
Viasys VDC
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2/27/2015
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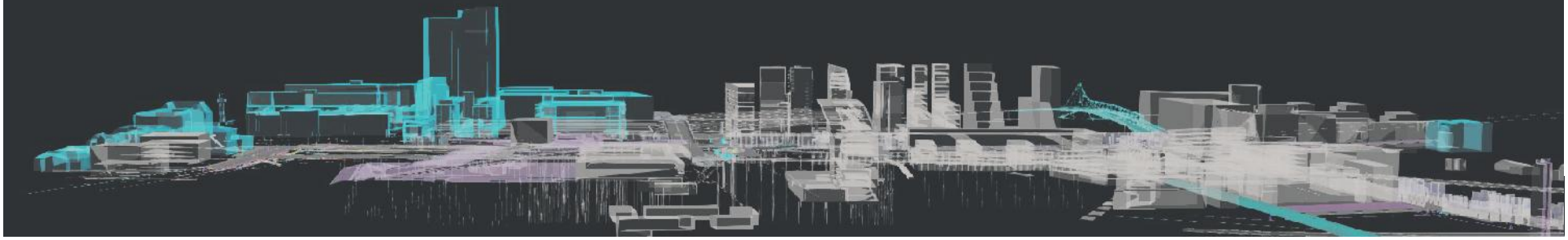
Lean and BIM experiences for large clients

Heikki Halttula
President & CEO
Viasys VDC
Tallinn 27.2.2015



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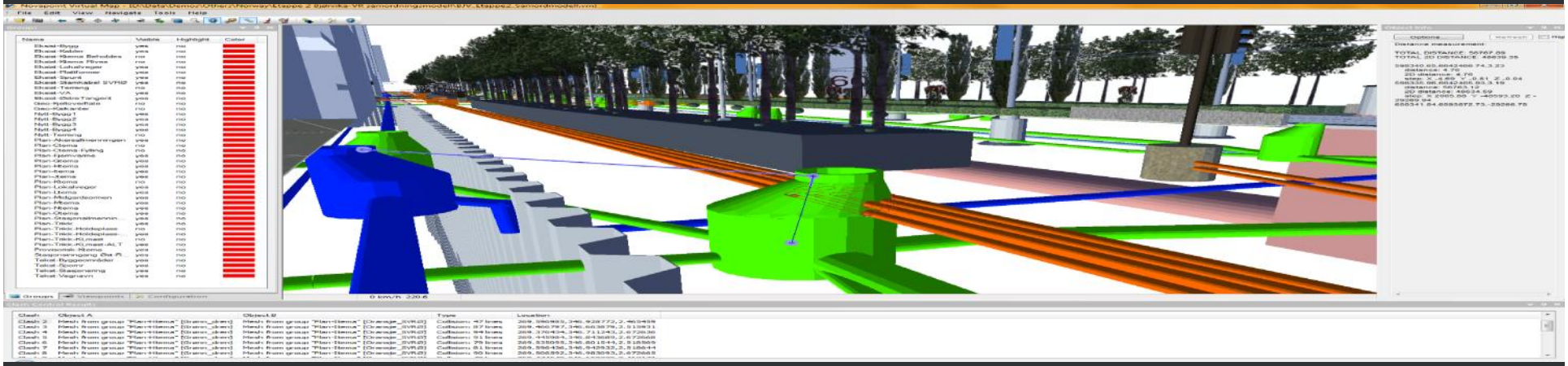
- Dedicated to civil engineering
- Business critical total solution
- Customers as strategic partnerships
- Agile value creation for customer
- Strong commitment to long term development
- Promotes open standards



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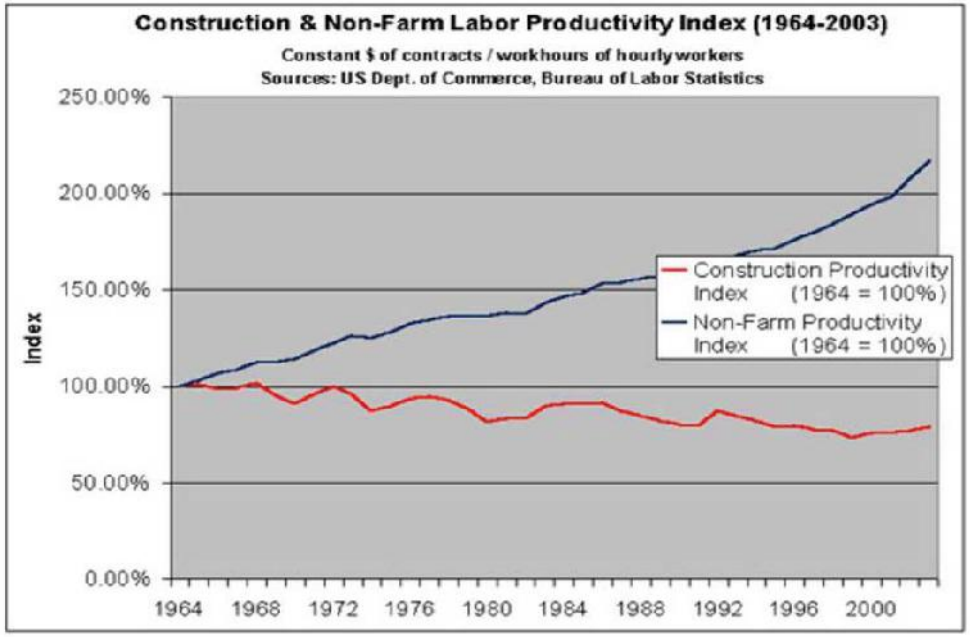
Industry Productivity Challenge



Courtesy of Stanford University

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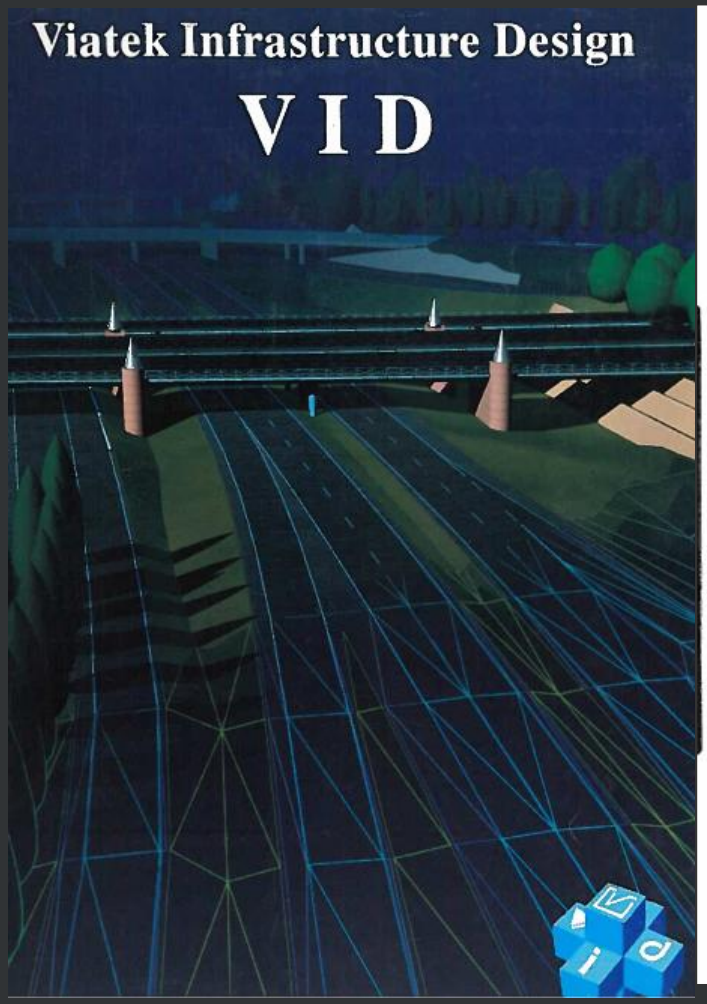
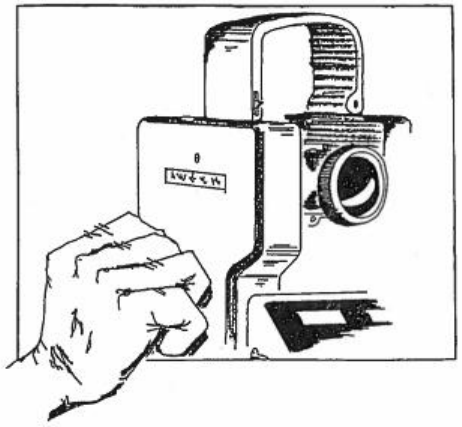


TAHYS

TÄHTÄYSMERKKIEN LASKENTAOHJELMA

KÄYTTÖOHJE



TIEHALLITUS

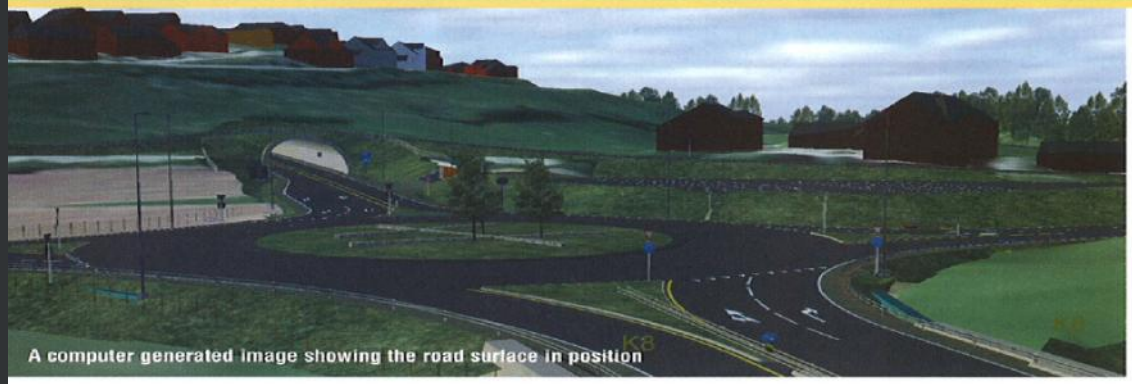
RAKENNUSOSASTO, TIENRAKENNUSTOIMISTO

VIASYS OY VERSIO 2.04 02.1990

Closer to non-paper construction

A highly precise virtual reality model is being created in parallel with the design of a Norwegian road, to help avoid conflicts in both design and construction. *(World Highways 7 January 2008)*

VISUALISATION



A computer generated image showing the road surface in position

drawing. And then that would have been too cluttered and you would ask them to separate it all again," he adds.

The model has helped particularly on this project which is being carried out very fast in just a year from start to finish, including the tunnel.

He would like to see more included in the visualisation to get a more direct link between the model and the work on site. At present the process of building the model is one way, information is passed into the model and it can be used for seeing all the problems – "and to keep the local community

> **"We think it is the first time a scheme has been done like this, certainly in Norway and probably in Europe"**
>
> **Asbjørn Hagen**

being used on site were from Denmark company Mikrofyn.

"We are closer to completely non-paper construction," says Olsson, though not quite there yet. He says that increasingly the contractor will ask for much more detail about coordinates from the consultant rather than just being given perhaps two end points for a curve or a top position for a manhole, as was traditionally done. We had to calculate ourselves the intermediate points but now we ask for those too."

But though the 3D design model can generate such information, he

like this are promised by Novapoint, which is upgrading its basic architecture to allow one single data model to feed the various layers and design sectors in the future (see panel).

Olsson also wants to the see models becoming more acceptable to various government inspection agencies. For example he believes that the accuracy and realism of the model could allow the signage on the project to be approved directly for line of sight and legibility, because the signs are shown in exactly the position and to the design that they finally have. For this pilot at least however, the physical inspection is still being demanded for items like that.

Hagen would also like to see the model being advanced to allow the contractors to use it for planning their construction sequences and looking for potential difficulties.

