IFC became ISO PAS.
- Now
  - Many countries adopt IFC as BIM standard.

Dr. Renate Fruchter's PBL

- Dr. Fruchter, Stanford Univ., has been conducting Project-Based Learning (PBL) education since 1992.
- In the PBL coursework, students are divided into multiple teams.
- Each team consists of players of an architect, a structural engineer, a construction manager, and an owner (TA).
- Each team designs a building, executes structural analysis, and makes a construction plan including a construction cost collaboratively.

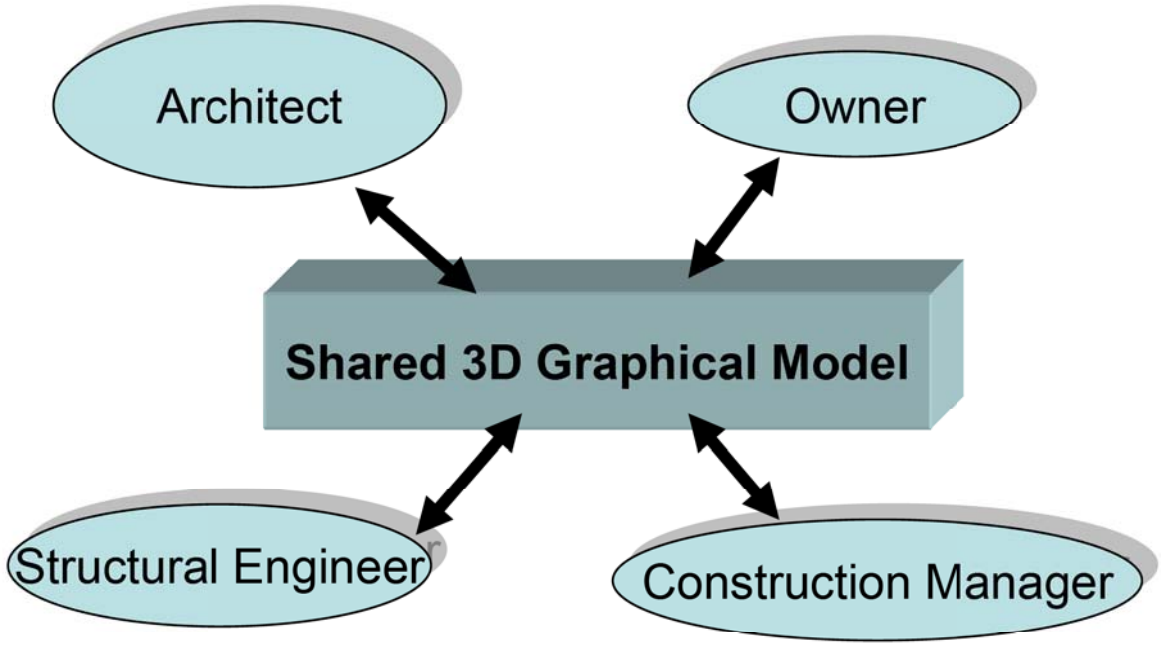
PBL with a shared 3D CAD model



- Not only Stanford students but also any graduate students from other universities in and out of the US can be registered and can take units if those universities have contracts with Stanford.
- Many universities in the US, Europe and Asia have joined this course.
- Remote students can join the class and group meeting via the Internet. But they have to attend the first and last classes at Stanford.
- Real professionals join as mentors to the teams.

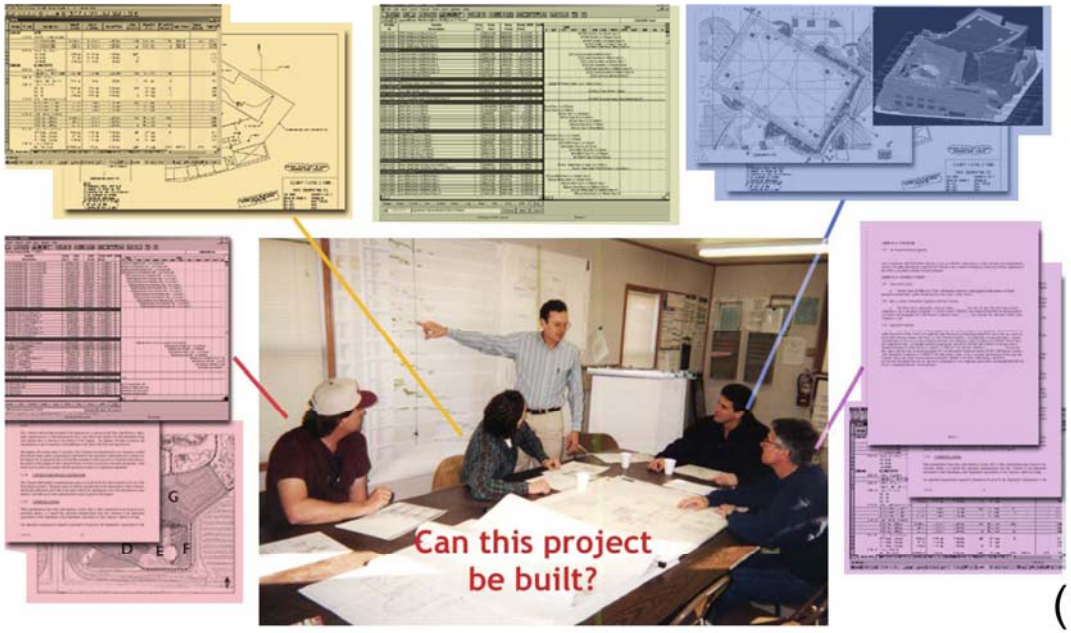
- The objective of the PBL course effort is to educate a new generation of professionals how to team up with practitioners from other disciplines and take advantage of IT to produce a better, faster, and more economical product.
- How can professionals in a multidisciplinary, geographically distributed team create and use IT to communicate, collaborate, and coordinate? (Fruchter, 1999)

Stanford PBL in Civil Engineering



- Communication cycle (propose, interpret, critique, explain, change notifications)
- Synchronous and Asynchronous
- Semantic Modeling Extension (SME) for defining specific discipline perspectives or contexts
- Knowledge capture during the project

Prof. Martin Fischer's Virtual Design and Construction (VDC)



(Fischer, 2004)

- The purpose of the meeting was to coordinate the detailed design and construction methods, cost, and schedule for an office building.
- A large portion of the planning and coordination of the project occurred primarily in the engineer's heads and was not supported by IT (Fischer, 2004).

