

Heidi Berg, Trimble Solutions

September 2017



BIM for Infrastructure through the lifecycle – How Governmental BIM and VDC requirement is pushing the Norwegian infrastructure business



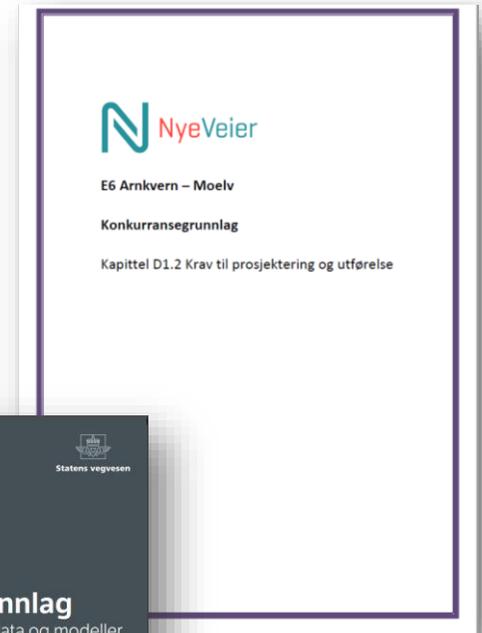


# Design with Confidence

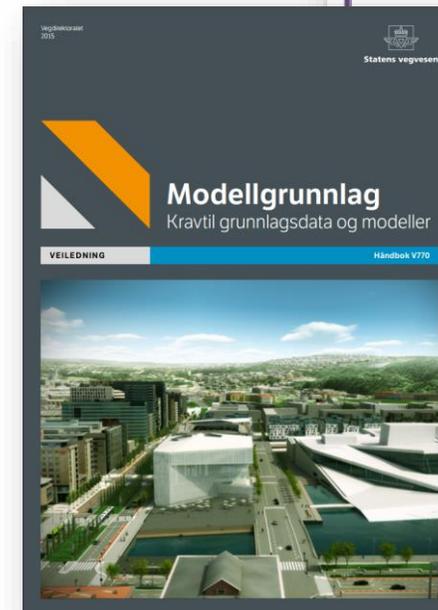


# Governmental BIM and VDC requirement

- Infrastructure Clients in our region
  - Nye Veier (main highway network projects)
  - Norwegian Public Roads (All other road projects)
  - BaneNOR (Railway projects)
  - Contractors (on PPP/DBO projects)



*Since 2017*



*Since 2012*

# Norwegian Public Roads.

## Model-based project requirements – since 2012, preliminary version 2010

Manual: V770 Model Data, requirement



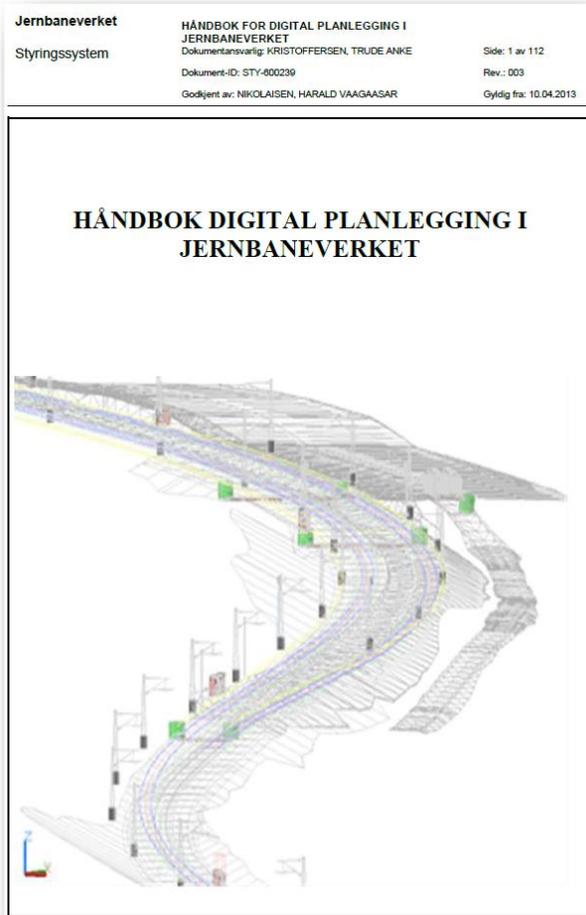
- High quality on ground surface data
- Requires 3D modelling of all disciplines
- Requires multi- discipline collaboration model methodology (clash detection)
- Requires stake out data to be extracted from model
- Requires model delivery back to maintenance database