"We are not there completely with this trial," says Hagen, but with this project we have taken a large step" ■

Novapoint
www.novapoint.com

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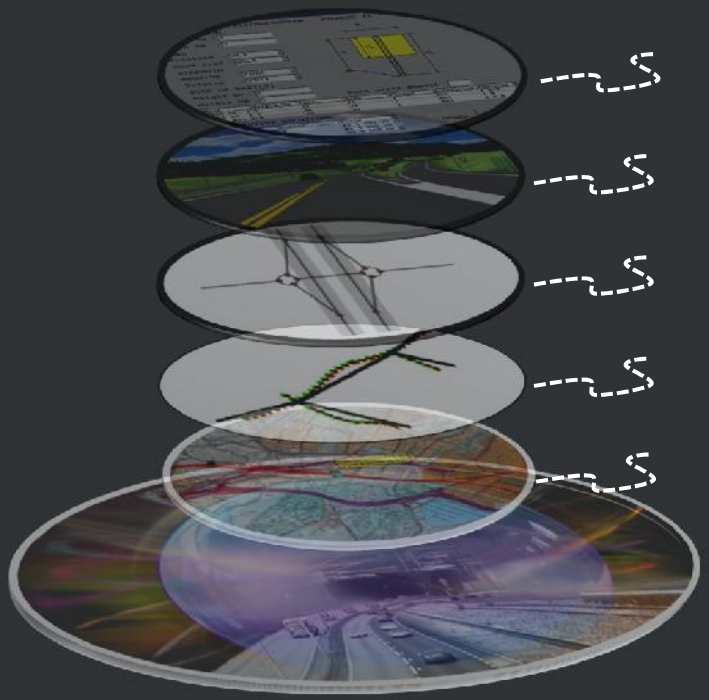
Civil Information Model



Objects and attributes

3D Model

Routes

Traffic network

3D Map

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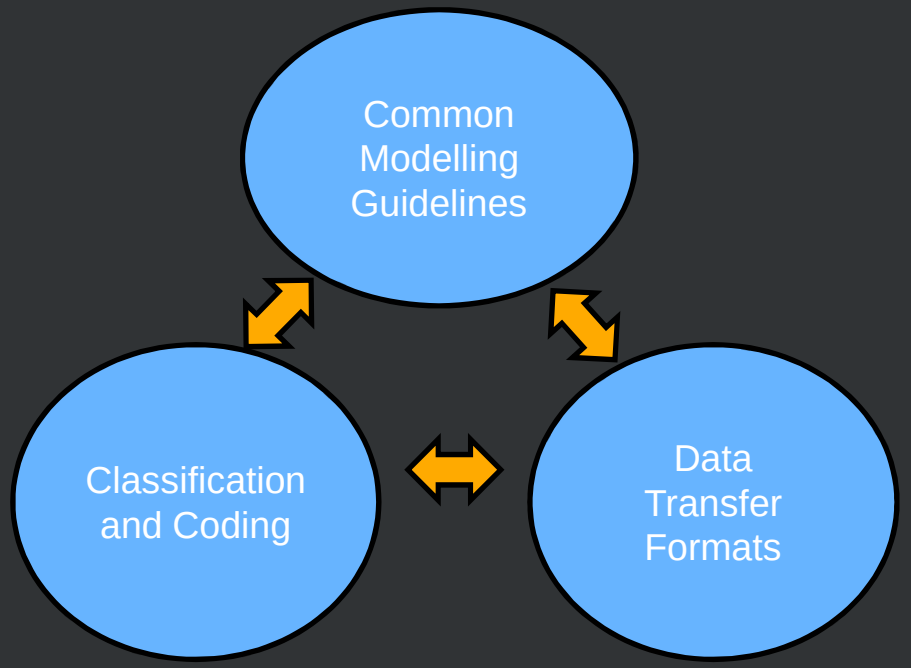
BIM Standardization

- Data Transfer Formats
  - LandXML for roads and pipe networks
  - IFC for structures
- Classification and Coding
  - Coding and naming of objects
- Common Modelling Guidelines
  - Describe the requirements and process in different project phases



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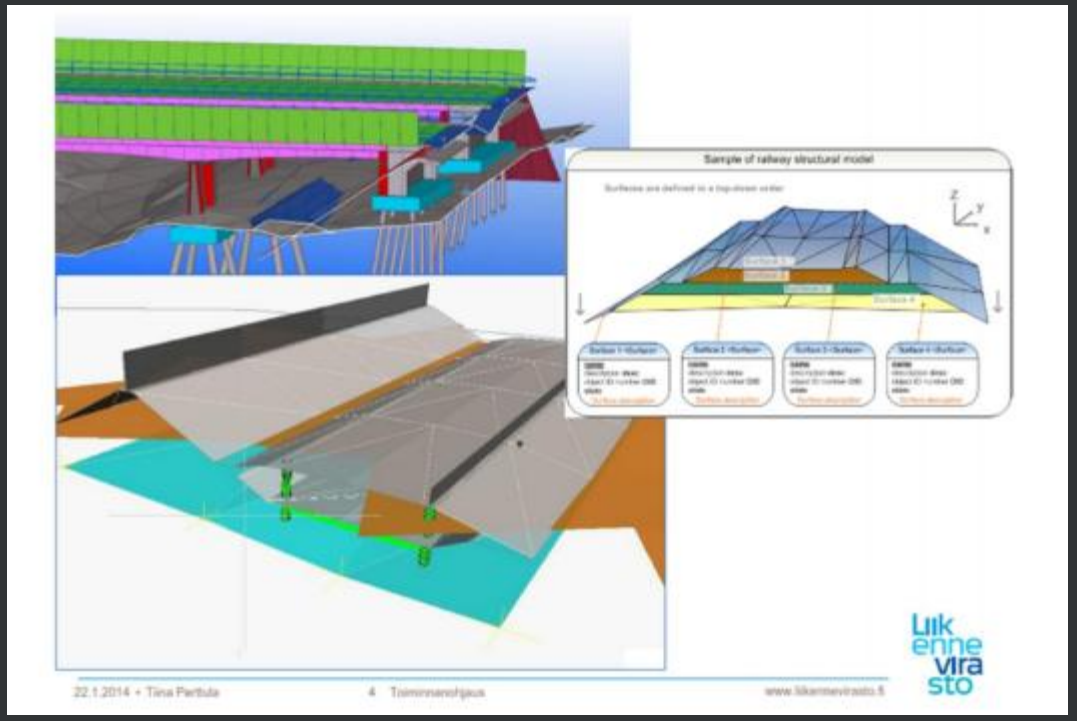
buildingSMART and OGC

Organizations for Developing International Standards

- On-going projects
  - LandXML MVD
  - Alignment definitions in IFC
  - IFC-Bridge
- Planned projects
  - IFC-Road
  - As-built data
  - Data dictionaries for infrastructures
- Other activities
  - Liaison with Open Geospatial Consortium (OGC)
  - InfraGML (OGC & buildingSMART)



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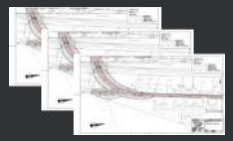
Industry is changing from documents to models

Where we are | Where we are going

2D Drawings



Single discipline
Manual & CAD
Discipline approach

3D Models

Single discipline
Limited intelligence
Discipline approach

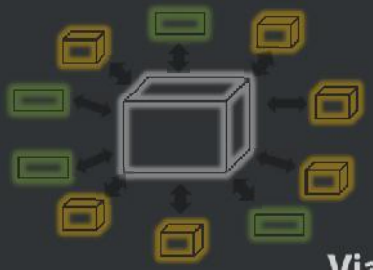
3D Collaboration models

Multi discipline
VR-Visualization
Project approach

3D Integrated Intelligent models

Multi discipline
Multi phase
Web-Server based
Life cycle approach

ISOLATED | COLLABORATIVE | INTEGRATED



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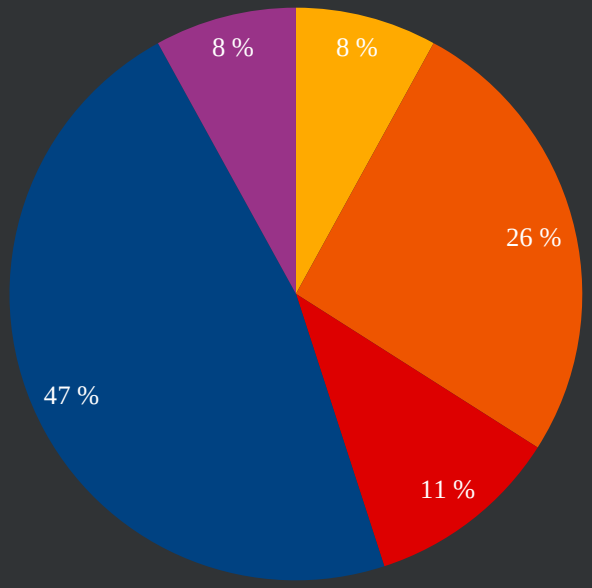
Barriers to Achieving the Benefits of BIM



- Halttula *et al.* (2015)

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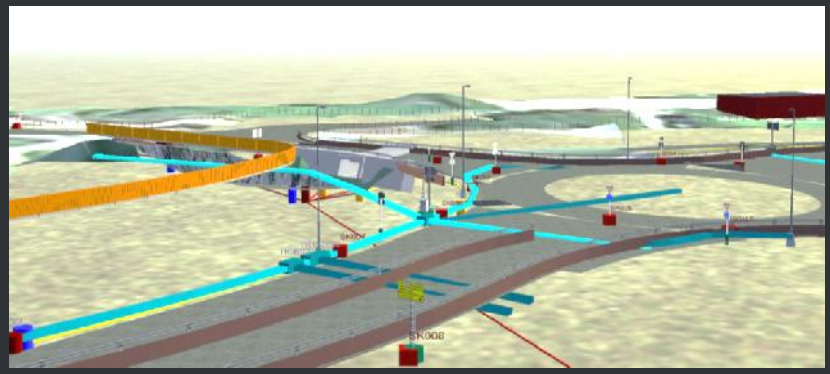
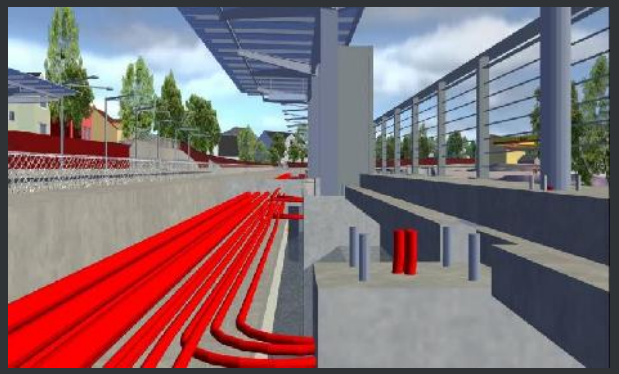
VDC Model Definition

- A collection of DTM, sub-surface models and all domain models within the same model
- All data should have their correct 3D geometry and could be used directly to produce stake out data
- Should be used to run clash detection and other simulation and analysis
- Should be possible to view in a free viewer, where you could move around in 3D





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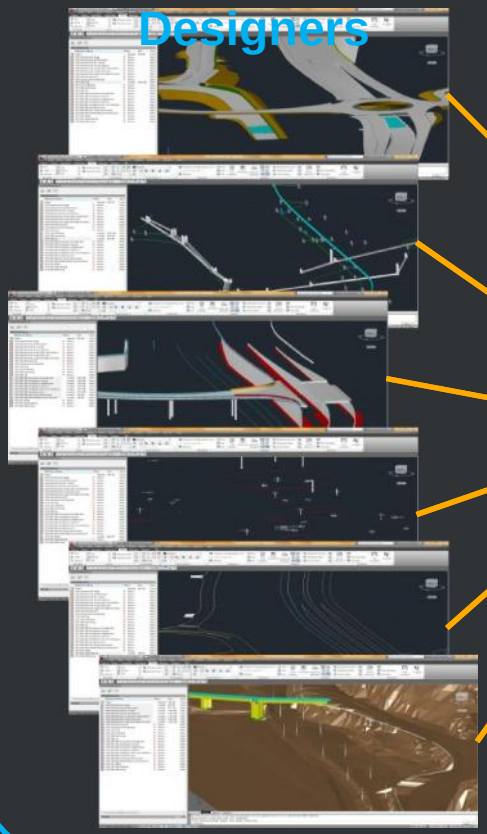
Roles and responsibilities