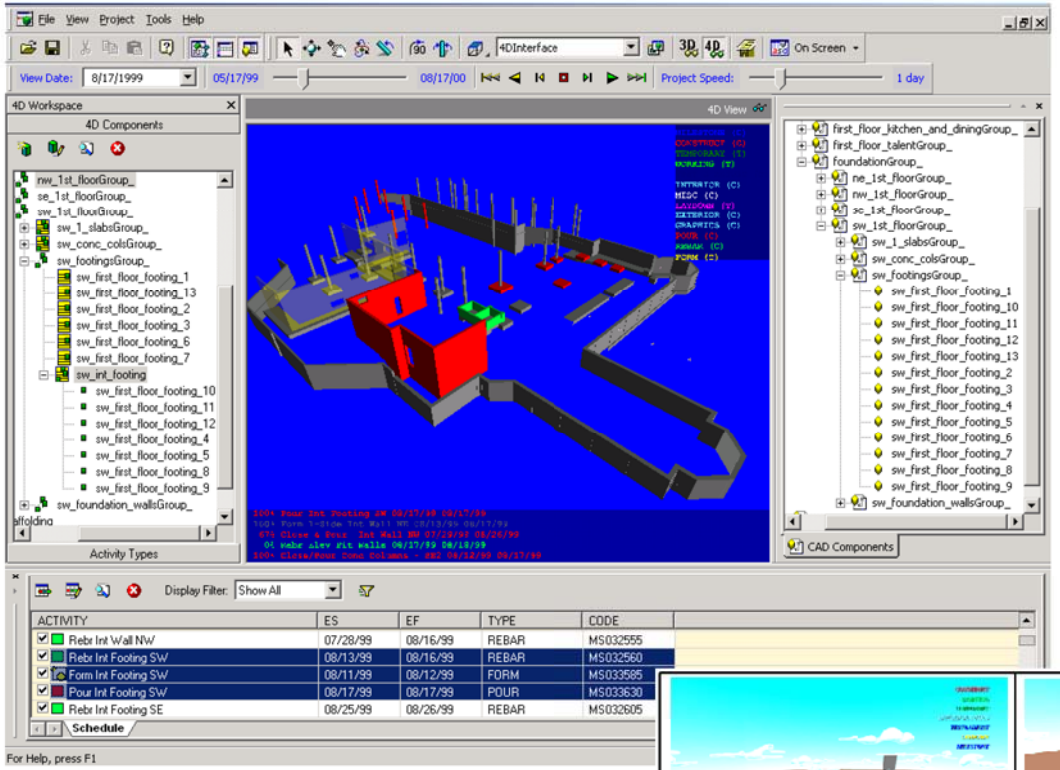
Martin Fischer and John Kunz: The Scope and Role of Information Technology in Construction, Journal of Construction Management and Engineering, JSCE, No.763/VI-63, pp.1-18, 2004

Definition of VDC

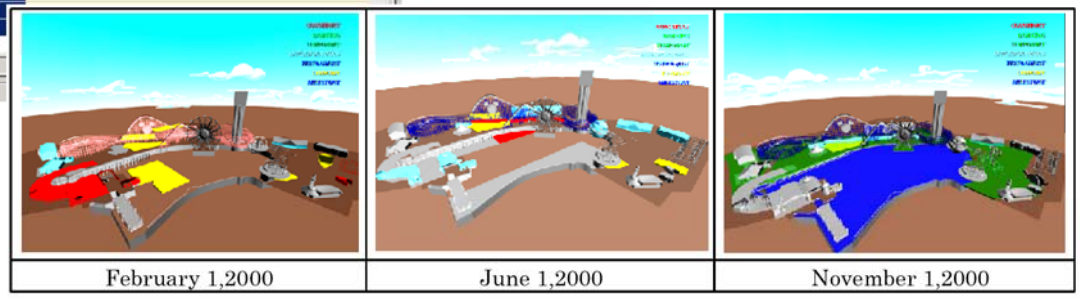
- The use of multidisciplinary performance models of design- construction projects, including the product (i.e., facilities), organization of the design- construction-operation team, and work processes, to support explicit and public business objectives (Fischer, 2004).
- Product, Organization and Process (POP) model.

Product and Process Modeling: 4D-CAD

- 4D Models link components in 3D CAD models with activities from the design, procurement, and construction schedules.

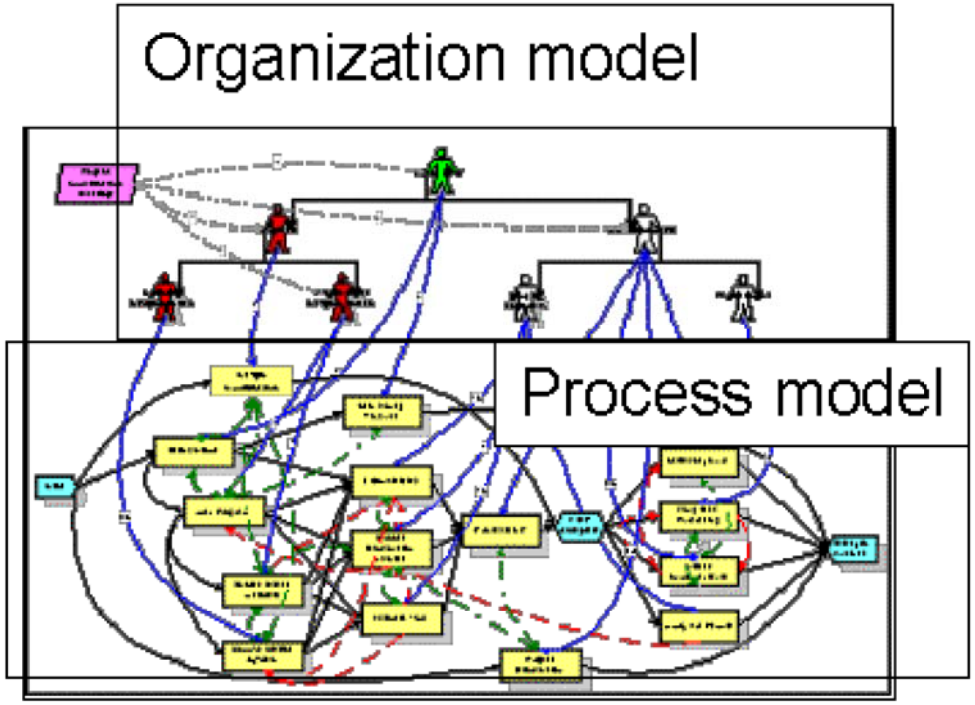


(Fischer, 2004)



Organization – Process Modeling

- The Virtual Design Team (VDT) model combines an organization model and a process model.