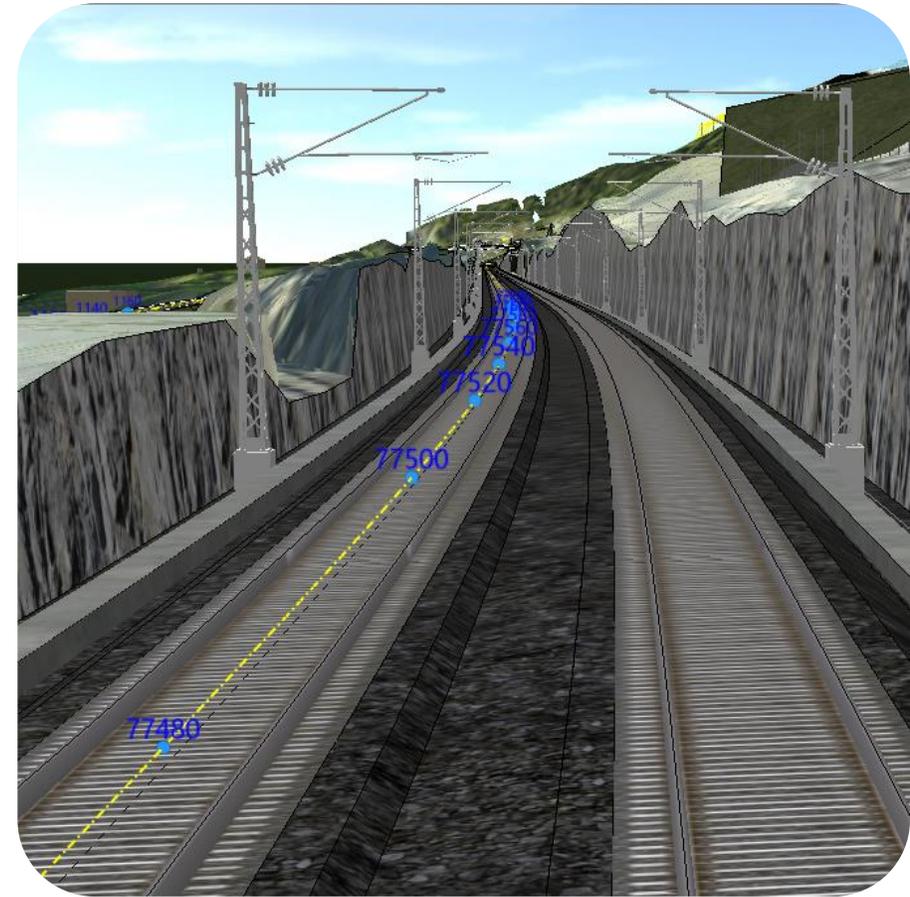
Sydhavna, Oslo – Norwegian Public Roads/Vianova Plan and traffic as

