Virtual Techniques (VT) and Building Information Modelling (BIM) for Building Trade & Architecture
Chances, Drivers & Barriers

Dr.-Ing. Dipl.-Kfm. Christoph Runde
Virtual Dimension Center (VDC) Fellbach
Auberlenstr. 13
70736 Fellbach
www.vdc-fellbach.de

Dipl.-Arch. Günter Wenzel
Fraunhofer IAO
Nobelstraße 12
70569 Stuttgart
Content

- Overview
- Surveys regarding virtual techniques for building trade and architecture
- Surveys regarding BIM for building trade and architecture
Definition: Virtual Techniques

- Support development or planning processes
- Using digital, three-dimensional models and spatial interface techniques (VR/ AR/ MR)
- The aim is to provide high-fidelity and functional prototypes
- Virtual Engineering: product development and production processes
- Construction: planning, realization, communication, operation
Overview

- Expert interview regarding virtual techniques

How do we want to use VT in the building trade in the future? Wishes, ideals, examples

What encourages the use of VT in construction?

What inhibits the use of VT in construction?

Structure of the answers

- Technologies
- Data availability
- Processes & functioning
- Costs, market, business model
- Qualification
- Society
- Law & Politics
Virtual techniques: Technology as vision, driver, barrier

**Vision**
- Open standards - uniform interfaces
- BIM is the documentation standard
- Buildings are designed in real time in the holodeck
- Computers are better and different than before - direct and dynamic simulations become possible
- Simulation of the life cycle of a building
- The atmosphere of a building can be simulated and visualized in advance
- Construction site is digital
- Robot production on the construction site
- Thinking in LOD
- Multi-container from 3D models
- Context-related provision of information

**Driving forces**
- Faster hardware
- Simulations possible -> sustainability
- Stair tool -> app mindset in small steps
- Programming and IT technology
- Usability, intuitive, easy to handle
- Production capabilities

**Barriers**
- Data processes, data transfer, content conversion, loss of data interfaces between software tools
- Software does not match with processes
- Usability, no standardized interaction
- BIM is too little, more LODs are necessary in BIM
- Software heterogeneity
- Software manageability
Virtual techniques: Data availability as vision, driver, barrier

**Vision**
- Standards for LODs / LOD8
- Standards for quality of 3D data (e.g. direction surfaces, precision, detailing,...)

**Driving forces**
- Requirements of the planner
- Increasing complexity of construction projects
- Increasing demands on quality of planning

**Barriers**
- Low quality of the data base (city model)
- Quality requirements on visual implementation, too low LOD for 1:1 experience
- Availability of 3D data (e.g. underground), also in terms of precision
- No quality standards
- Use cases for 3D data undefined
Virtual techniques: Processes & functioning as vision, driver, barrier

**Vision**
- Process simulation for large projects is standard
- Automation of construction (“architect becomes redundant”)

**Driving forces**
- Desire for participation
- Politics: BIM thought in large public projects

**Barriers**
- Lack of change management in the design/planning process/execution
- Missing interfaces between BIM, BAM, BOOM
- Performance profiles, phases predefined
- “Islandization” (small planning units)
- Lack of willingness to provide detailed insights (especially to inexperienced citizens ...)
  → missing verifiability → correct data? right statements? quality seal of data/presentation
### Vision
- For private clients, there are web-based interactive 3D house configurators
- Interaction of the architect with the client also and especially in the planning (the architect becomes the "consultant")
- However, components should also be standardized and/or flexible free-form buildings are just as cheap as with standardized components

### Driving forces
- Create incentives
- Cost pressure ➔ efficiency ➔ building/planning
- Transparency of processes and costs
- Implementation of building processes in CAM structures

### Barriers
- Costs
- Business model building process ➔ Trade division in the construction process
- Value-added processes
- Lack of strain (for changes)
- Companies lacking critical mass, order fluctuations
- Legal situation impede new business models
- Low margins
Virtual techniques: Qualification as vision, driver, barrier

**Vision**
- Consistently qualified employees in the construction value creation process
- Study program BIM-Manager

**Driving forces**
- Interdisciplinary studies
- Teenagers → Education
- Internet
- Computer games
- New degree programs (e.g. geomatics)