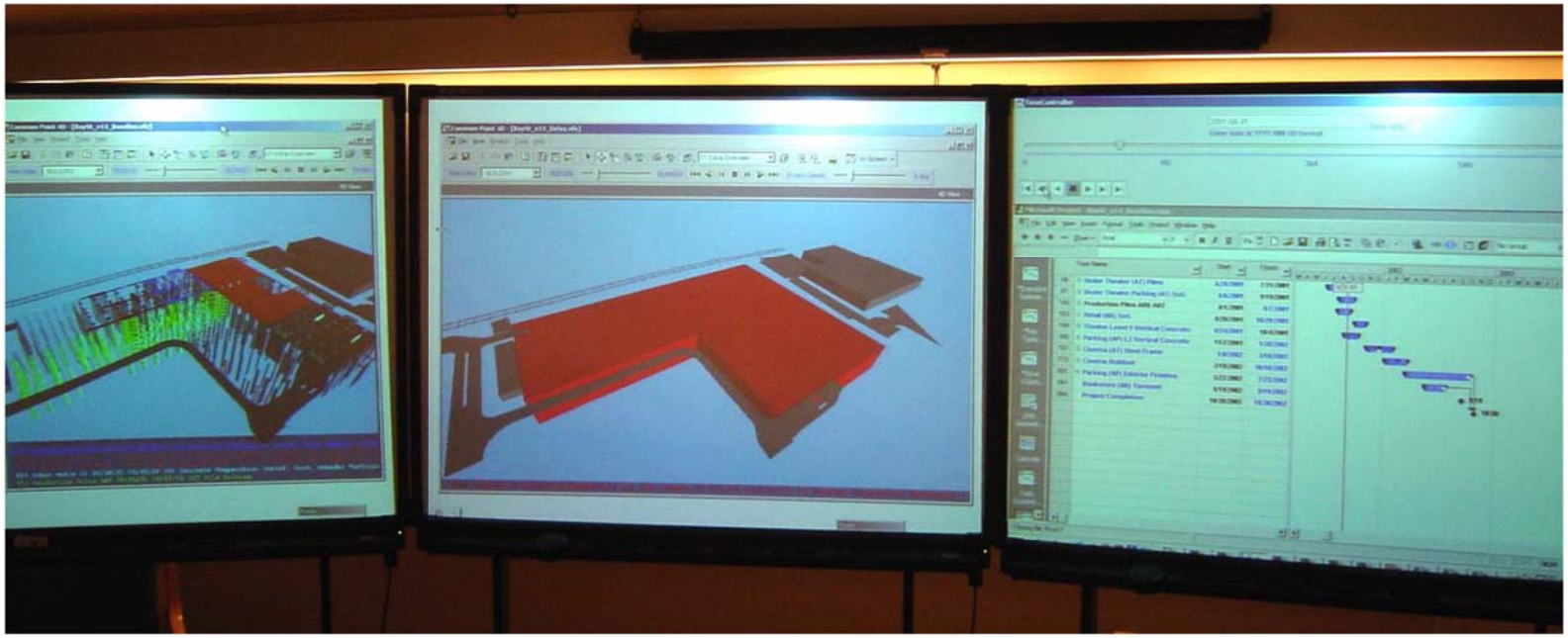


(Fischer, 2004)

POP and Multi-User Multi-Display HCI

- Many engineers from different disciplines contribute to and review the POP design of a project, which is difficult.
- Fischer developed CIFE iRoom.

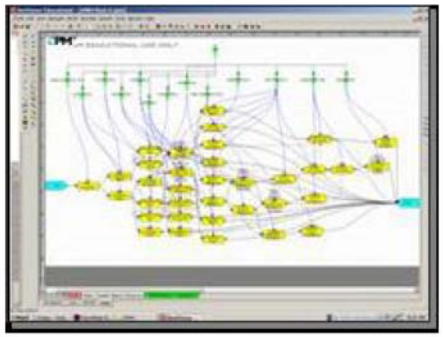
(Fischer, 2004)



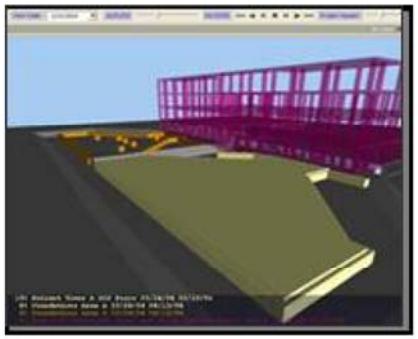
Fischer's 4D Model Applications

3D CAD

Sim Vision

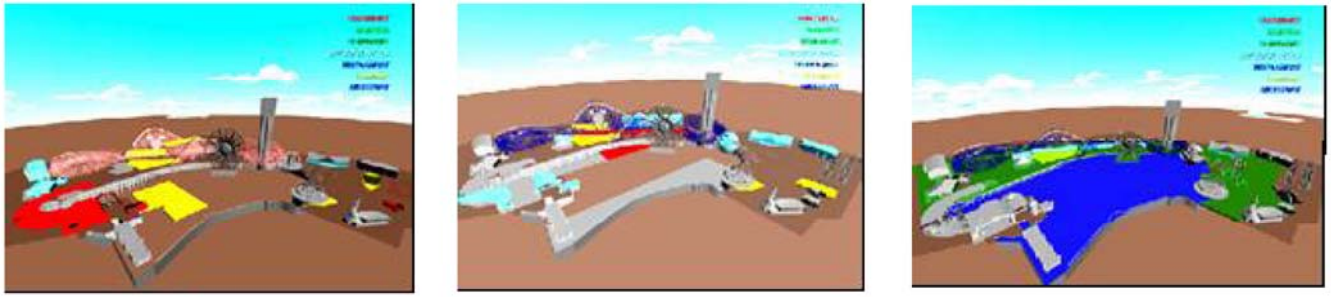


Project 4D



Product, Organization, Process model for a health care project in California using several commercial software tools, including Autodesk's Architectural Desktop and Graphisoft's ArchiCAD, ePM's SimVision, and Common Point's Project 4D. (Fischer, 2004)