# Railway authority (BaneNOR) Model-based project requirements – since 2013

Manual: Digital planning, requirement



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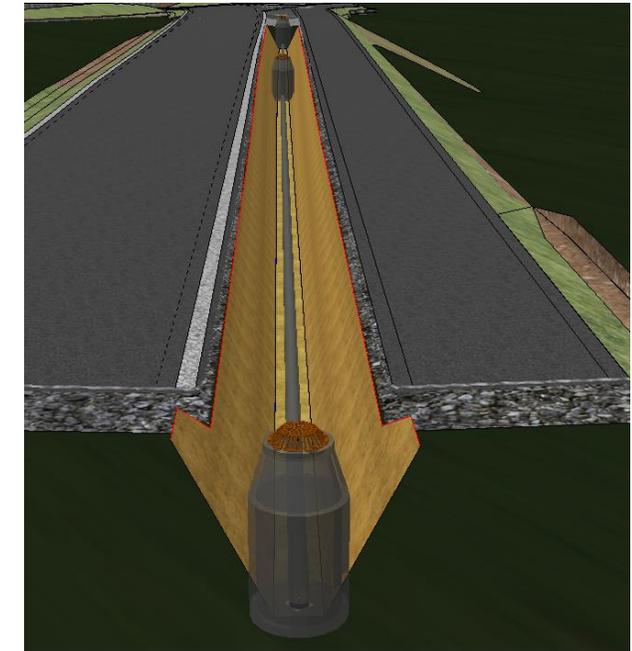
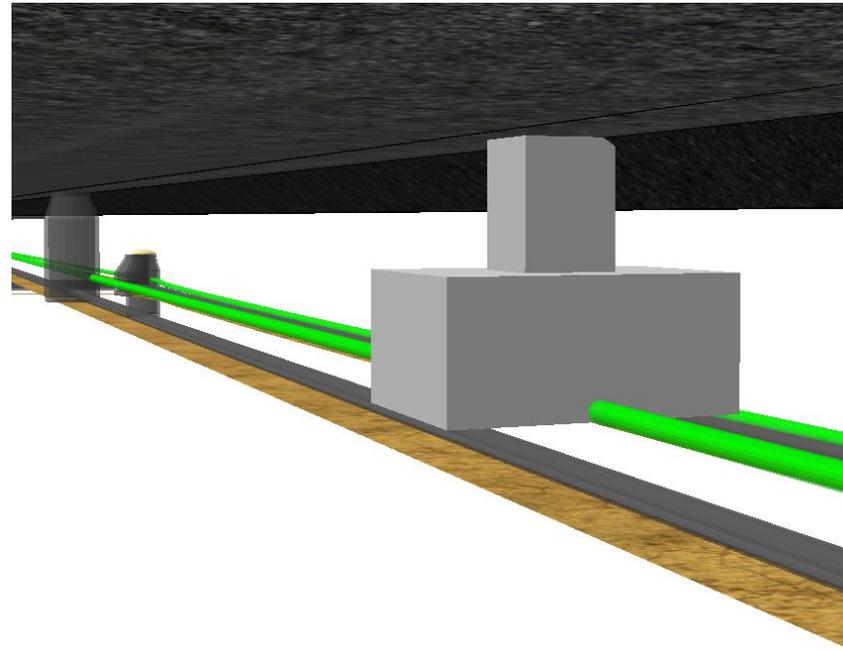
# V770 Model Data