Designers



BIM/CAD Coordinator

DWG
XRef

LandXML
Civil3D, NP

- Clash calculations
- Problem locations
- Reports and agenda lists
- Virtual model delivery

Services

- Model cloud
- Support
- Modeling aid
- **Vianova services**
- Internet
- Visualization
- Presentations

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Value for Several Dimensions of VDC

- Enables 20% savings in civil construction cost
  - Collaboration models Integrate design sub models to be used for construction defect free
- Better coordination and communication
- Effective presentations ja automated visualization
- Designed for mainstream VDC production
- Solution for each project phases and roles

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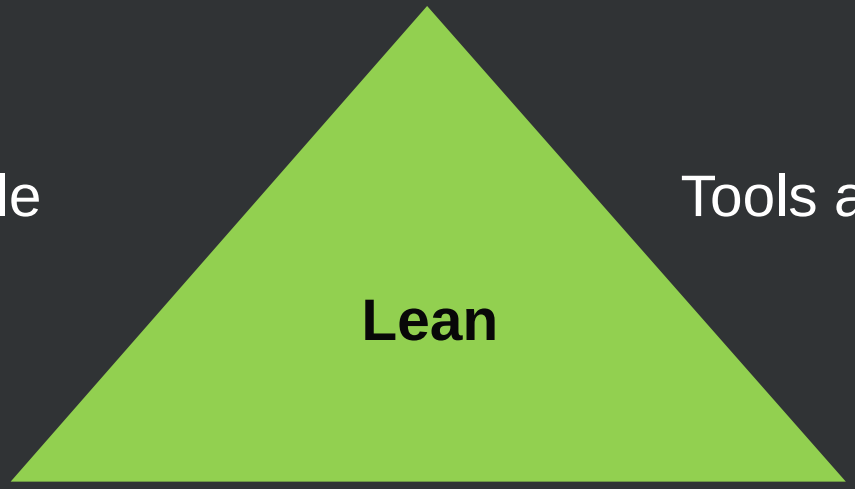
The Lean Ideal

Give customer products exactly fit for purpose, instantly, with no waste

Maximize value for customer and minimize waste

Lean production system



Lean Construction vs. typical contemporary practices

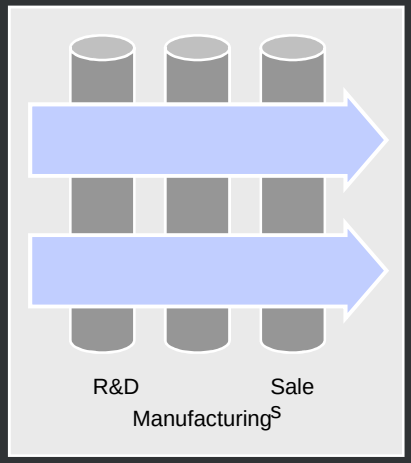
- According to Tommelein and Ballard (1999), managing construction using Lean Construction methods differs from typical contemporary practices in the following ways:
  - It employs a clear set of objectives for the delivery process;
  - It is aimed at maximising performance for the customer at the project level;
  - It designs products and processes concurrently and
  - It applies production controls throughout the life of the project.

Lean design vs western tradition

Better results faster, with less work

Four differencies:

- Leadership
  - Project managers have more power
- Teamwork
  - projects are well done vs. line oragnization's profit
- Communication
  - Confront conflicts directly
- Simultaneous development
  - Work starts immediately, when there is enough information vs sequential from department to another



- (Machine that changed the world, Womack & Jones)

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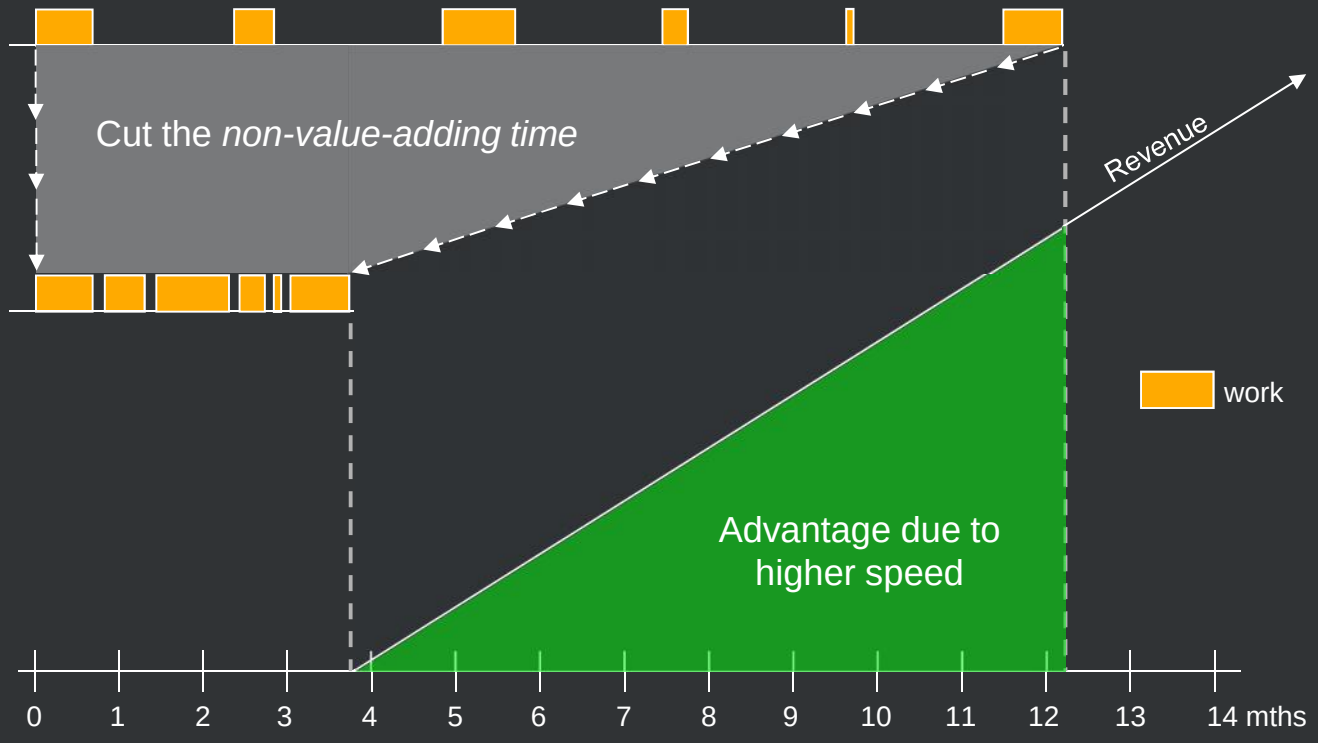
Speed is important factor in production



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The contemporaneous use of BIM and RPDA

- The key features of BIM are collaboration models, simulation and comprehensive data storage.
- The key features of RPDA are integration, a mutual and single project objective, early involvement and communication.
- The contemporaneous use of BIM and RPDA give benefits to the project.

Halttula et al. (2015)

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The characteristics of BIM

Information centre	- All information is stored into the model or the model has direct links to the information.
Collaboration model	- A collaboration model can be used to find clashes between design domains and to find other design mistakes. - A common real-time collaboration model helps improve communication between stakeholders. - BIM helps to arrange collaborative meetings based on a shared model and a virtual reality application.
Simulations	- Model can be used to simulate the construction operation and maintenance process.

Halttula et al. (2015)

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The characteristics of RPDA (Relational Project Delivery Arrangements)

Mutual and single object	- Mutual and single project objective. - Open accounting documents among team members - Shared project benefits and risks (value-based approach) - Unrestrained communication and wide use of technology
Integration	- No organizational boundaries - Co-location of a project team - Focus on solving problems, not on finding out who is guilty (‘no blame’ culture) - Fair and respectful culture among team members. - Value co-creation
Early stakeholder involvement	- Early involvement of key stakeholder - Each team member has an equal opportunity to contribute to the project objective and delivery process. - Increased predictability of overall costs and schedule - Unrestrained communication and wide use of technology

Halttula *et al.* (2014)

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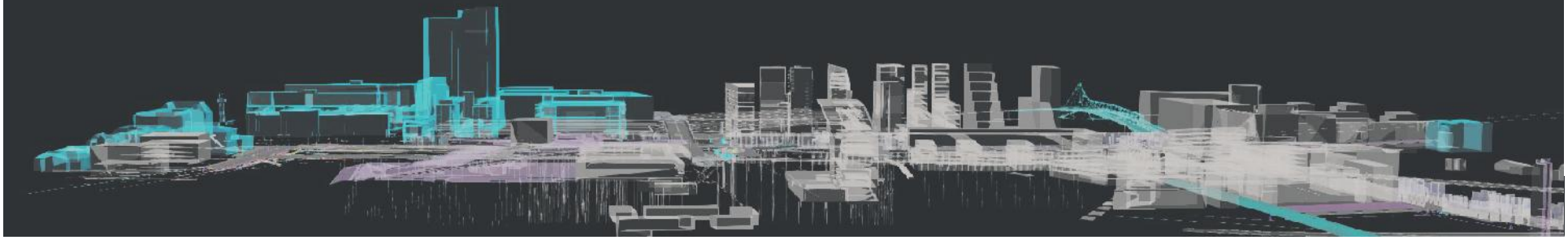
VDC Benefits



VDC Benefits, Norway study

Norwegian Public Road Administration

Project	Contract type	Project method	Contract sum	CCO costs	CCO number	CCO %	Contractor	Consultant
RV 150 - E03; Ring 3 Ulven-Sinsen	Construction contract Unit price	Traditional	301 mill	57 mill	680	18,9%	NCC Construction	Multiconsult
RV 150 - E22; Ring 3 Ulven-Sinsen	Construction contract Unit price	Model HB 138	532 mill	52 mill	491	9,8%	Veidekke	ViaNova/Aas-Jakobsen/Multiconsult
E6 – Nordre, Trondheim	Turnkey	Model HB 138	263 mill	20 mill	80	7,6%	Skanska	ViaNova/Aas-Jakobsen-nettverket
Fv. 456 Vågsbygdveien, Auglandsbukta-Flødemelka	Construction contract Unit price	Model HB 138	43,7 mill	1,8 mill	86	4,2%	Veidekke Entreprenør	ViaNova Kristiansand
E6 Skaberud - Kolomoen	Construction contract Unit price	Traditional	470 mill	85 mill	385	18,1%	Hæhre Entreprenør	Multiconsult
Joint Project E6-Dovrebanen	Construction contract Unit price	Model HB 138	1,8 mrd	149,5 mill	178	8,3%	Hæhre Entreprenør	Cowi

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VDC Benefits, Norway study

Norwegian Public Road Administration

- We can assume that model-based projects reduces errors and deficiencies in the design material. This means faster construction and lower cost.
- We can also assume that more focus on basic model data quality will reduce the "unforeseen" proportion of CO´s.
- The change orders are reduced significantly. The analysis shows an 11% decrease in change orders using the model design method vs traditional.

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VDC Benefits, Norway study

Contractor Comments

"The 3D discipline **models make our work day simpler and more effective**. There are almost no errors or conflicts between the disciplines in the models, from which we build the E22."

Petter Bakke
Project Manager

"The collaboration model provides a true understanding of the objects. **This improves communication and provides a neat and accurate picture that everyone understands.** We eliminate misunderstandings. This includes communication with the public, as well as with the participants of the project."

Erling Guttormsen
Statens vegvesen Region Sør

"The use of a coordination model in the project made sure we had **practically no stops due to design errors**, such as collisions between disciplines. We could produce continuously. Uninterrupted construction by crew and equipment, are the two most important factors for a cost-efficient production."

Bård Olav Aune
BIM Manager
Skanska Survey

"The quality of the set out data using a coordination model is the greatest benefit of model use. **The data flow to machine control prevents manual errors**."

Jarle Kristian Tangen
Division Manager
Statens vegvesen Region Sør

"BIM models no doubt contribute to **reducing the contractor's risk**. One feels safer both about price and project implementation when handing over the tender."