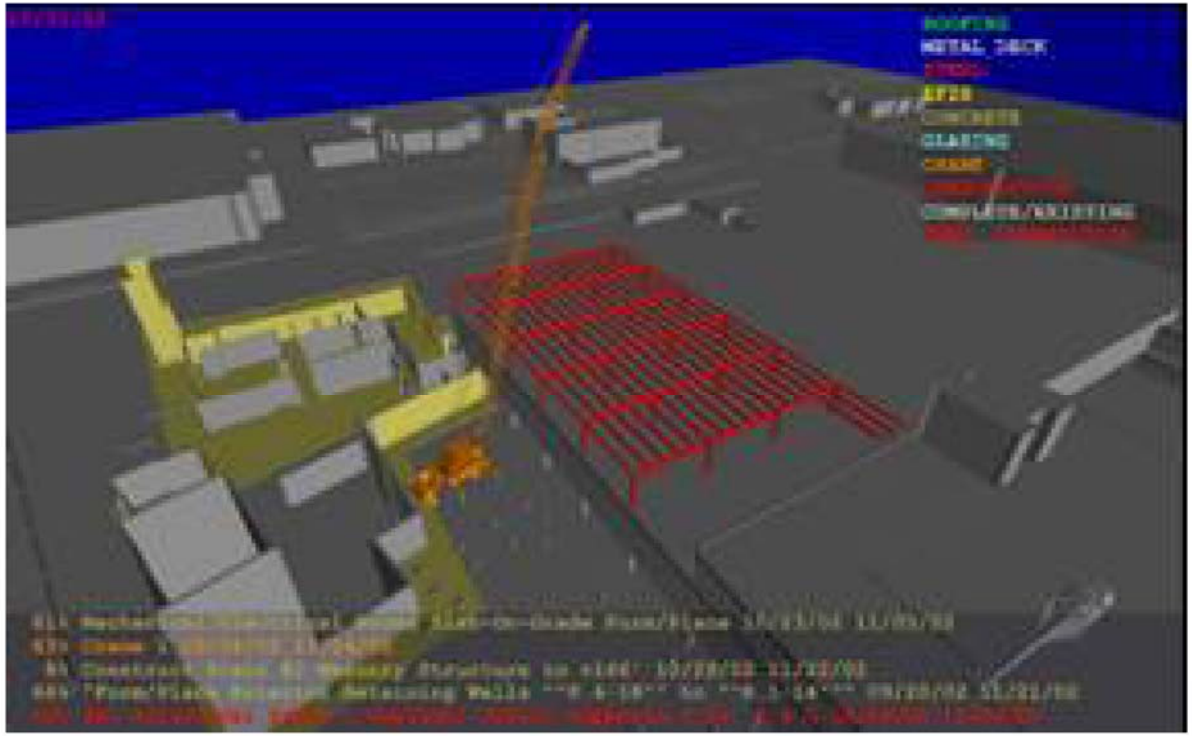
Fischer's application of 4D CAD



Feb. 1, 2000 June 1, 2000 Nov. 1, 2000

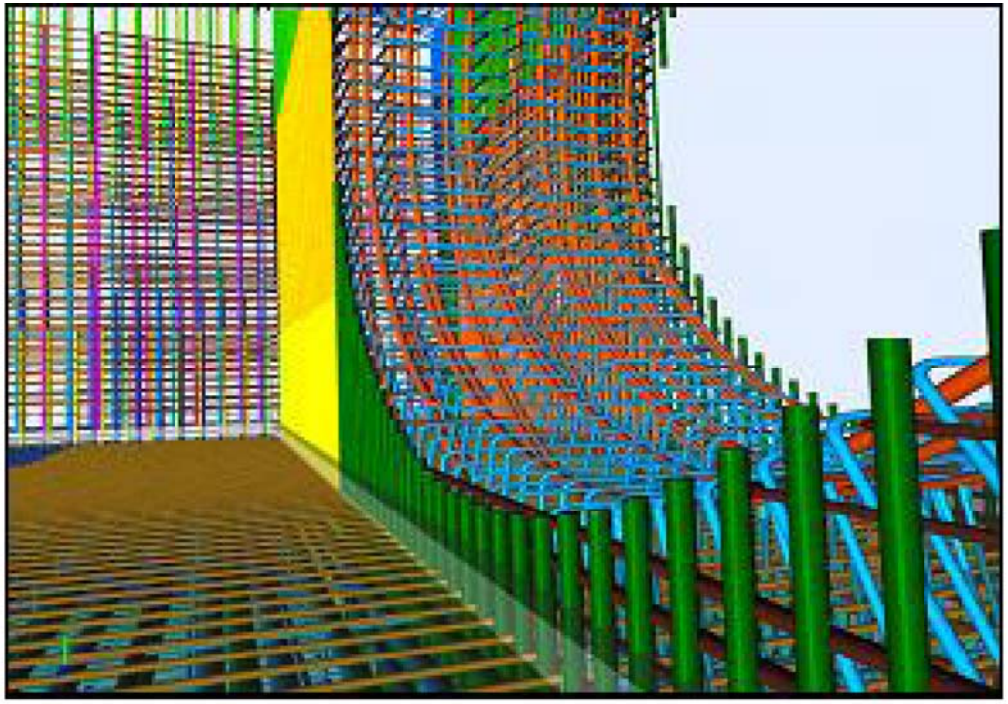
4D model snapshots of the construction schedule of part of Disney's California AdventureTM as planned during the detailed design stage of the project. (Fischer, 2004)

Fischer's application of 4D CAD



Early identification of the interference between the crane needed for steel erection and the flight path for the medevac helicopter allowed the Banner Health Good Samaritan Hospital in Phoenix, AZ, to request timely approval of a modified flight path from the Federal Aviation Administration (FAA) in the U.S. (Picture courtesy of DPR Construction) (Fischer, 2004)