**Barriers**
- Cooperation between faculties (IT, architecture, civil engineering, interdisciplinary in general) or between different roles in the project (builder, architect, construction company, ...)
- Lack of exchange, “islandization”, too little (lateral) thinking
- Personnel structure
- Qualification, study without 3D, CAD, VR
- Lack of transfer competence (too tight education)
- Lack of IT project management (which is necessary for meaningful use of new IT tools)
Virtual techniques: Society/ history as vision, driver, barrier

**Vision**
- VT are getting suitable for mass production (easy and intuitive to operate, inexpensive, miniaturization)
- The population accepts the new technologies
- Citizen participation is made even easier by VT

**Driving forces**
- Media literacy
- Generations are growing
- Fun game 3D virtuality/ 3D communities are common knowledge
- Virtuality accepted as a habitat
- More demanding architecture → built environment
- Claims of the builders are rising
- Mature users
- Individuality in the building trade
- Spinning → realizing

**Barriers**
- Chicken-and-egg problem, demand-supply IT tools
- Lack of financing for the start-up phase (of a comprehensive SW deployment)
- Lack of creative will in the industry, lack of strain (for changes)
- Oligopoly market IT tools, limited number of companies driving the market → blockades
- Education → perception → persistent building culture
- Technology phobia of architects, trust (in IT)
- HOAI speaks against continuous processes (trades, planning phases)
- Lack of personnel (in general)
Virtual techniques: Law/ politics as vision, driver, barrier

**Vision**
- Legal framework supports, demands and promotes new technologies

**Driving forces**
- Policy requirements

**Barriers**
- Rights to data unclear
- Unclear liability issues in exchange, rights, use
  → IP issues, rights to data, rights to draft, copyright
- Lobbies, e.g. chambers
- Missing protection against replicating, sharing
  (→ technology?)
# Virtual techniques: Distribution of results

<table>
<thead>
<tr>
<th></th>
<th>Vision</th>
<th>Drivers</th>
<th>Barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technologies</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Society</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Costs, market, business model</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Law &amp; Politics</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Qualifications</td>
<td>-</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Processes &amp; Functionings</td>
<td>○</td>
<td>-</td>
<td>○</td>
</tr>
<tr>
<td>Data availability</td>
<td>-</td>
<td>-</td>
<td>○</td>
</tr>
</tbody>
</table>
Virtual techniques: Estimates today’s status

- Answers (marked answers were mentioned most frequently)

<table>
<thead>
<tr>
<th>Areas of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality assurance</td>
</tr>
<tr>
<td>Simulation actual state/planning</td>
</tr>
<tr>
<td>Orientation</td>
</tr>
<tr>
<td>Analysis/ Visio</td>
</tr>
<tr>
<td>Building condition</td>
</tr>
<tr>
<td>Light simulation</td>
</tr>
<tr>
<td>Visualization perception of space</td>
</tr>
<tr>
<td>BIM/ 5D</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Visualisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>VR</td>
</tr>
<tr>
<td>Animations</td>
</tr>
<tr>
<td>Rendering</td>
</tr>
<tr>
<td>Building and production planning (layout planning)</td>
</tr>
<tr>
<td>Visualization in real-time HMDs / games</td>
</tr>
<tr>
<td>3D scanner</td>
</tr>
<tr>
<td>3D scan</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Society (games, cinema)</td>
</tr>
<tr>
<td>iPad, iPhone</td>
</tr>
<tr>
<td>Good imagination</td>
</tr>
<tr>
<td>Overview/ communication</td>
</tr>
<tr>
<td><strong>Cost-efficient hardware</strong> (Oculus)</td>
</tr>
<tr>
<td>Cost-efficient CAVE</td>
</tr>
<tr>
<td>Consistent process chain</td>
</tr>
<tr>
<td>System world builder/ client</td>
</tr>
<tr>
<td>Mobile VR/ AR/ MR</td>
</tr>
<tr>
<td>Realtime engines</td>
</tr>
<tr>
<td>Advantages when coordinating trades (implementation phase)</td>
</tr>
<tr>
<td>Builder</td>
</tr>
<tr>
<td>Vision of data consistency (necessity, alternative?)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance (CPU/ GPU)</td>
</tr>
<tr>
<td>On site?</td>
</tr>
<tr>
<td>Expensive</td>
</tr>
<tr>
<td>Specialization of existing models difficult to implement in VR  →  trivial model</td>
</tr>
<tr>
<td>Volume of data vs. real-time</td>
</tr>
<tr>
<td>Blockades at interfaces “bottleneck” (e.g. CAD-format libraries)</td>
</tr>
<tr>
<td>Inconsistent process definitions within the project structure</td>
</tr>
<tr>
<td>Uniform data formats</td>
</tr>
<tr>
<td>No real-time possible</td>
</tr>
<tr>
<td>Lack of information base</td>
</tr>
<tr>
<td><strong>Volume of data</strong></td>
</tr>
<tr>
<td>Tradition</td>
</tr>
</tbody>
</table>
Virtual techniques: Estimates ideal state