Arve Krogseth
Project Manager

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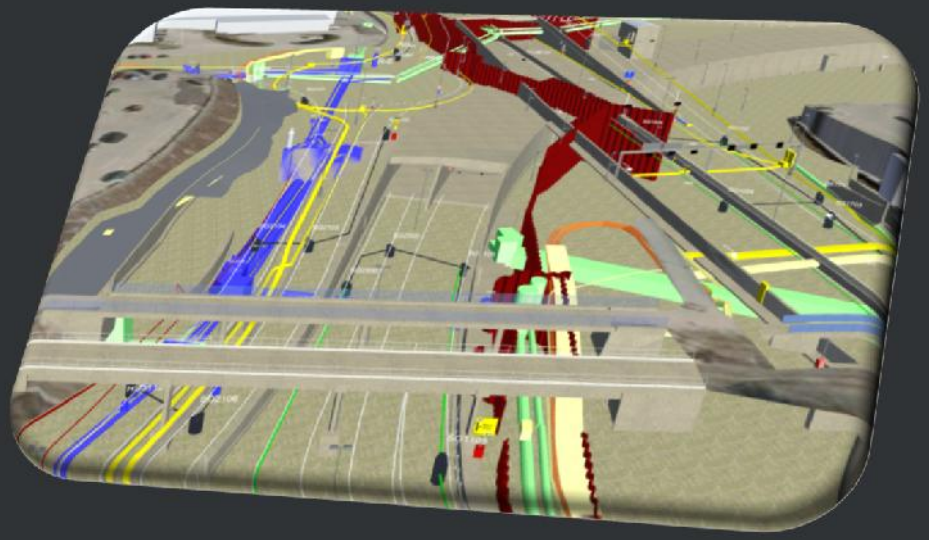
Case Study: RV 150 Ring 3, Ulven – Sinsen

Owner: Road Department, Contractor : Veidekke

- Average cost per change/conflict has been calculated to be about $ 9600 (Norwegian Road Authority)

- Part 1: VDC model was not used
  - About 250 out of 600 changes were caused by design conflict between domains
  - Additional cost of $ 2.4 mill. (+4,6%)

- Part 2: VDC model was used
  - “There has been almost no design change/conflict on this parcel, E22”, Petter Bakke, Veidekke
  - Potential cost savings $ 2.4 mill.



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Case Study: 31774 Gjønnes station

Owner: KTP AS, Contractor: Veidekke

- Total 350 conflicts was found
- Half of them had not been detected without a VDC model

- Based on Norwegian Road Authority estimate potential cost savings have been $ 1.7 mill.

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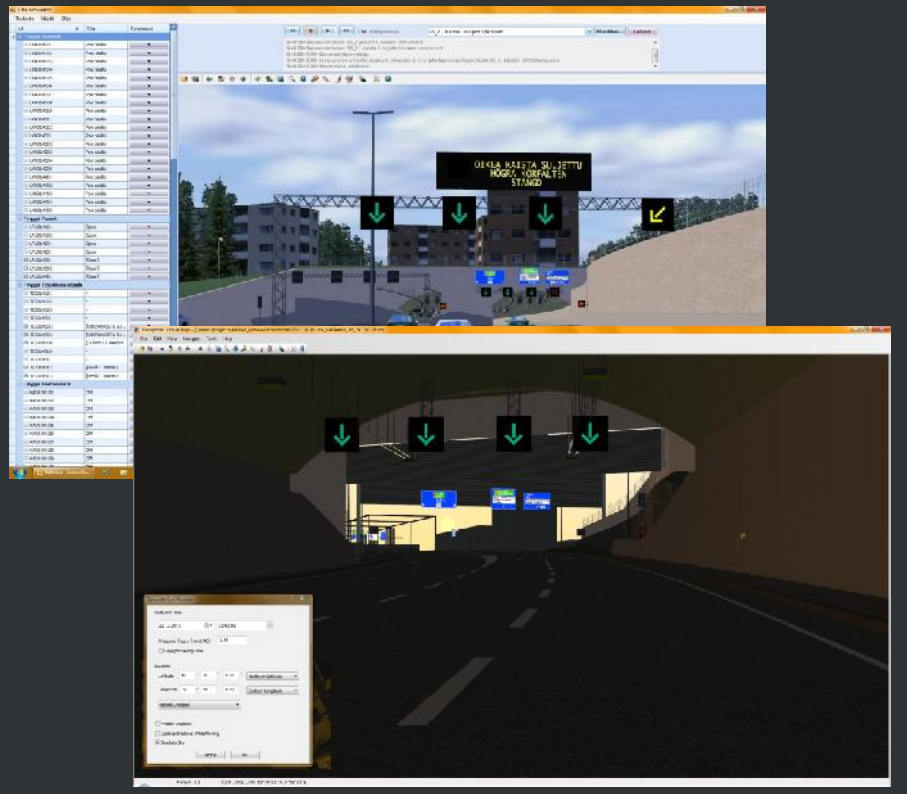
Case Study: Ring-I Mestari tunnel, Finland

Owner: Road Authority, Contractor YIT

- VDC model for simulating traffic guidance and safety
  - Sequence planning
  - Virtual training and testing
  - Traffic camera placement
  - Sunlight protection
- Major time savings
  - Delivery 3 months earlier
  - Overall project 1 year earlier
- Infrastructure construction of the year 2010 award



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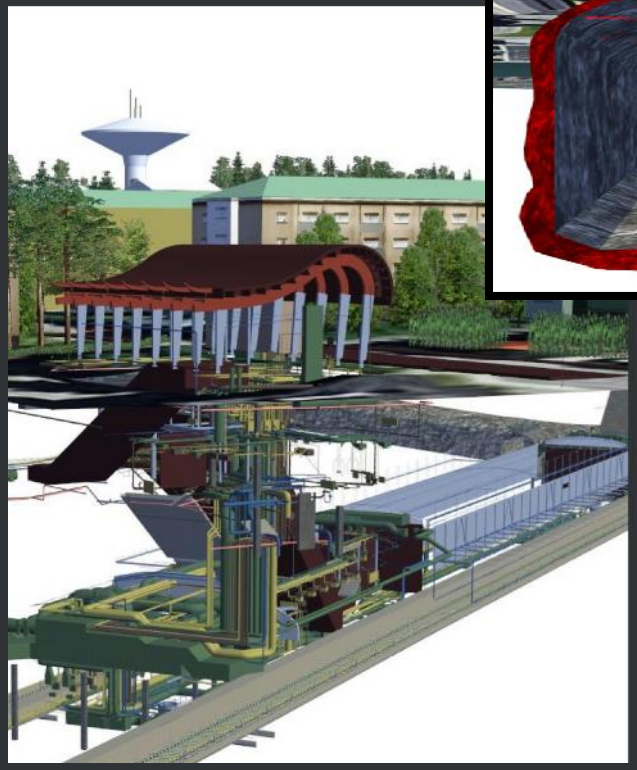
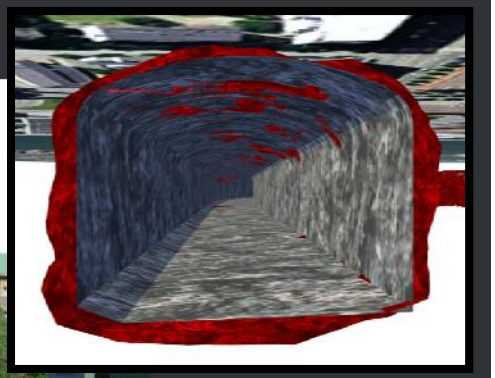
Case Study: Länsimetro, Finland

Owner: City of Espoo and Helsinki, Contractors: Multiple

- Combined data model
  - GIS (GML: surroundings)
  - CIM (LandXML: subway)
  - BIM (IFC: structures, MEP)
- Target in maintenance
  - AsBuilt model
  - Maintenance planning and operations in 5D
  - Digital service manual + 3d model + mobile
- Lifecycle Management
  - Design → Construct → Maintenance





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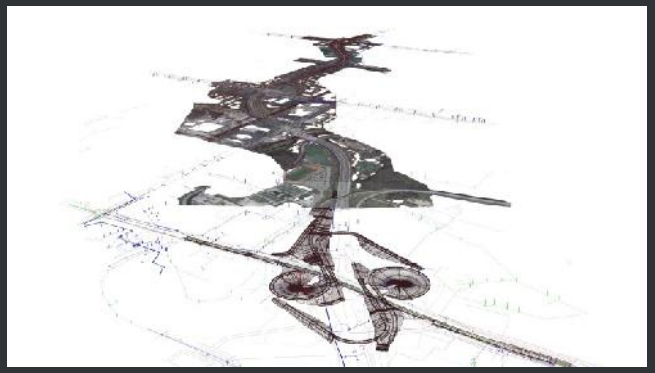
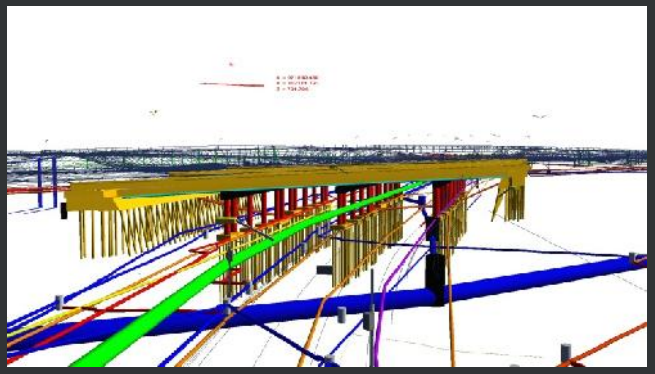
Case Study: Zoo Interchange Pilot
Owner: Wisconsin Department of Transportation

- Input data
  - Utilities, Civil3D into Viasys VDC direct
  - Revit structures into DWG / IFC
  - Bentley InRoads data into LandXML
- Modeling
  - Parametric tools allows automatic utilities modeling from line data
  - Direct links to input data allows automatic model updates when design changes
- Results
  - Cost effective modeling in 1 day
  - Design system independent via LandXML (Civil3D & InRoads)
  - Whole Zoo IC as one model





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Case Study: Helsinki City Rail Loop

Owner: Finnish Transportation Agency

- BIM service includes verified information models
  - VDC Stream – BIM on Cloud
  - VDC Explorer – BIM Analysis
- Combined information model
  - Delivered materials are verified
  - Continuous model updates
- BIM service (project server)
  - Easy access to information everywhere and any time
  - 3D BIM preview in browser

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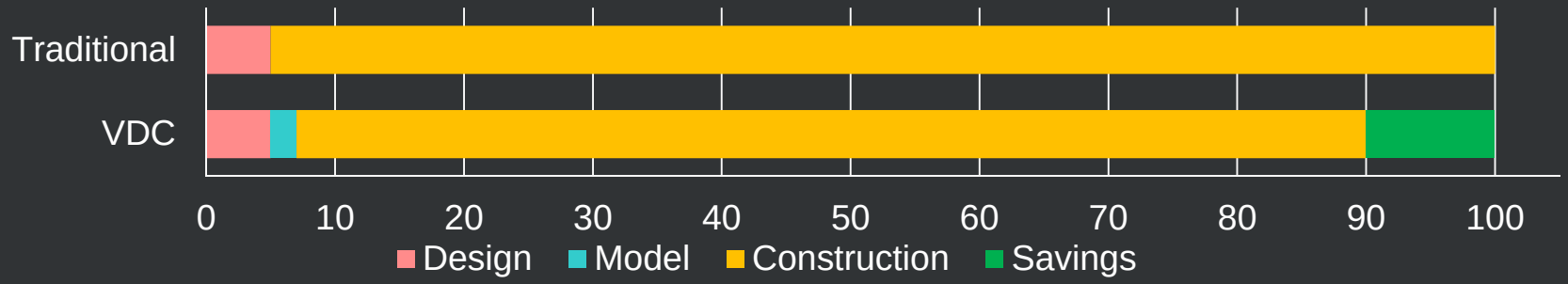
VDC Potential in Construction