=>Not just delivery requirement – but PROCESS requirement

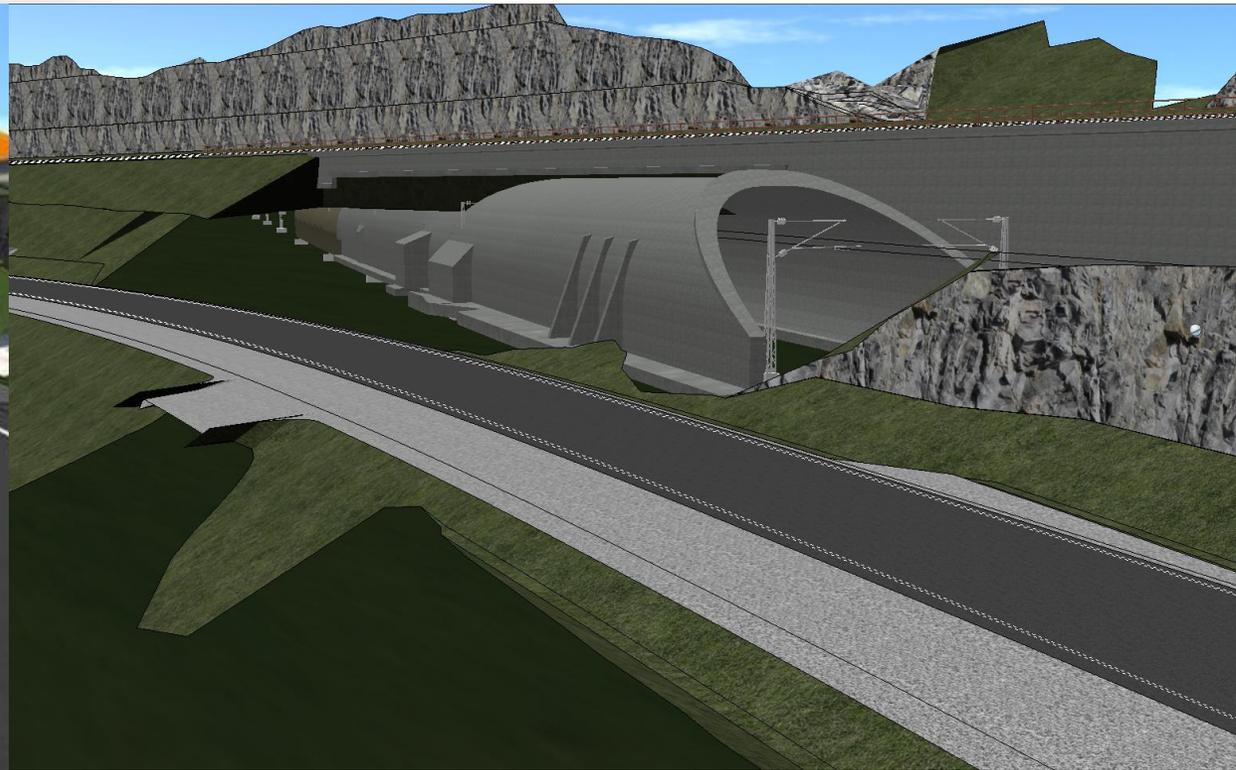


Requires multi-discipline collaboration model methodology process

- All domains in the same model
- Optimization between domains
- Clash detection (also when changes on site)
- Clash detection (towards modelling of existing situation)



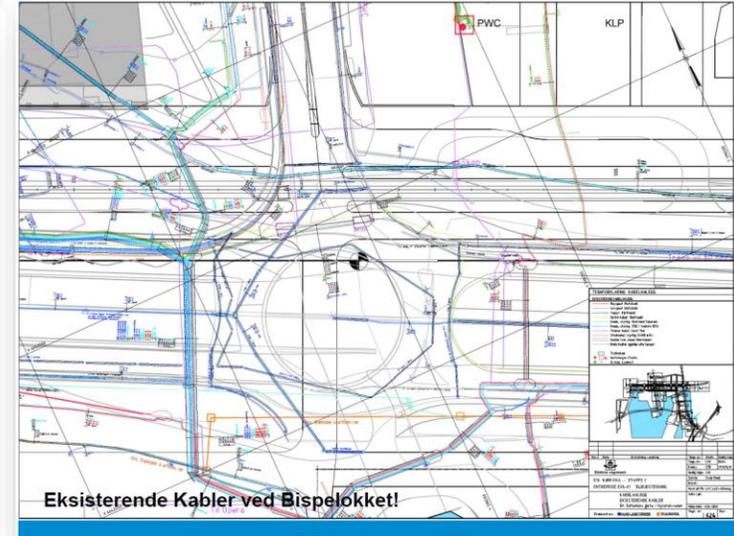
# REAL CONSTRUCTABLE DATA – not just visualization



# Can positive effects of BIM methodology be documented?

The Norwegian Public Roads administration and Trimble Solutions have analyzed change orders\*) from model-based projects and compared them with resulting change orders from "traditional" 2D road projects.

