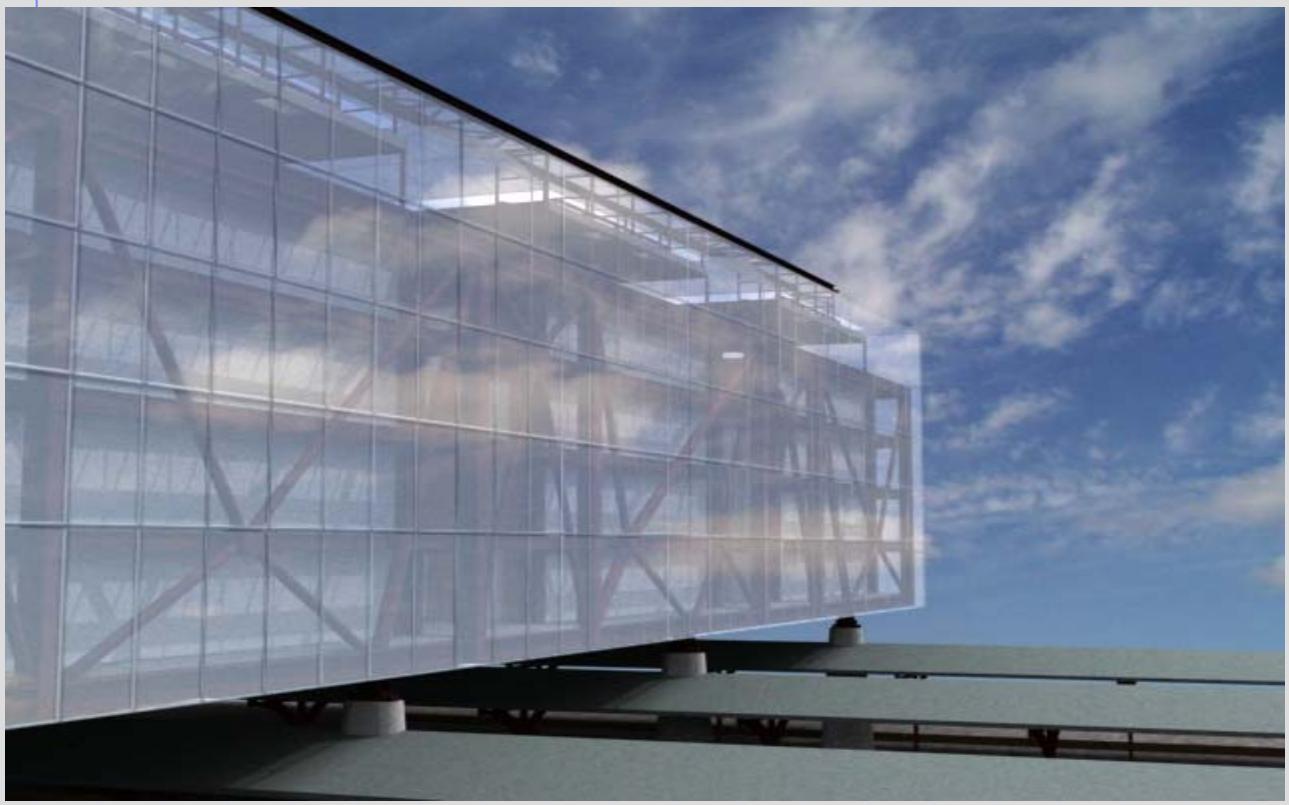
Applied Virtual Reality for Large and Complex Buildings (VRlcb)



A collaborative project between Chalmers, NCC AB and IT Construction & Real Estate 2002

CHALMERS

NCC

IT Construction & Real Estate 2002

A study of how Virtual Reality can be used in the construction of a large and complex building

VRlcb Project outline

- The Vision
  - To create and utilise computer generated buildings as virtual prototypes.
  - To use VR in all phases of the building's lifecycle.
- Aim and Scope
  - Study how Virtual Reality can be used in the planning and early construction of large and complex buildings
  - Study different modelling paradigms