- Typical construction change orders are about 5-20% of construction costs
- By using VDC about half of change orders can be avoided
- Potentially 4-10% savings in costs
- Almost 0 change orders because of design errors

- VDC increases design costs but saves more in construction
  - More re-design in earlier phases due to digitally found clashes and design optimization between disciplines
  - Less waiting on site and less re-design during construction
  - Clearly positive ROI



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Industry is changing from documents to BIM

Where we are | Where we are going

2D Drawings	3D Models	3D Collaboration models	3D Integrated Intelligent models
			
Single discipline Manual & CAD Discipline approach	Single discipline Limited intelligence Discipline approach	Multi discipline VR-Visualization Project approach	Multi discipline Multi phase Web-Server based Life cycle approach

ISOLATED (Level 1) | COLLABORATIVE (2) | INTEGRATED (3)

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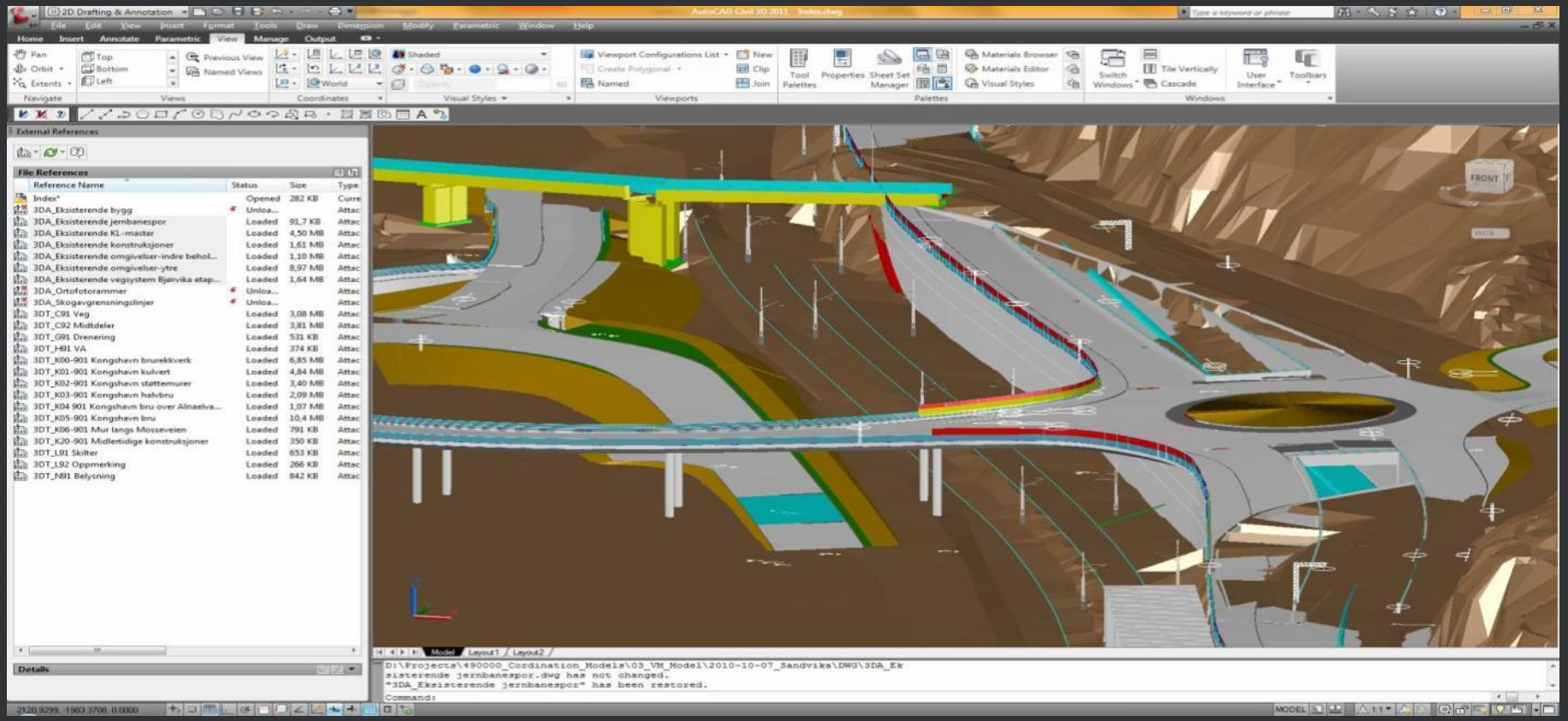
Complete model from discipline sub-models



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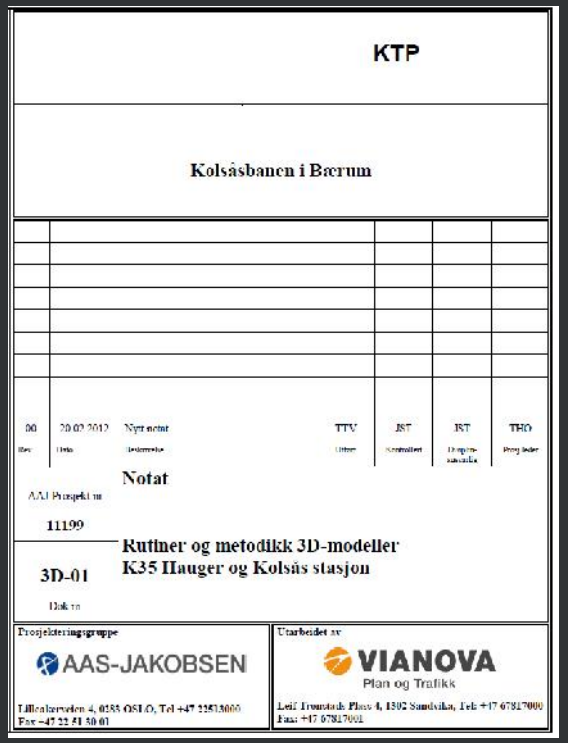
Example Implementation of VDC

- Process
  - Agreements
  - Roles and responsibilities
  - Schedules
- VDC Manual
  - General guidelines
  - Naming (Layers, files, folders, …)
  - Methods
  - Used software
  - Interfaces
  - Formats
  - Data contents
  - Grouping
  - Quality requirements
  - Feature data
- Pre-defined templates
  - Modeling rules, DWG templates, libraries
- IT Infrastructure
  - Data storage
  - Model distribution


KTP

Kolsåsbanen i Bærum

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Rev	Dato	Endringer	Utført	Kontrollert	Prosj.leder

Notat

AAJ Prosjektnr

11199

Rutiner og metodikk 3D-modeller
K35 Hauger og Kolsås stasjon

3D-01

Dok.nr

Prosjekteringsgruppe

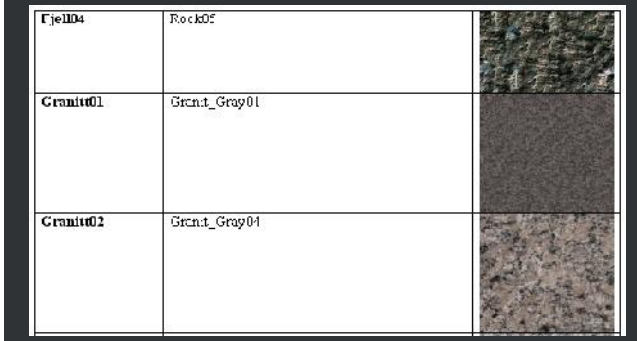
AAS-JAKOBSEN

Lilleakerveien 4, 0283 OSLO, Tel +47 22513000
Fax +47 22 51 50 01

Utarbeidet av

VIANOVA
Plan og Trafikk

Leif Tronstads Plass 4, 1302 Sandvika, Tel: +47 67817000
Faks: +47 67817001



Fjell04	Rock05	
Granitt01	Granit_Gray01	
Granitt02	Granit_Gray04	

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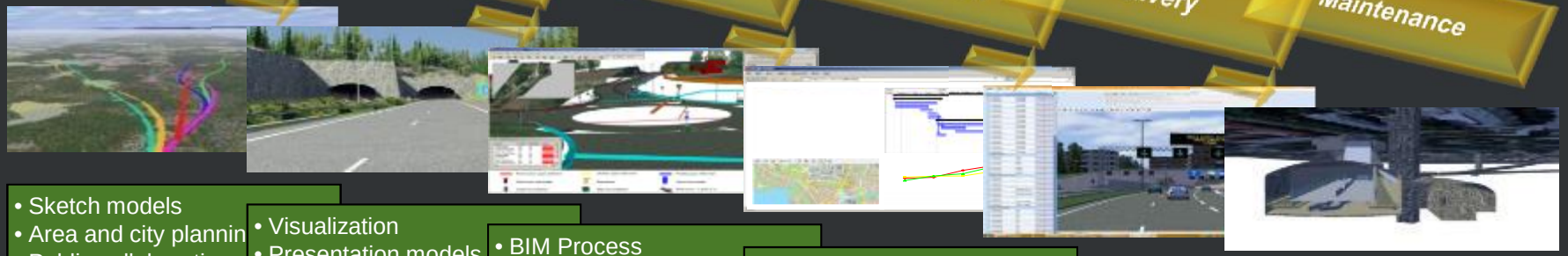
BIM in Project Lifecycle

Conceptual Planning | Planning | Design | Construction | Delivery | Maintenance



- Sketch models
- Area and city plannin
- Public collaboration
- Alternatives
- Feasibility
- Impact on environme
- Rough cost etc. estim
- Modeling of existing

- Visualization
- Presentation models
- Social acceptance
- Decision making
- Cost estimation, fund
- Presentation models, images, animations,

- BIM Process
- Detailed models of exis and designed
- All disciplines
- Simulation
- Analysis
- Clash detection
- Quality management

- BIM Process
- 4D Staging / Schedul
- 5D Cost, resources,
- Stakeout data from m
- Machine control data
- Construction safety
- Site planning
- As-Built data collecti

- BIM model based As- quality inspections
- Maintenance planning
- Simulators for operati training, safety

- Maintenance model
- Maintenance planning and operation
- Model updates
- Digital Service Manuals
- Life Cycle Management

Data Life Cycle Management using Open Standards

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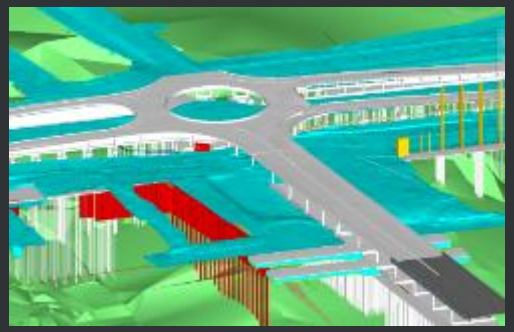
What Does BIM Mean in Civil Engineering?

The existing situation is modelled: Basic data/terrain models



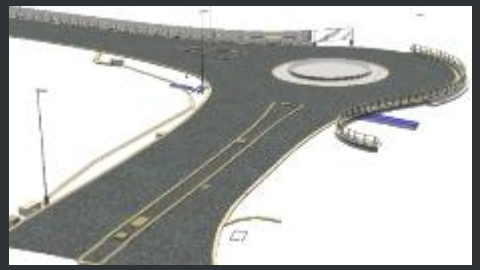
→ The new infrastructure design is modelled: Discipline models

→ Multi-discipline presentation models ease the decision processes

The contractors use the models to build from: Planning, setting out data, machine control

→ Approved changes are registered by the contractors – updating the discipline models «as built».