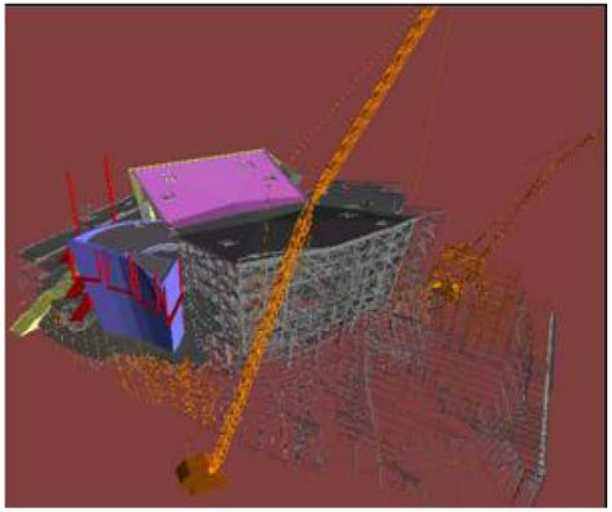
Fischer's application of 4D CAD



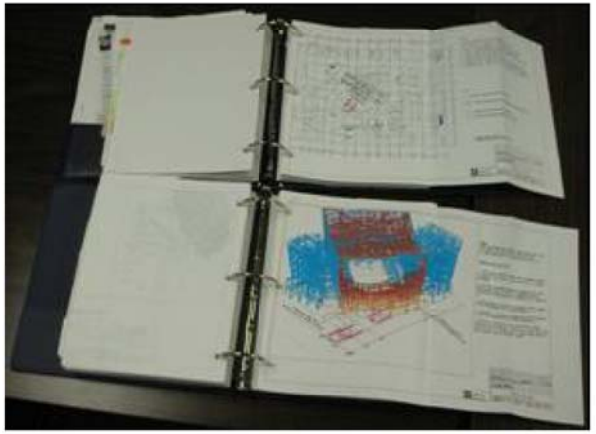
The Terminal 5 project at London Heathrow Airport. Detailed, integrated reinforcement steel design with 3D models.

(Picture courtesy of Strategic Project Solutions). (Fischer, 2004)

Fischer's application of 4D CAD



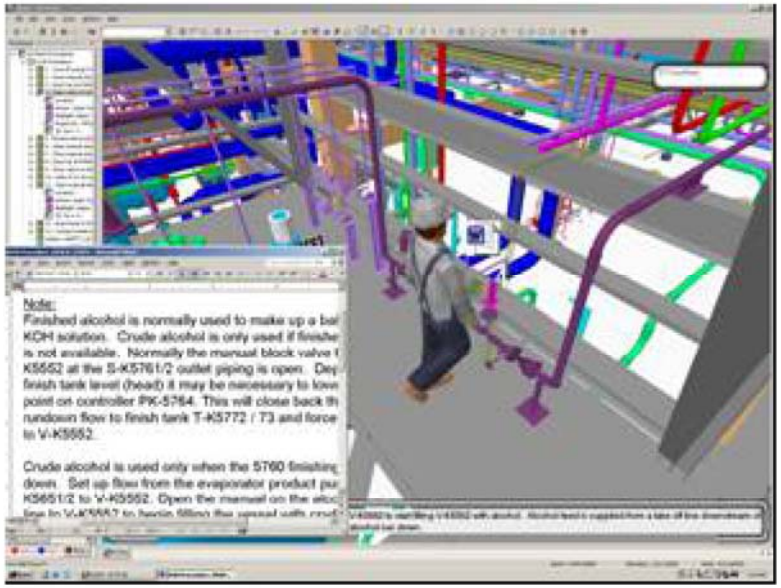
Snapshot of 4D model for Walt Disney Concert Hall in Los Angeles.



The two binders used by Mortenson to explain the crane usage plan for the WDCH project. Officials were able to understand this plan much more rapidly when presented in 4D model format.

(Fischer, 2004)

Fischer's application of 4D CAD



Operations simulation and operator training with a virtual model leveraging the 3D model produced by the design engineers.(Snapshot of OpSim application courtesy of Common Point Technologies, Inc., San Jose, CA). (Fischer, 2004)

VR applications by Maeda Corp.