- How should it be? - Answers (marked answers were mentioned most frequently)

### Areas of application
- Real time visualization and data access
- Implement materiality and haptics
- Multi-user VR
- Individually tracked avatars
- Compatibility (SW developer, CAD, DB, AVA, schedule)
- VT + schedule as a communication tool on site
- Photorealistic real time visualization (actual/target comparison with AR)
- Mobile use (no physical plans on site)
- Walkable rooms
- Interactive

### Drivers
- Multi-user immersion
- VR to Go
- Holodeck

### Barriers
Building Information Modeling (BIM)

- Formalized process/method for creating a holistic central data model
  - Object: description of the "product" building (geometry, material, costs, etc.)
  - Process: description of the planning, realization, operation, rebuilding/conversion (responsibilities, dates, plans, quality, construction process, site logistics, supply chains, acceptance criteria, building management, ...)

- Idealized
  - Uniform for each individual object and project
  - Access for all stakeholders
Building Information Modeling: Estimates today’s status

- Answers

**Areas of application**
- Shell construction
- Steel construction
- Visualizations
- Quantity determination
- Timber construction
- Civil engineering
- Operation

**Drivers**
- Complexity
- Projects
- Saving of time
- Planning security
- Costs
- Builder
- Data
- Economic efficiency
- Inventory recording
- Tenders

**Barriers**
- Inventory recording
- Interfaces
- Data availability
- Personnel
- Builder
- Different software
- Lack of additional remuneration or recognition of builder and clients
### Building Information Modeling: Estimates ideal state

- **How should it be?** – Answers

  **Answers**
  (marked answers were mentioned most frequently)

<table>
<thead>
<tr>
<th>Areas of application</th>
<th>Drivers</th>
<th>Barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy and intuitive model</td>
<td>Multidisciplinary building database</td>
<td>Adaptation of the degree programs</td>
</tr>
<tr>
<td>Complete 3D model with all relevant data</td>
<td>Collaboration</td>
<td></td>
</tr>
<tr>
<td>Easy, uniform merging of specialized models/improvement of 5D software tools</td>
<td>1:1 simulation of the construction process</td>
<td></td>
</tr>
<tr>
<td>More publication of successful BIM projects in the media</td>
<td>Lossless, neutral exchange format / cooperation without competition</td>
<td></td>
</tr>
<tr>
<td>Consistent flow of data, central information</td>
<td>Simple, intuitive interface for all users</td>
<td></td>
</tr>
<tr>
<td>First planning, then constructing (stress-free)</td>
<td>Open BIM and Big BIM</td>
<td></td>
</tr>
<tr>
<td>Synchronisation with external database</td>
<td>Real time planning virtual incl. costs</td>
<td></td>
</tr>
</tbody>
</table>
Thank you very much for your interest!
You are interested in this topic and you are looking for contact persons/ implementation partners? Please contact us.

Work group „Virtual Techniques in the building trade“ (VDC): Link
Competence Center Virtual Environments (Fh-IAO): Link

Virtual Dimension Center (VDC) Fellbach
Auberlenstraße 13
70736 Fellbach
www.vdc-fellbach.de