Research activities

- State of the art report: Virtual Reality in Construction (Scandinavia and the UK)
- Pilot project "Centralhuset" - Paper
- Questionnaire of VR in the early production phase – Paper
- Experiences and Directions – Paper
- Licentiate report – November 2002

…also - conferences, workshops, collaboration with companies and universities, etcetera

VR modelling in Built & Environment

- Some experiences of creating a VR-model

Different modelling paradigms applied, tested and evaluated in an actual construction project – the building of a new hotel and office block ("Centralhuset") in Gothenburg, Sweden

Our aim is to provide some indications of direction in selecting the appropriate approach

"Centralhuset" – some data

- "Centralhuset" - approximately 34 000 m2
- Seven different blocks, five floors
- Offices, hotel, business activity and restaurants
- Steel structure and mixed prefabricated and cast-in-place concrete, etc.

- 3D and VR-modelling approximately 300 hours
- More than 10,000 objects
- "Only" 80 Mb

VR tools

Only commercial and commonly used SW and HW

Technical aids

- Software
  - Virtual Reality visualisation: Division MockUp
  - 2D/3D CAD/3D "vis" modelling and rendering: AutoCAD, 3D Studio, SolidWorks and Xsteel.
  - Lighting and image processing: Photoshop and Lightscape
- Hardware
  - PC/Laptop (graphics card, spacemouse)
  - PC monitor (mono or stereoscopic glasses)
  - 52" Plasma screen
  - Projector + screen

VR-visualisation

VRlcb

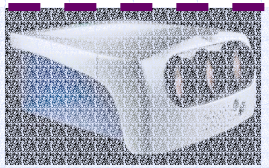
Degree of immersion

- Non-immersive (Desktop)

- PC monitor (mono-stereo)

- Projector (mono)

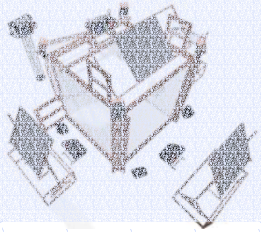
- Semi-immersive



- Projector (stereo)

- Immersive

- Head Mounted Display (stereo)