*\*)A change order is when there is a design error, design conflict, wrong basic data, unforeseen changes etc. that the contractor report to Client to get paid extra for, in addition to contract amount.*



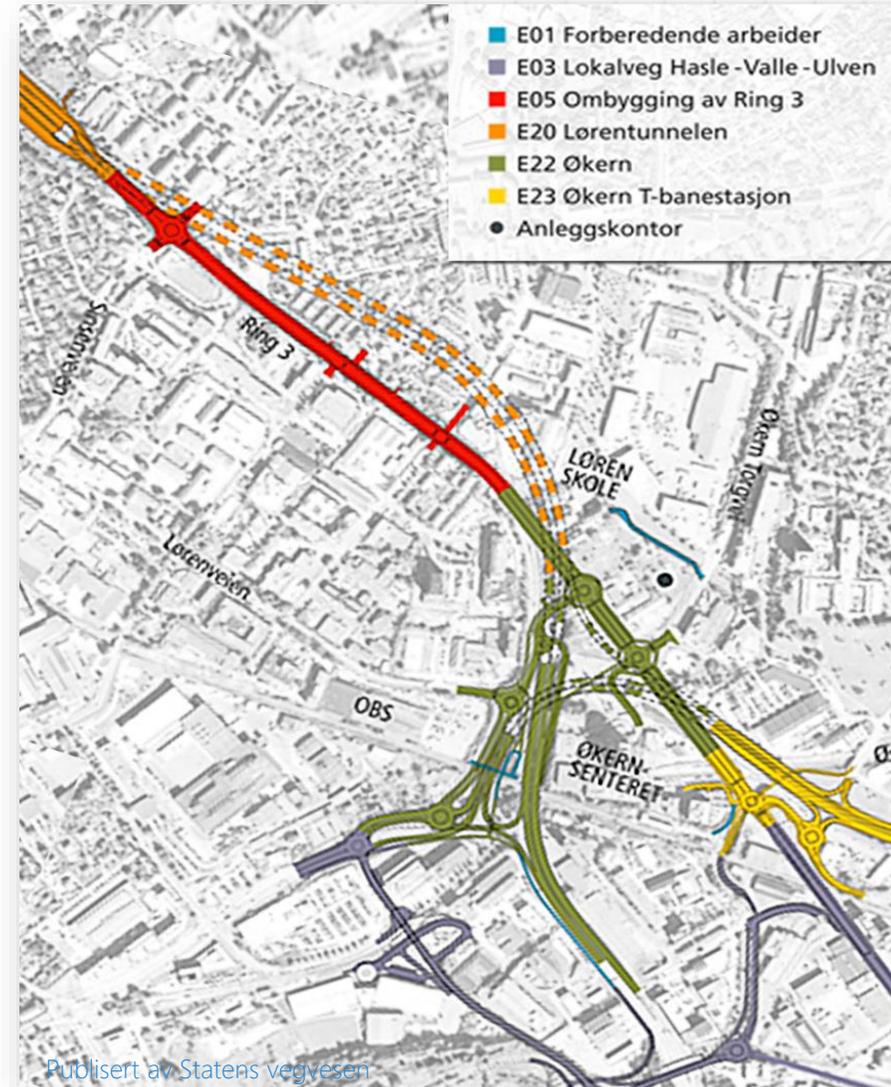


## Selected transport infrastructure projects included in the analyzes

1. RV 150, E03; Ring 3 Ulven-Sinsen (traditional)
2. RV 150, E22; Ring 3 Ulven-Sinsen (model-based)
3. E6 – Nordre, Trondheim (model-based)
4. FV 456, Vågsbygdveien, Kristiansand (model-based)
5. Joint project Dovrebanen-E6 Skaberud-Kolomoen, 4-lane E6 (traditional)
6. Joint project Dovrebanen-E6 and double railway track Strandlykkja and Kleverud/Labbdalen (model-based)