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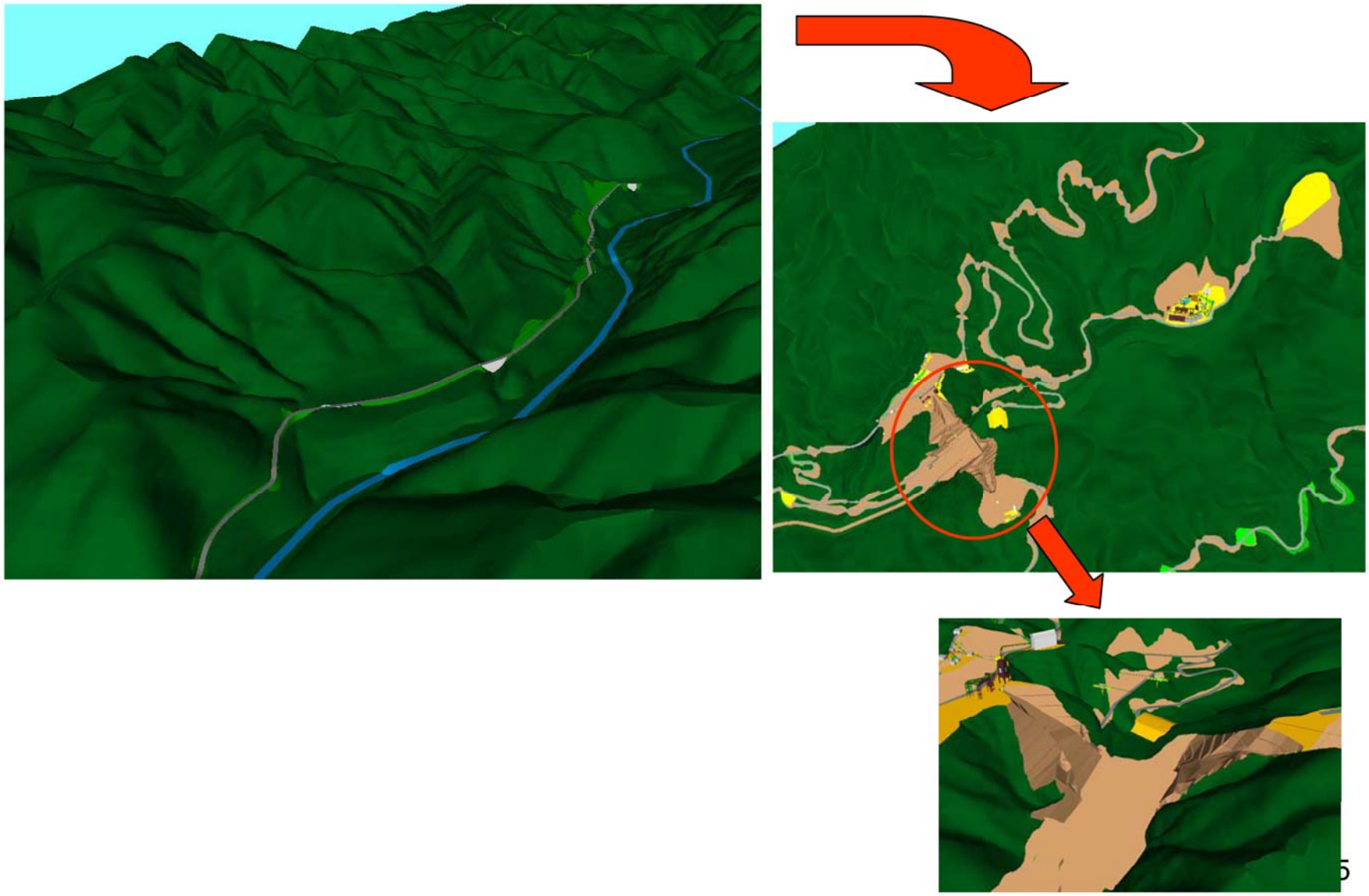
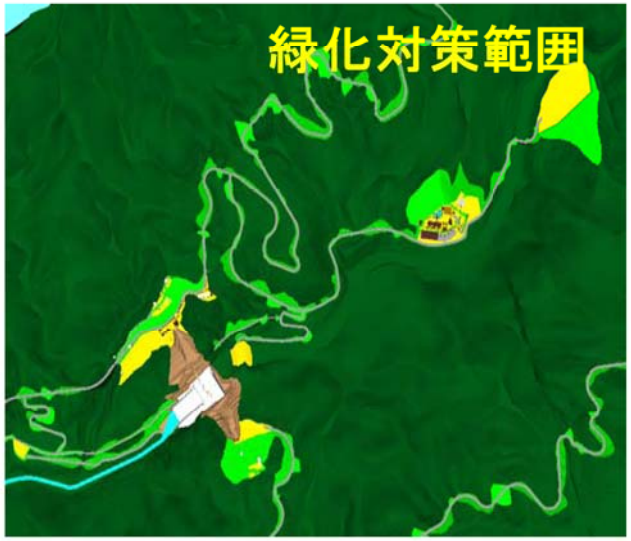
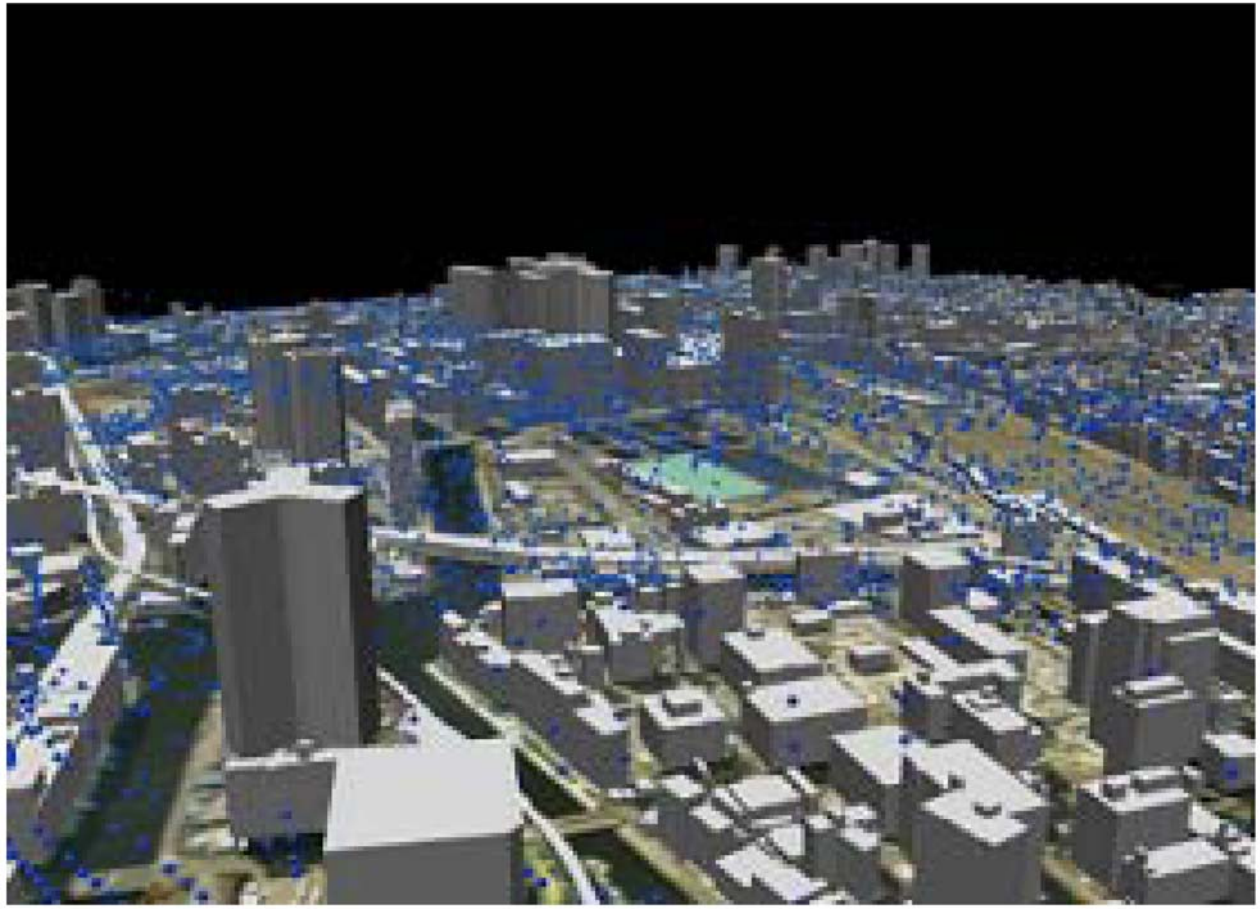


VR applications by Maeda Corp.