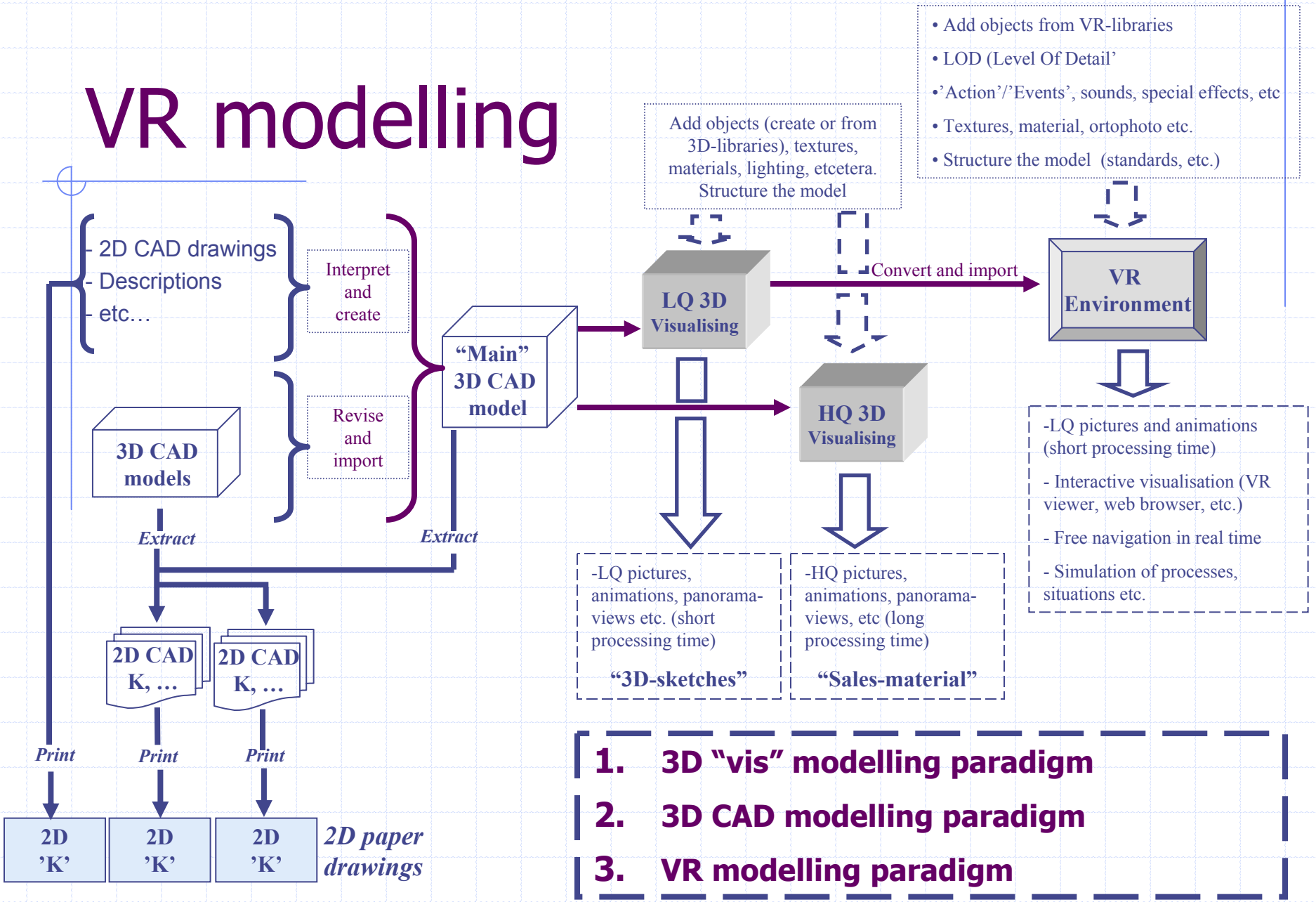


- 3D Cube/CAVE (stereo)

Sources of information

- Sources of information
  - Concrete structure – 2D CAD + paper drawings
  - Steel structure – 3D CAD
  - Pilings - 2D CAD
  - Façades and interiors – Architects description
  - Adjacent area – Old maps and real life conditions
  - Ortophoto – Bought from the National Land Survey

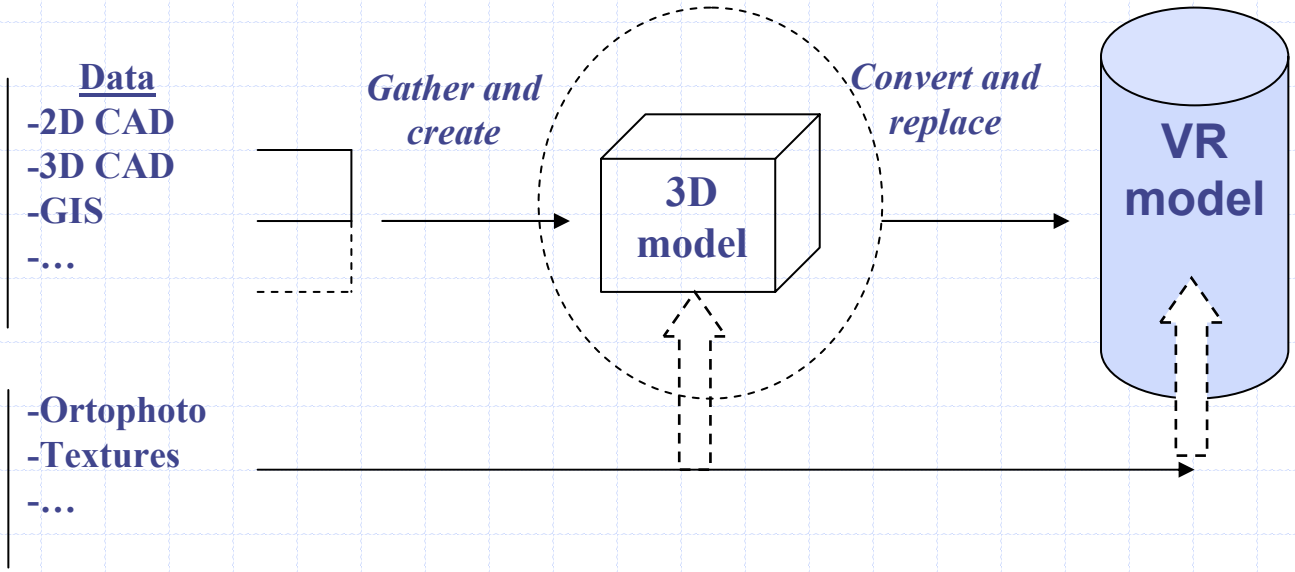
VR modelling



1. 3D "vis" modelling paradigm
2. 3D CAD modelling paradigm
3. VR modelling paradigm