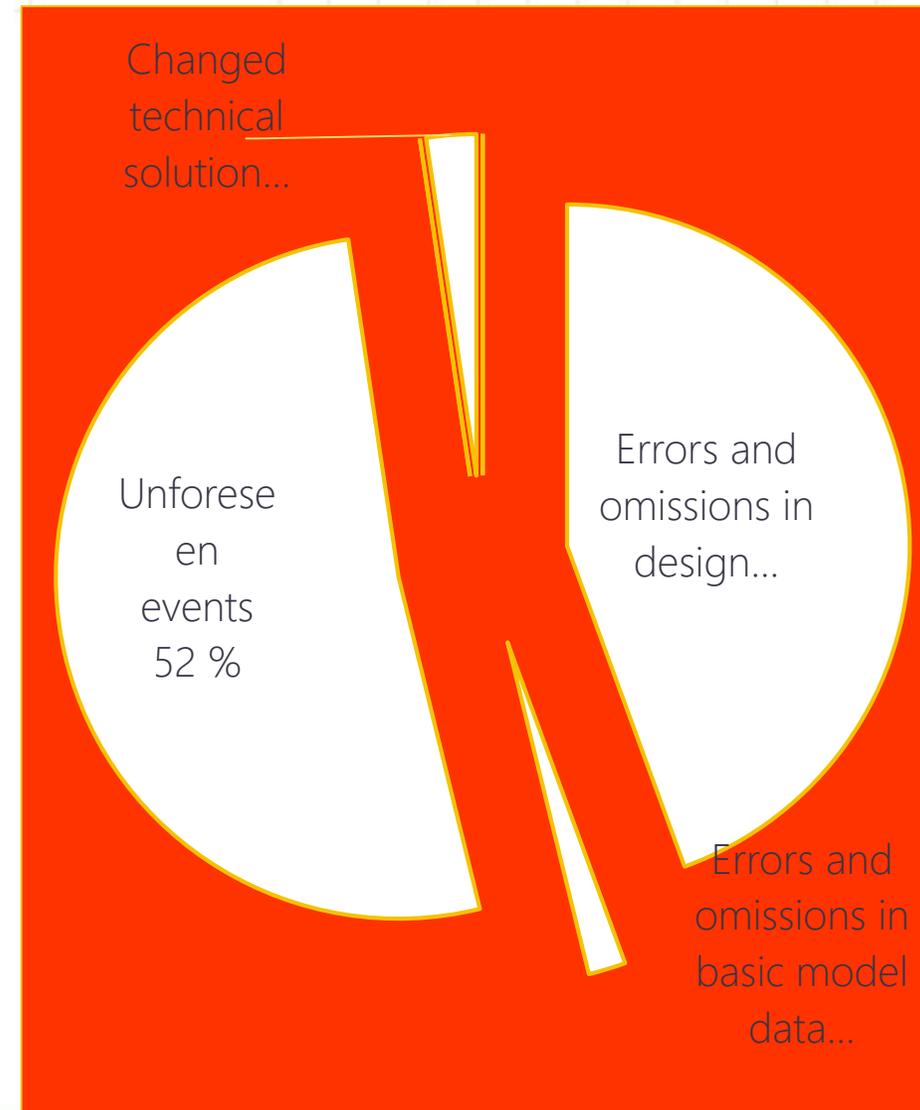
# Project 1: RV 150 - E03; Ring 3 Ulven-Sinsen

Key information	
Contract type	Construction contract Unit price
Project method	Traditional
Contract sum	301 mill NOK
Extra costs (T-Nota)	57 mill NOK
No. of Changes (CO's, T-Nota)	682
T-nota % of contract sum	<b>18,9%</b>
Contractor	NCC Construction
Consultant	Multiconsult