→ Data for operation and maintenance can be retrieved from the «as built» discipline model



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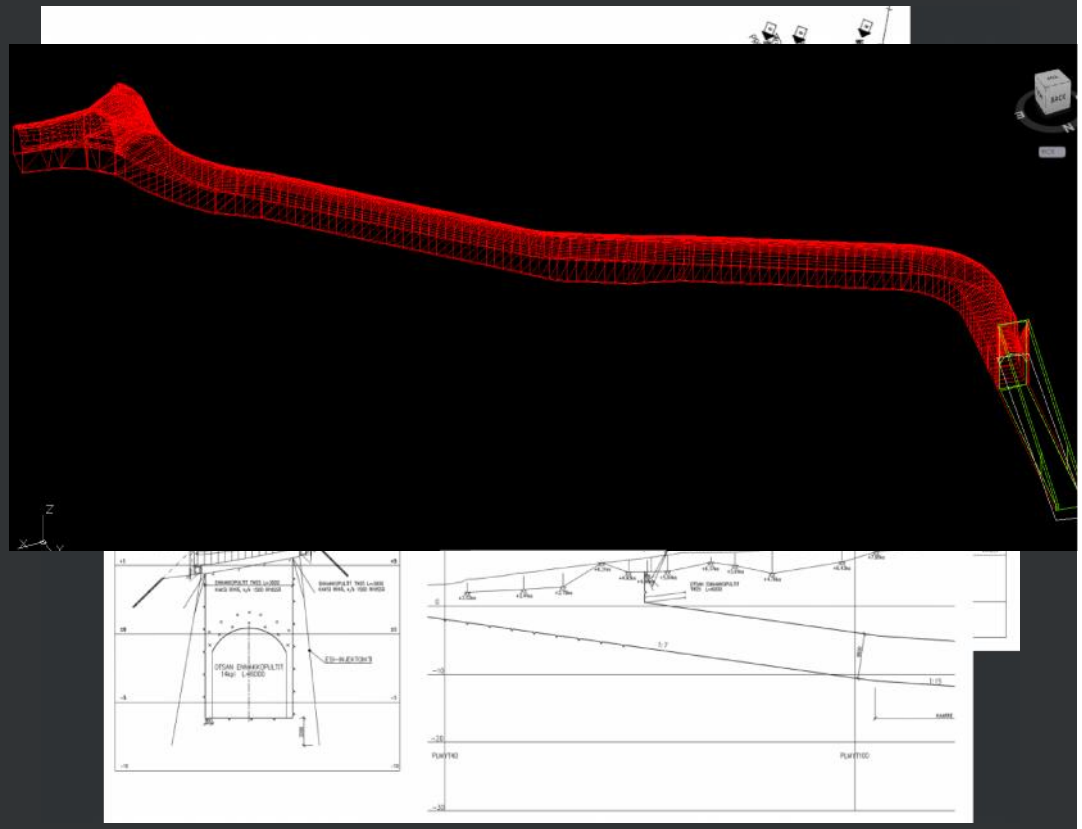
2D Plans to 3D Models as Service

- Initial data
  - Terrain Model
  - Design map (plan)
  - Longitudinal Section
  - Cross section
- Model output
  - VDC Explorer Package, LandXML, DWG



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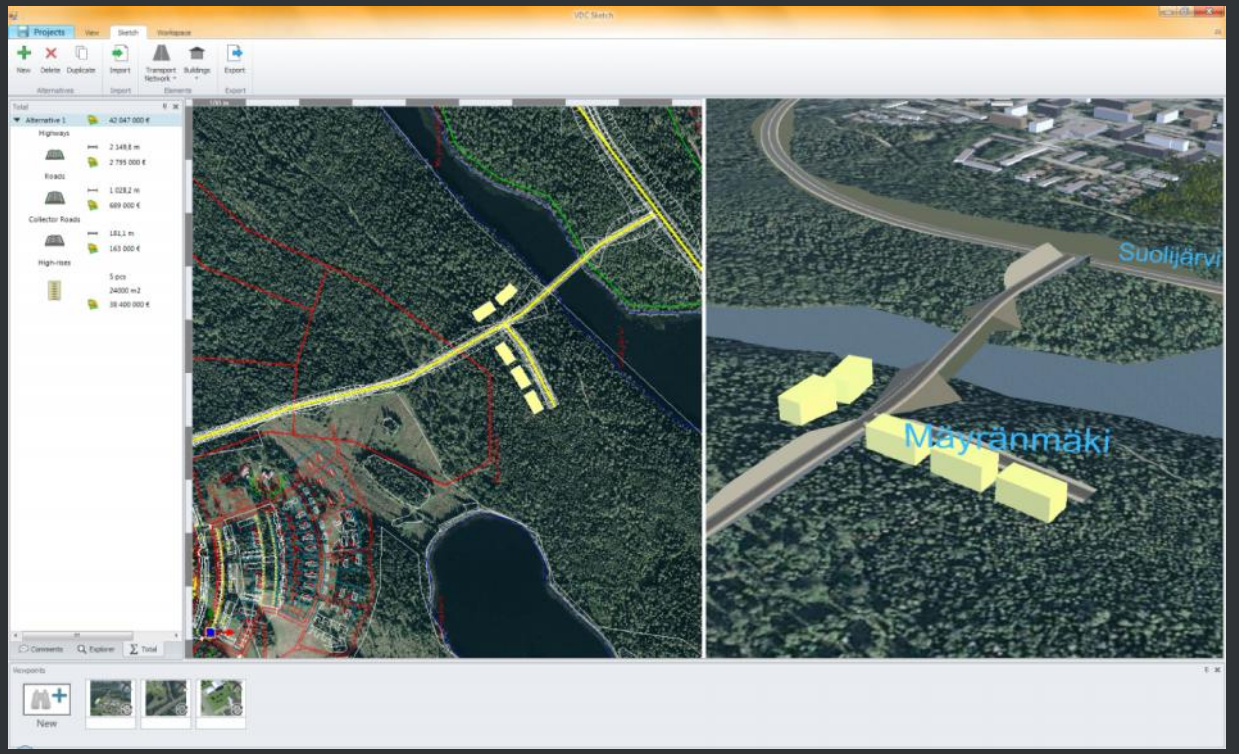
VDC for Planning



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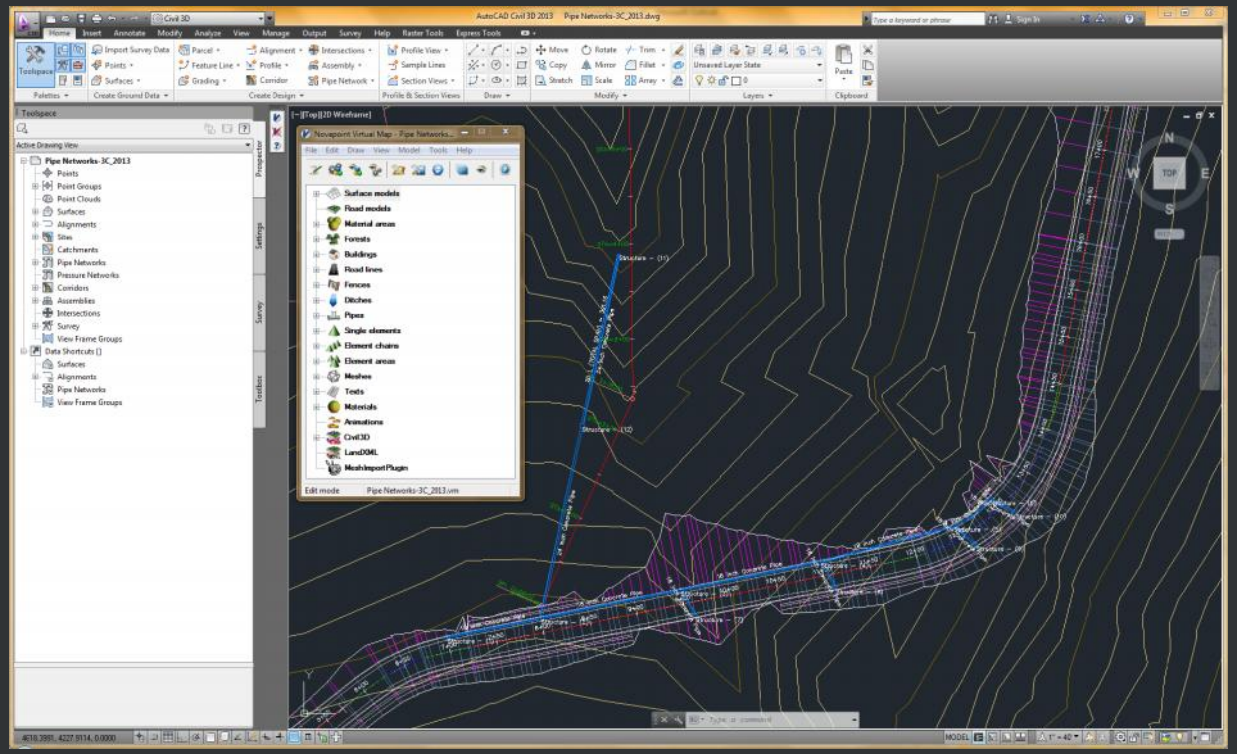
VDC for Design Modeling



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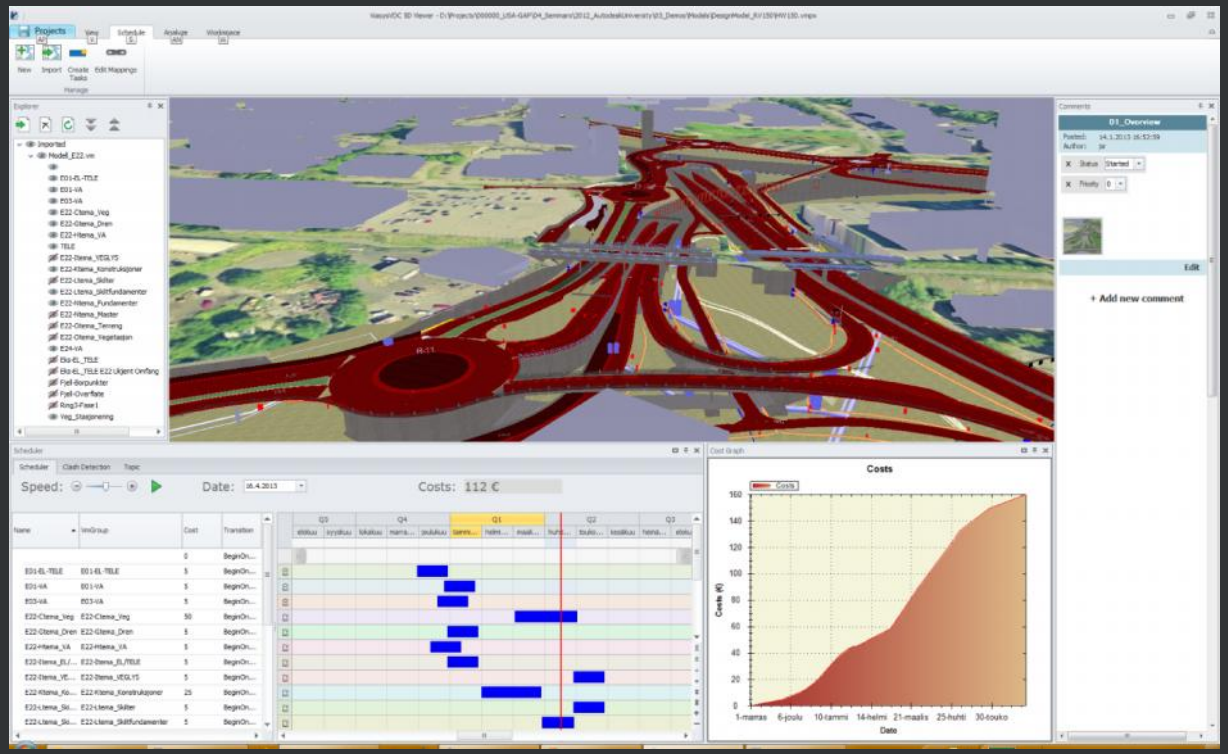
VDC for Project Management