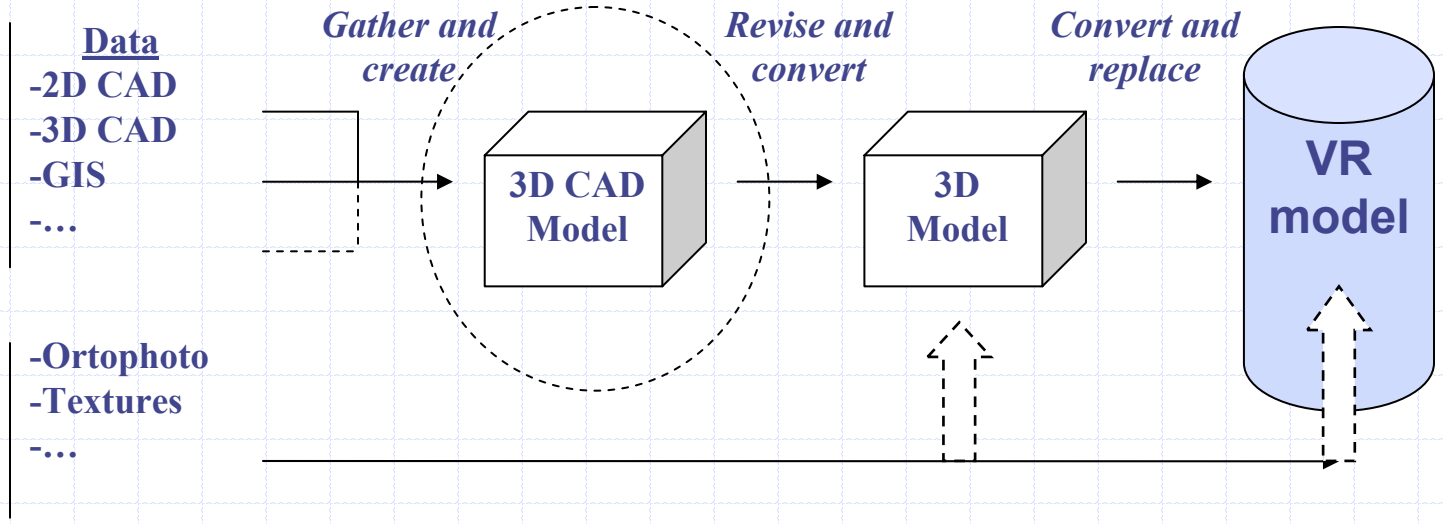
VR modelling – 3D "vis" paradigm

- The 3D "vis" model as the main model



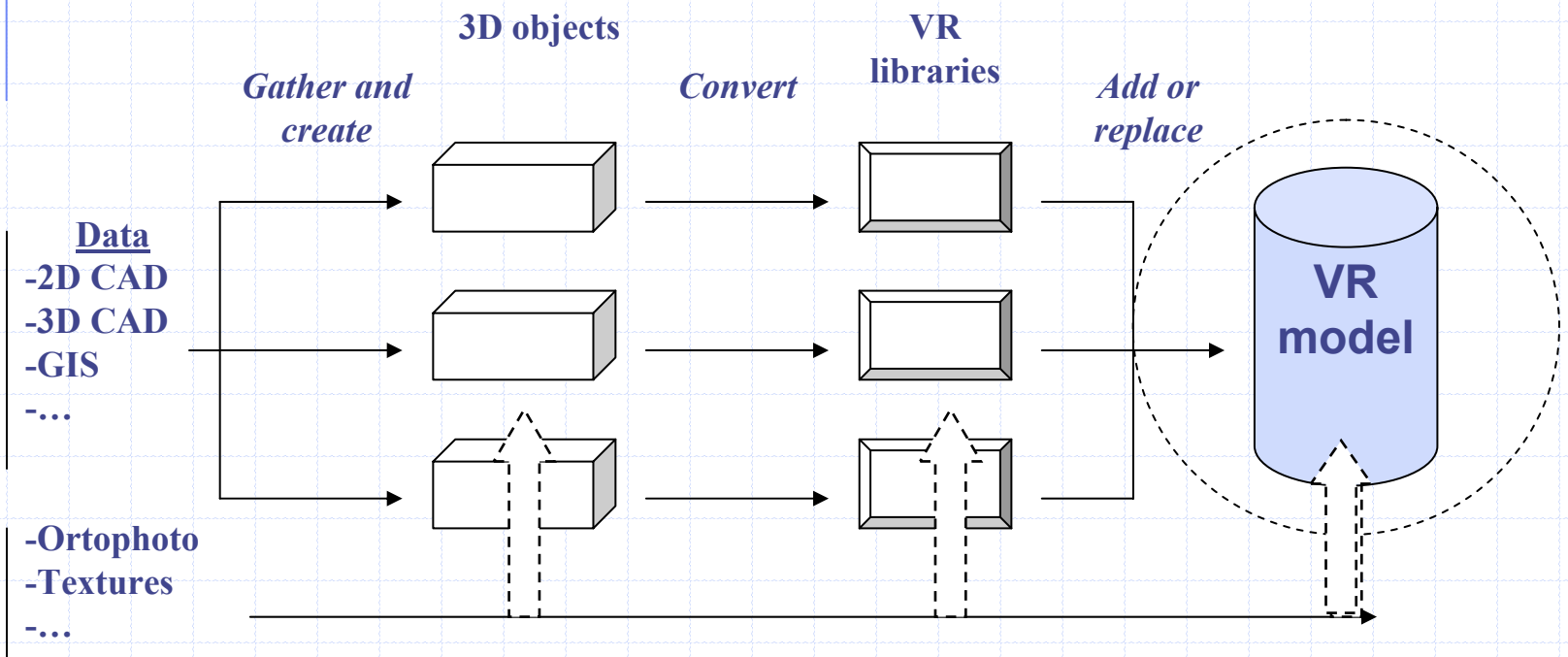
VR modelling – 3D CAD paradigm

- The 3D CAD model as the main model



VR modelling – VR paradigm

- The VR model as the main model



Results

1. The 3D "vis" paradigm

Some advantages and disadvantages

- **+ HQ pictures and animations**
- **+ Fast prototyping**
- **- Difficult to update**
- **- Difficult to extract 2D paper drawings**
- **- Difficult to gather information**

- For early design purpose or when the design or construction layout is fixed

Results

2. The 3D CAD paradigm

Some advantages and disadvantages

- **+ Easy to extract 2D paper drawings**
- **+ HQ pictures and animations**
- **+ Calculating costs, analyse the structure, etcetera**
- **- Difficult to update**
- **- Difficult to gather information**

- Complex structures – rather few updates

Results

3. The VR paradigm

Some advantages and disadvantages

- **+ Easy to update**
- **+ Use of standards (BSAB, IFC, Uniclass, etc.)**
- **+ Easy to create libraries**
- **-/+ LQ pictures and animations**
- **- Difficult to extract 2D paper drawings**

- Complex structures – constant revisions of the structure

Results

- From a general point of view:
  - Small investment compared to impact
  - Effective when concentrating on “problem areas”
  - Moving towards 3D CAD instead of 2D CAD