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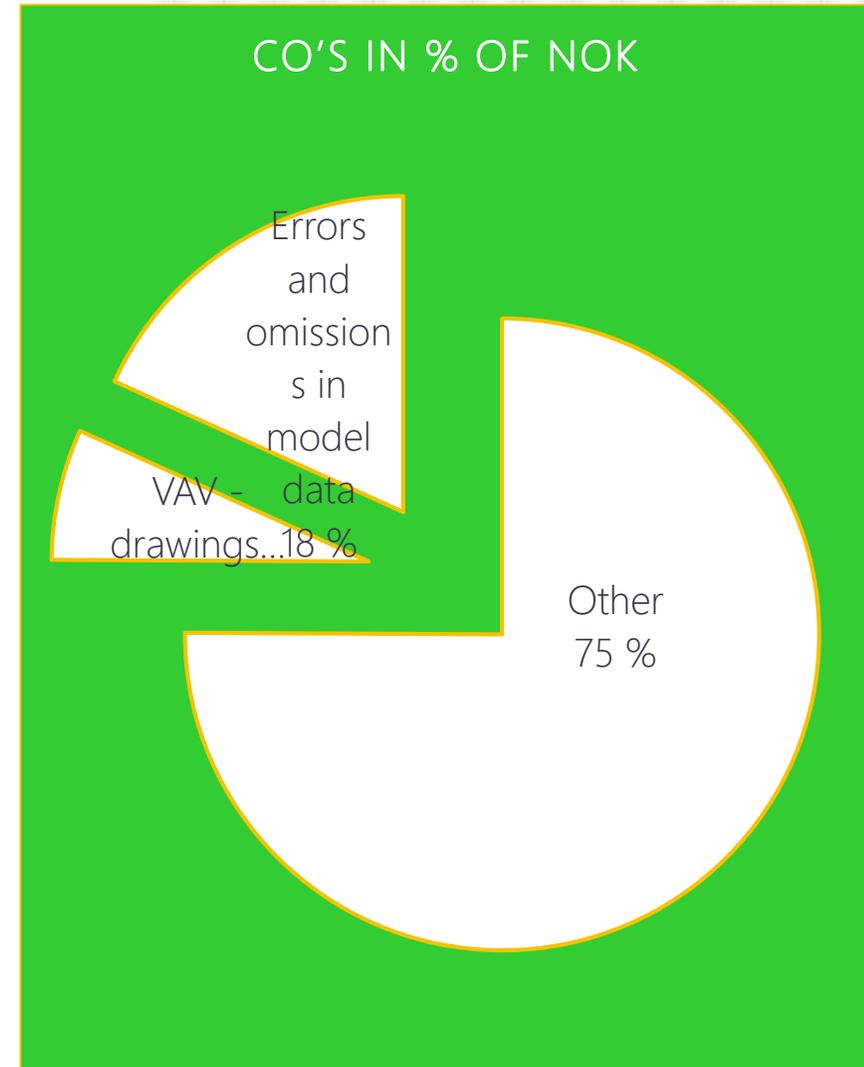
# Project 2: RV 150 - E22; Ring 3 Ulven-Sinsen

Key information	
Contract type	Construction contract Unit price
Project method	Model, Manual V770 (ex: W&S and cable design)
Contract sum	532 mill NOK
Extra costs (T-Nota)	52 mill NOK
No. of Changes (CO's, T-Nota)	491
T-nota % of contract sum	<b>9,8%</b>
Contractor	Veidekke
Consultant	ViaNova/Aas-Jakobsen/Multiconsult