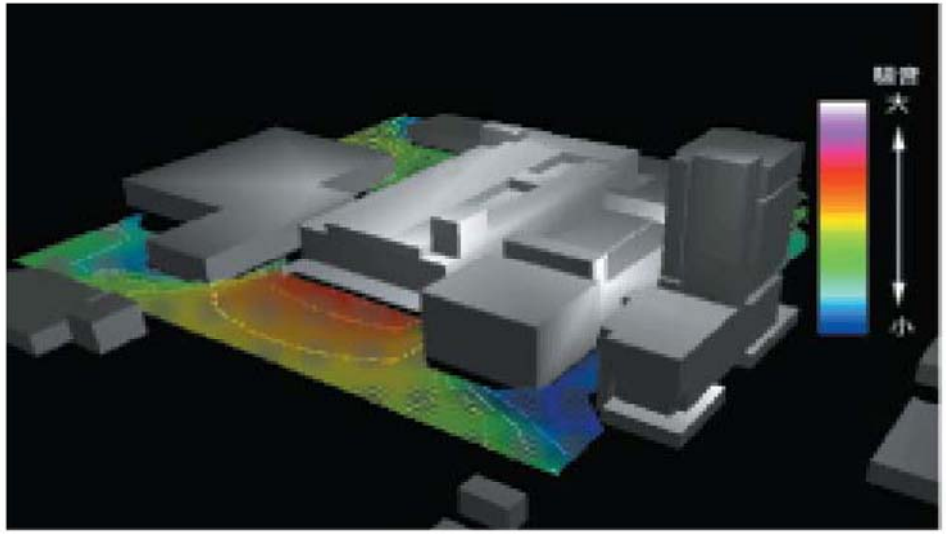


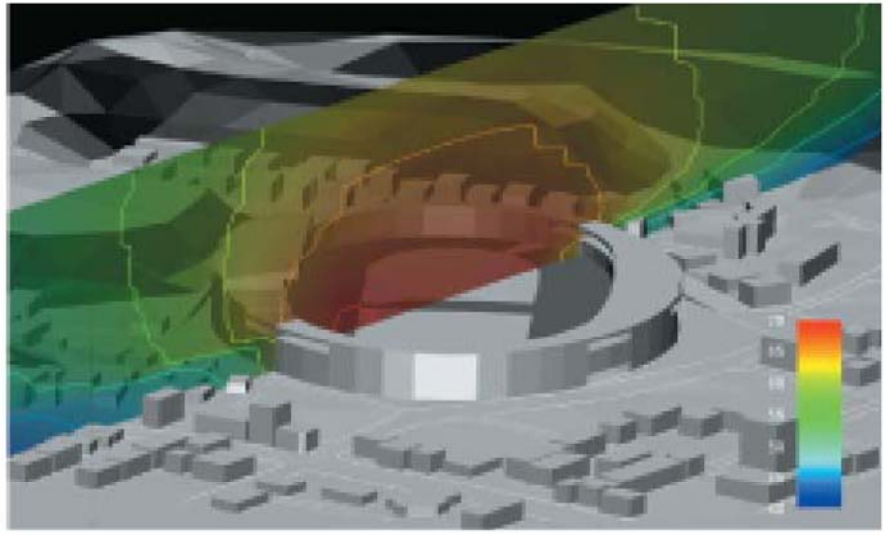
VR Applications in Urban Engineering and Architectue

Air flow in an urban area (from Morikawa of Taisei Corp.)

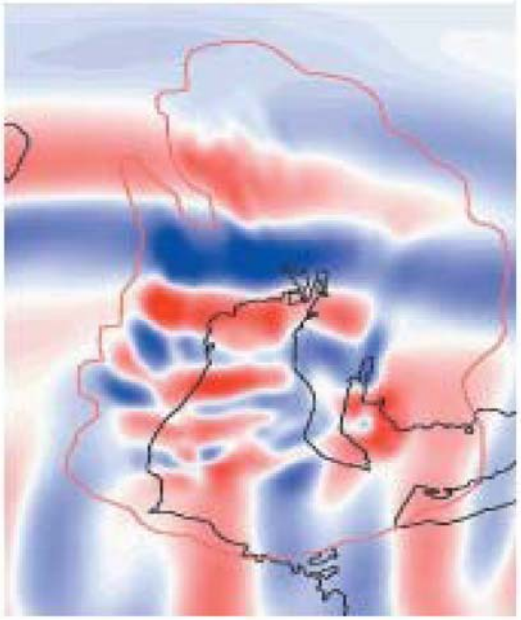


Sound simulation (from Morikawa of Taisei Corp.)