Take … into consideration

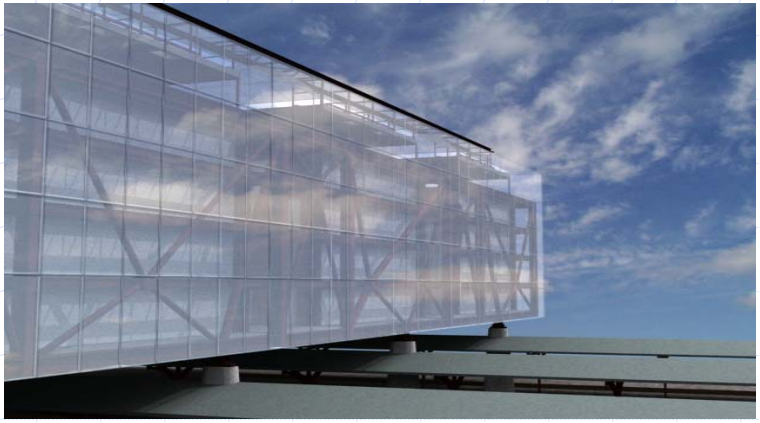
- The target formulation
  - Early design, planning… - for what purpose?
- The information flow
  - File, object and document handling, etc.
- The modelling procedure normally applied by the construction company
  - 2D CAD, 3D CAD, …
- …

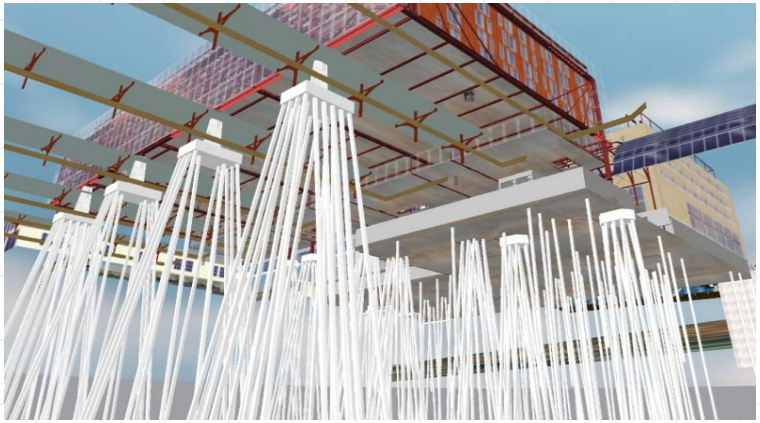
… which decides the modelling paradigm etc.

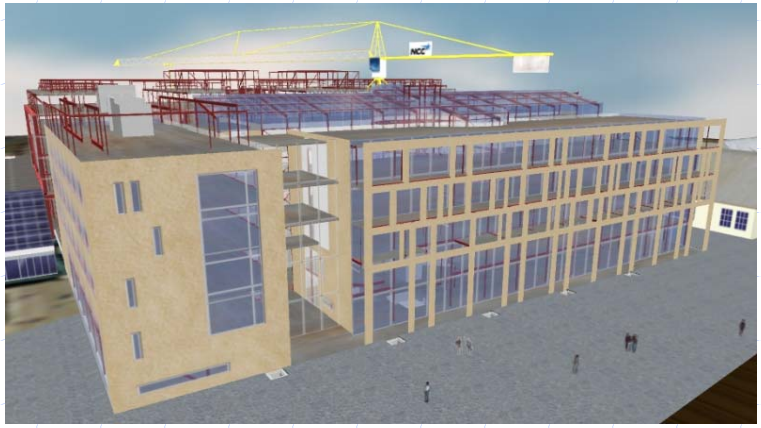
…also: coordinators, expert groups, use of standards, …