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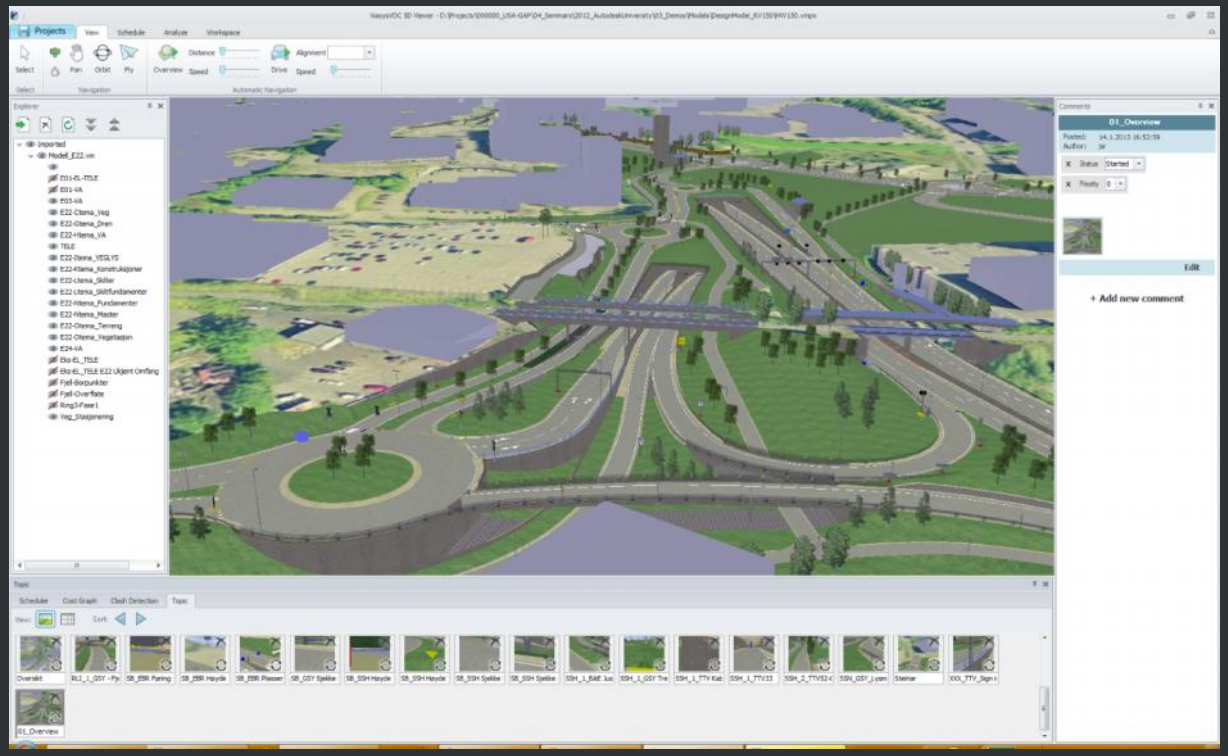
Multi Disciplinary VDC Model



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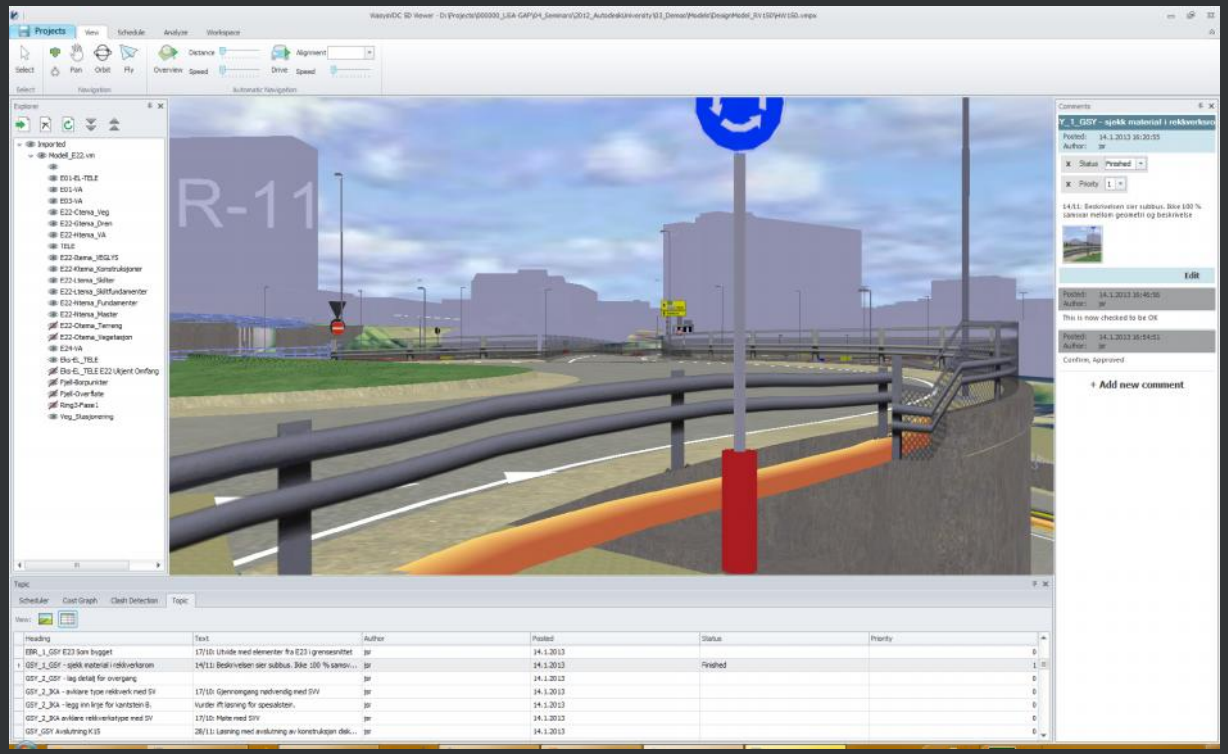
Project Issues Managed as Topics inside Model



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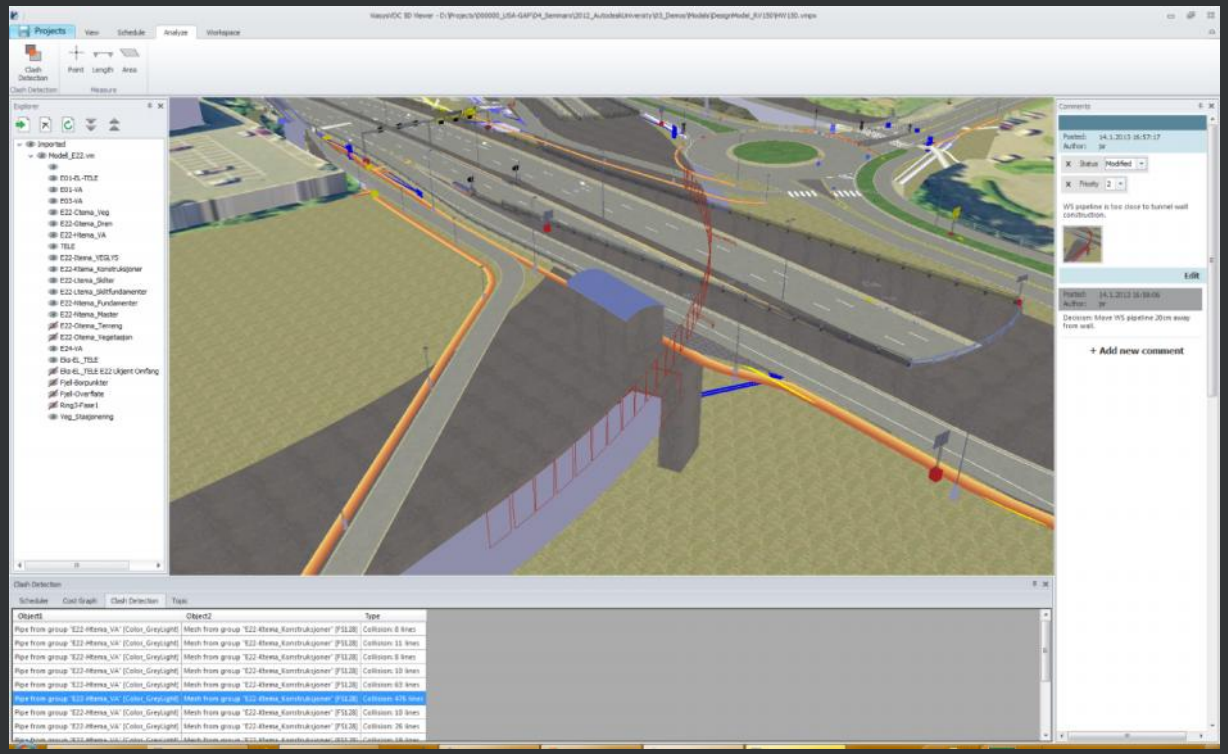
Clash Detection and Management



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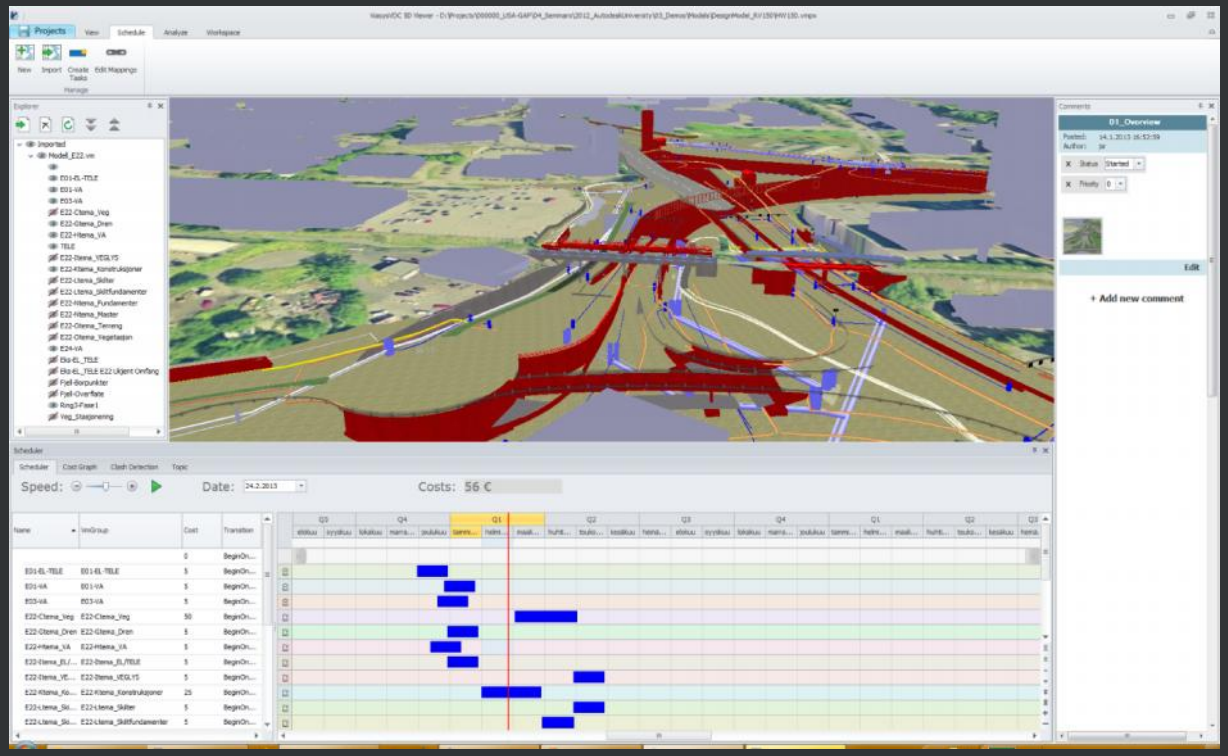
4D Sheduling