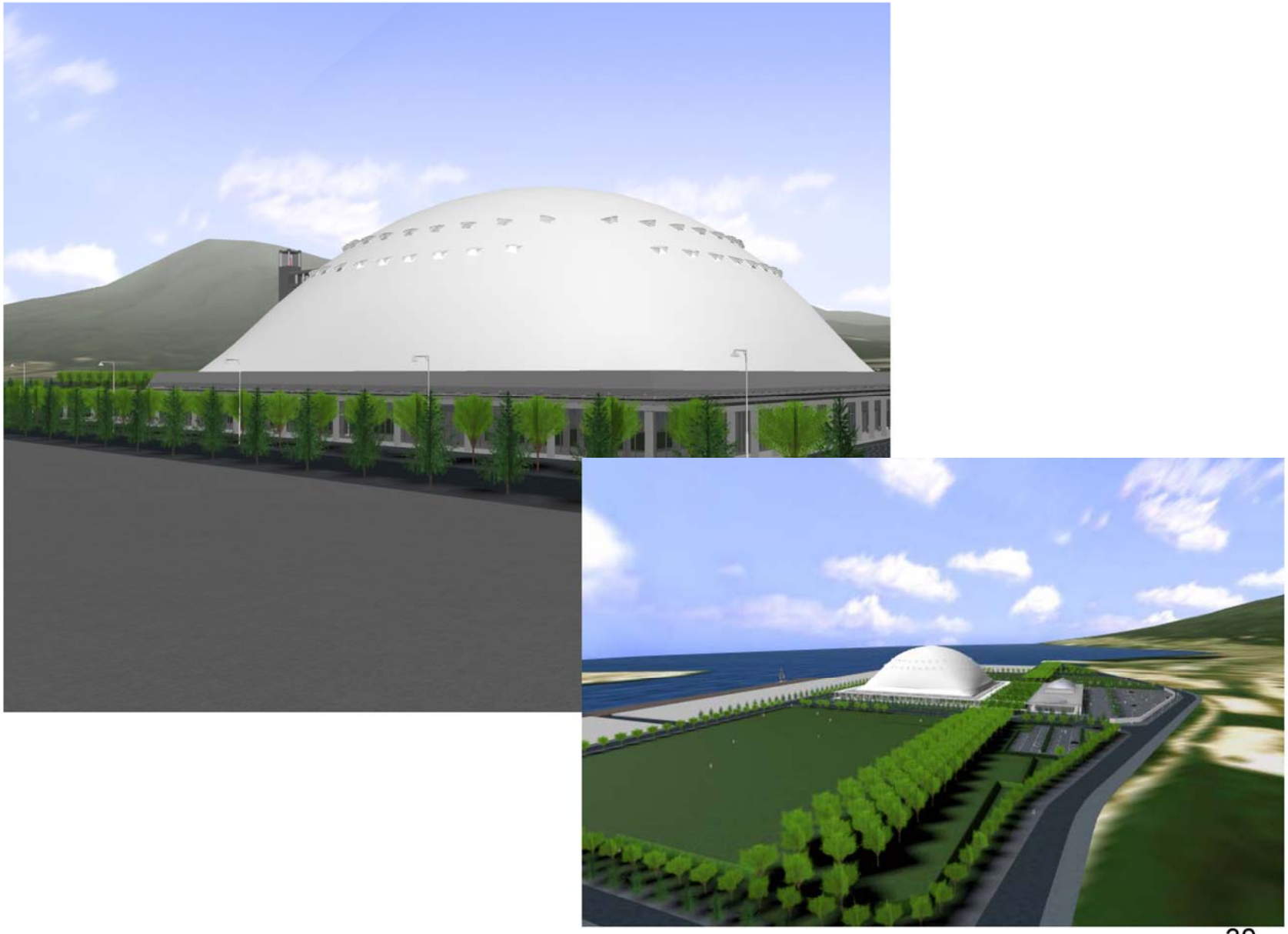




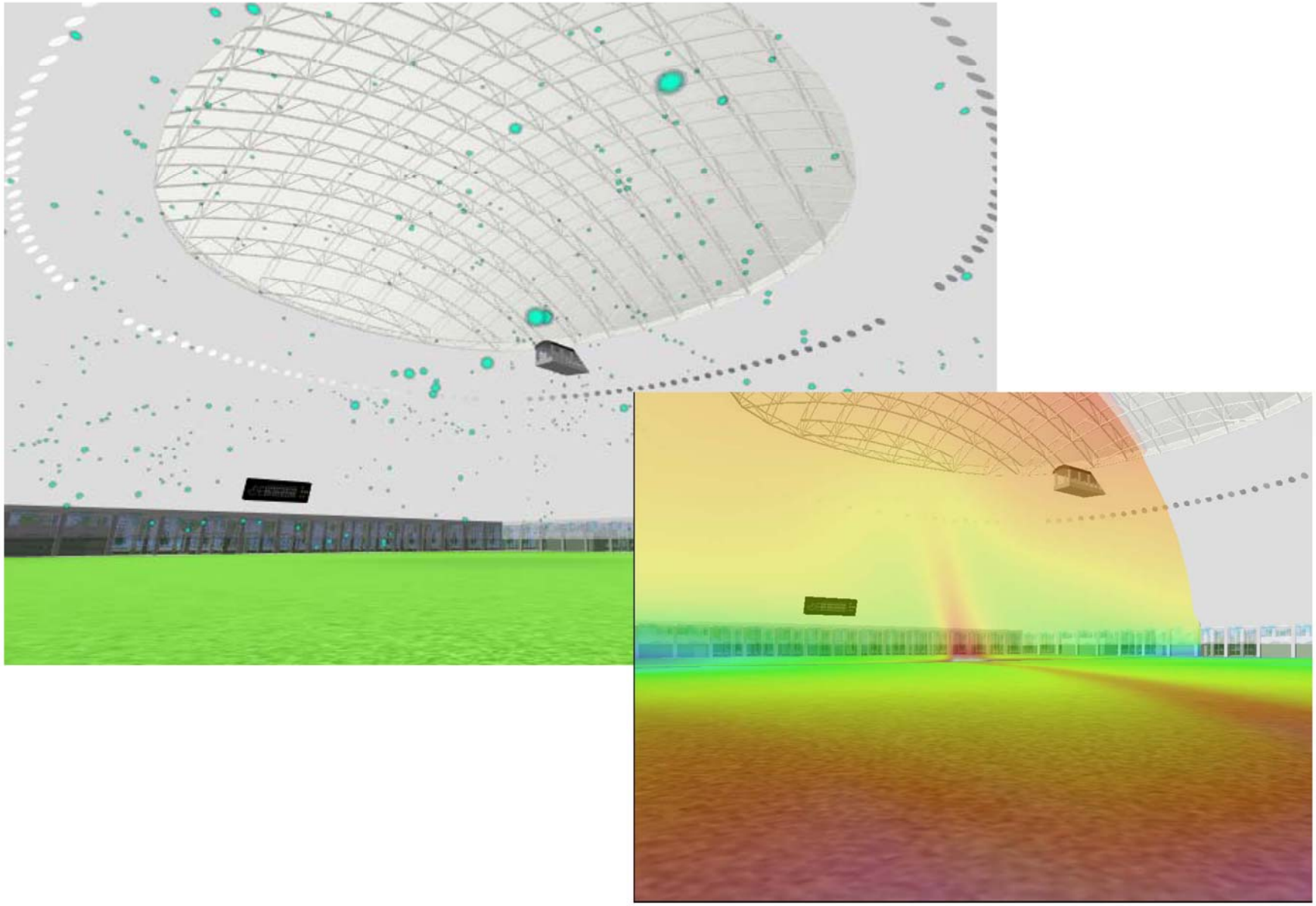
Ground motions (from Morikawa of Taisei Corp.)



Dome (from Morikawa of Taisei Corp.)



Ventilation in the Dome (from Morikawa of Taisei Corp.)



Hotel, Lighting, Material Selection (from Morikawa of Taisei Corp.)

Hotel (from Morikawa of Taisei Corp.)

Promotion of Computerized Construction by MLIT, Japan

- Serious concerns in low productivity in construction compared with manufacturing.
- Need to promote computerized construction.
- Primary target is road construction.
  - Convert 2D CAD drawings to 3D CAD data.
  - Automate construction machines by using the 3D CAD data, GPS, various sensors.
  - Automate conformance checking by comparing the 3D CAD data and measured data by Total Stations.
- Facilitate leasing and rental of necessary appliances.
- Provide training opportunities for both owners and construction company employees.
- Within 3-5 years, major-most national road construction will be done by this procedure.

The End

Thank you for your attention.