Some nice pictures

LQ pictures







Some nice pictures

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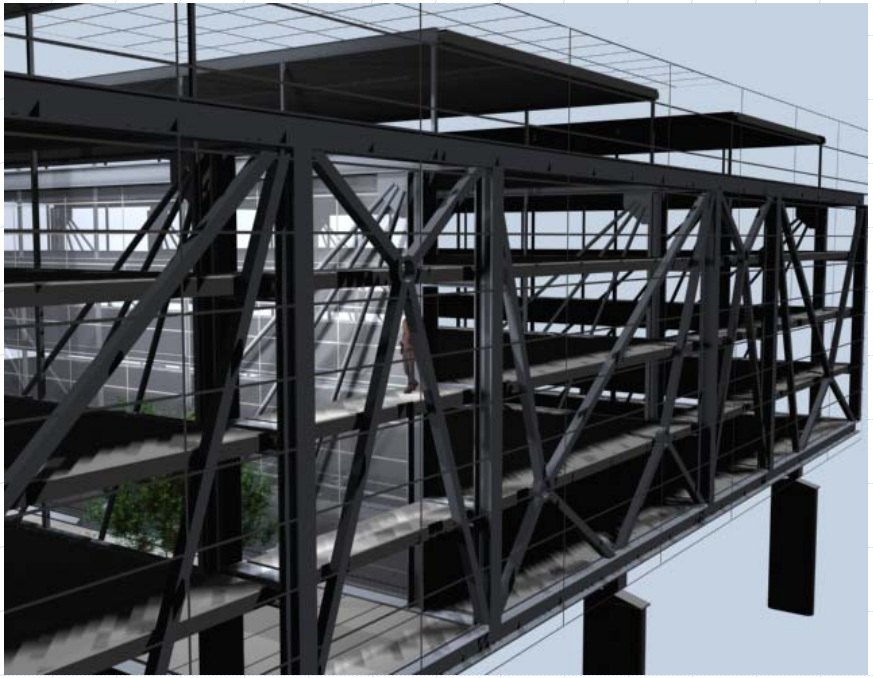

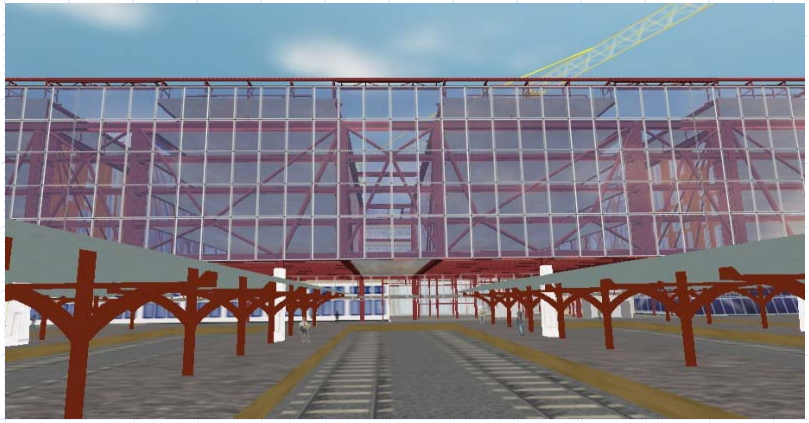

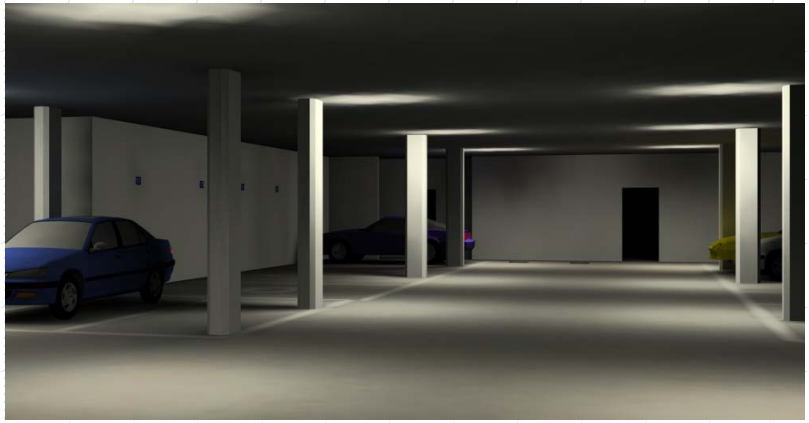

Summing up – in broad terms

From planning to early production phase

- The information handling is insufficient
- The VR model improves information handling
- Target formulation, specification of requirements, name structure – important!!
- VR /3D CAD paradigm is recommended (plan/prod)
- Updating, economical advantages? (more pilot projects/studies required?)

Suggested further research

- How can we streamline the process of transferring data from 2D paper,2D/3D CAD etc. into VR? – modelling paradigms, file handling etc.
- Installations/HVAC systems
- What kind of information can a VR model really supply – who owns it?
- 3D CAD instead of 2D CAD – when?

Thank You