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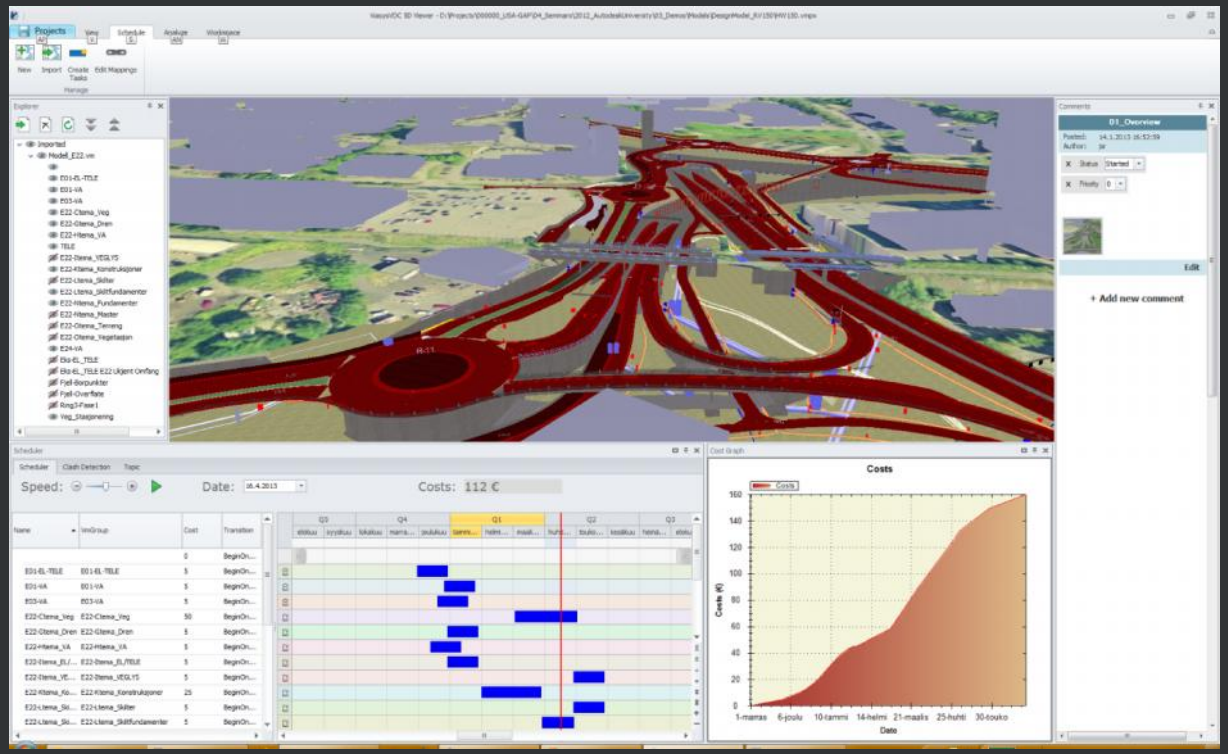
5D Costs



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VDC for Collaboration

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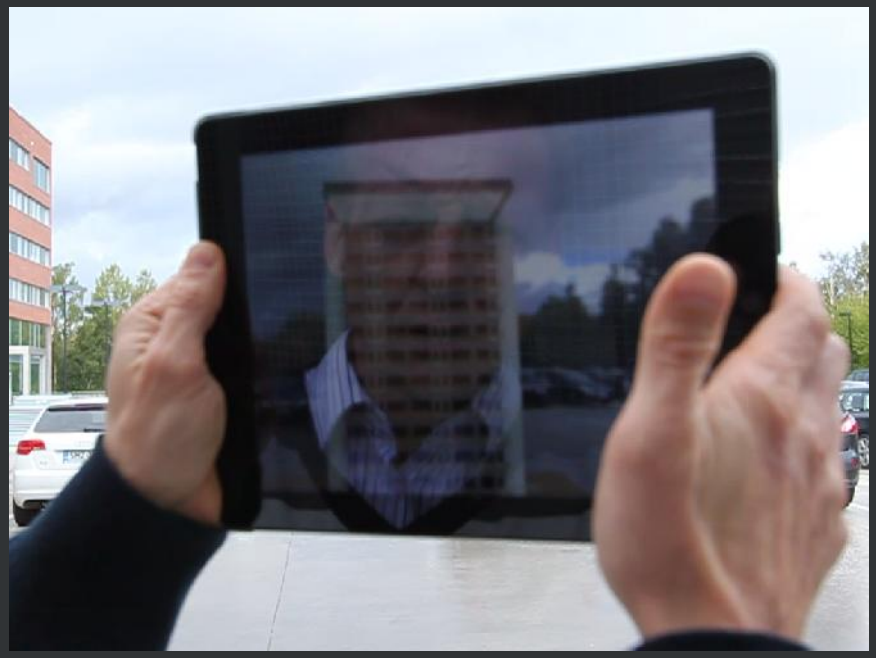
VDC for Web and Mobile



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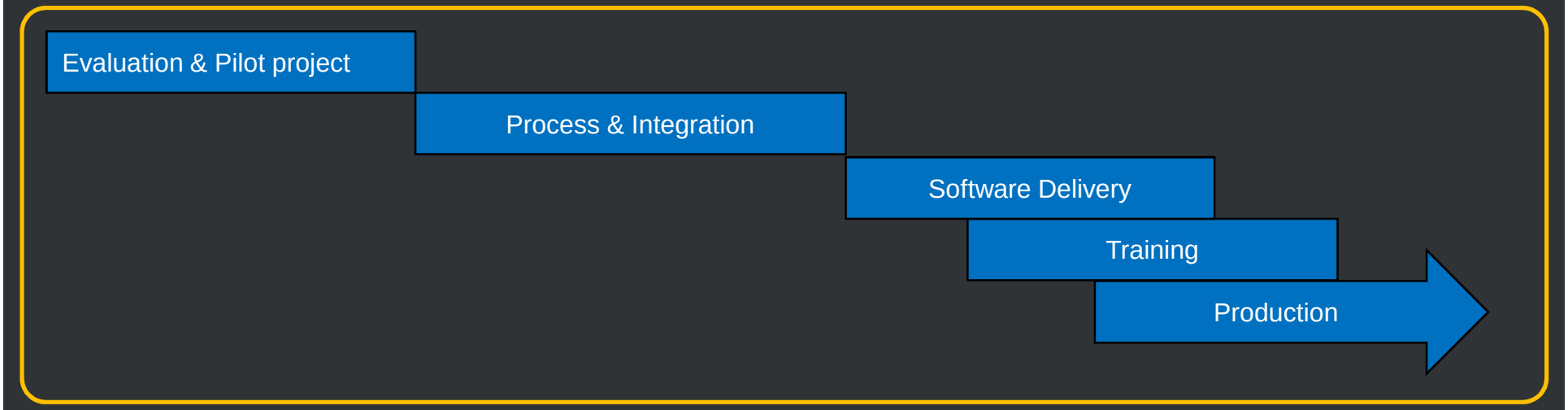
BIM Implementation Roadmap



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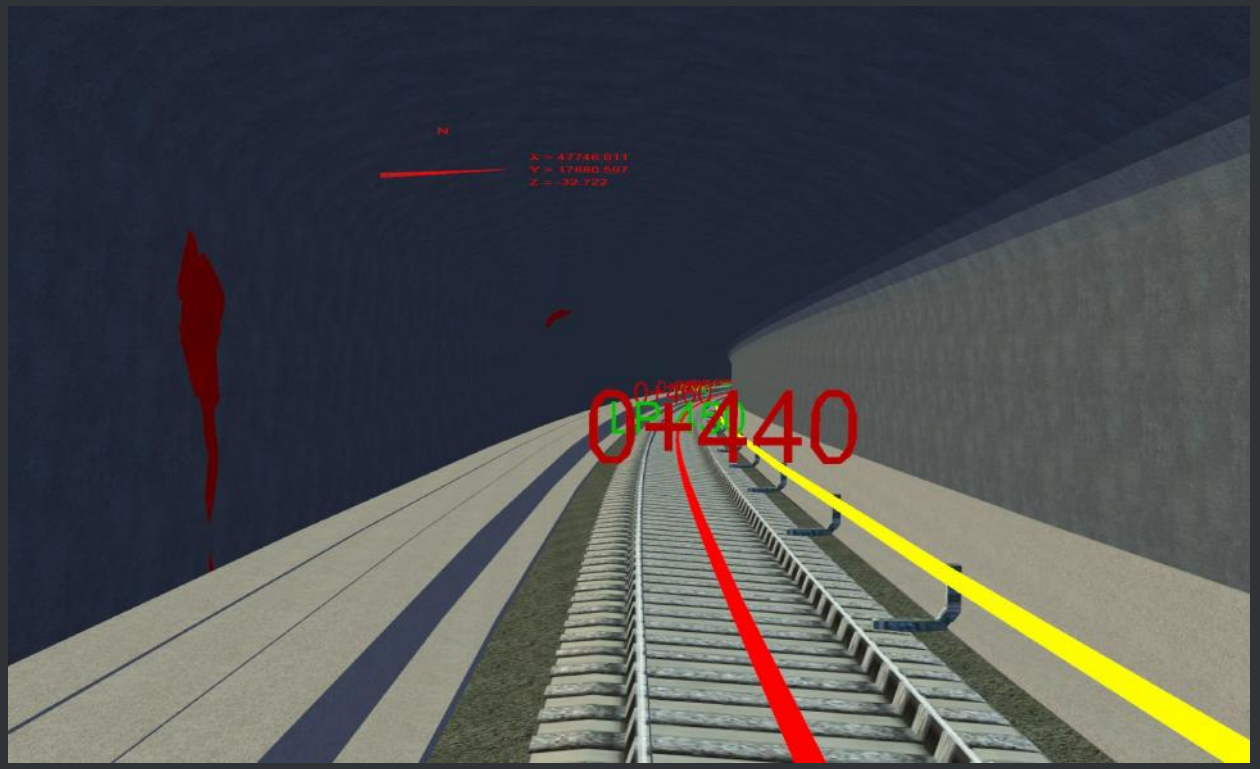
As-Built Data Comparisons



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Site Planning and Site Safety

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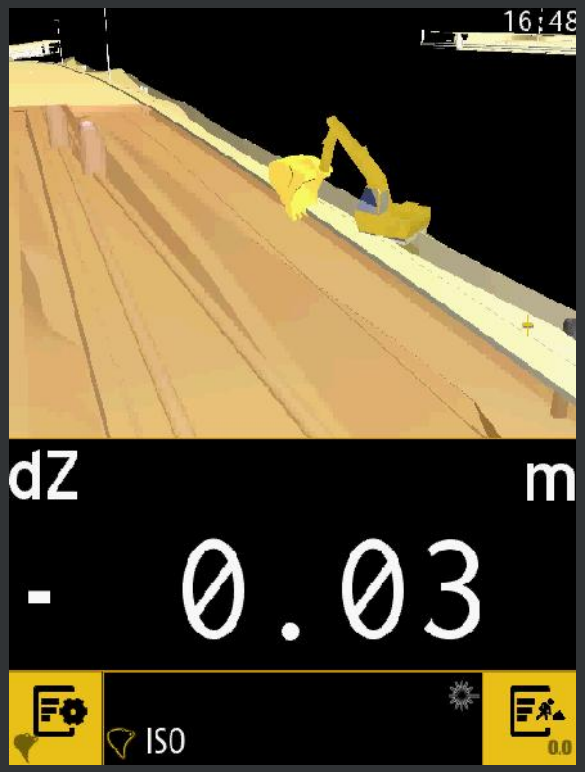
Automated Machine Guidance



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Making the Way

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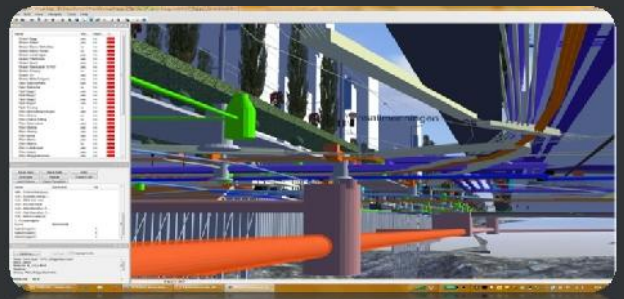
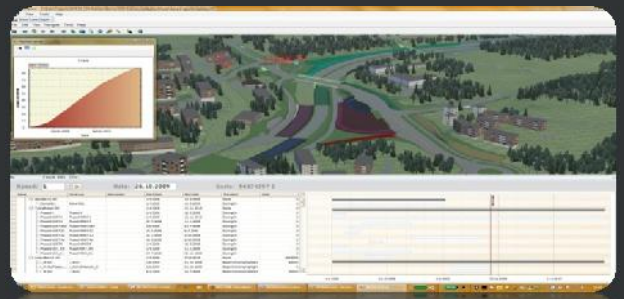
Model

Simulate



Collaborate



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