# Project 2: RV 150 - E22; Ring 3 Ulven-Sinsen

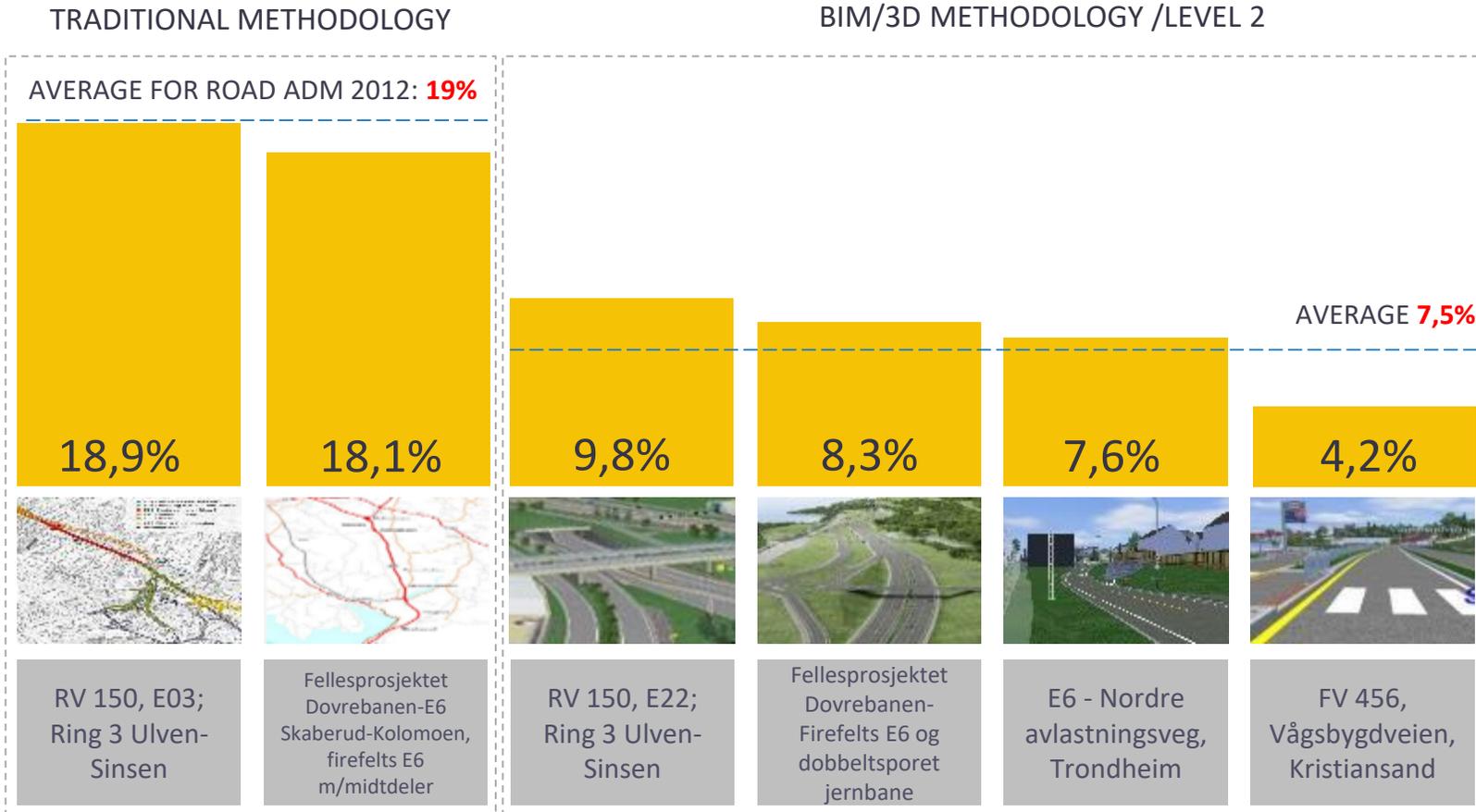
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# BIM implementation – Project study of 6 projects

The measured value of transformation from drawings to BIM Models

Change orders in % of original contract value



Analyzed Reduction in Change Orders In Construction

Reference: Norwegian Road Administration in cooperation with Vianova Systems AS, 2013.



## Contractor ex. 2: RV 150, E22; Ring 3 Ulven-Sinsen

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

Petter Bakke, Project Manager – Veidekke ASA





## Contractor ex. 3: E6 – Nordre, Trondheim

"The use of a BIM collaboration model ensured that we had practically zero downtime caused by design errors. We could produce continuously."

*Bård Olav Aune*  
*BIM Manager at Skanska Survey*

**SKANSKA**

# Customer Quote – Contractor using multi-domaine BIM model for the Bidding process

"BIM models contribute undoubtedly in reducing the contractor's risk. Without Novapoint design and collaboration models we wouldn't have managed to get such a good overview of the project in the short tender period"

*Arve Krogseth*

*Project Manager at Hæhre Contractor*

*E6-Dovrebanen Project*



"In understanding the tasks and scheduling work we used 80% model and 20% drawings at FP3"



# New Client in Norway from 2016. *Nye Veier* Responsibility: Some of the main highways connecting our country



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[OM SELSKAPET](#)

[AKTUELT](#)

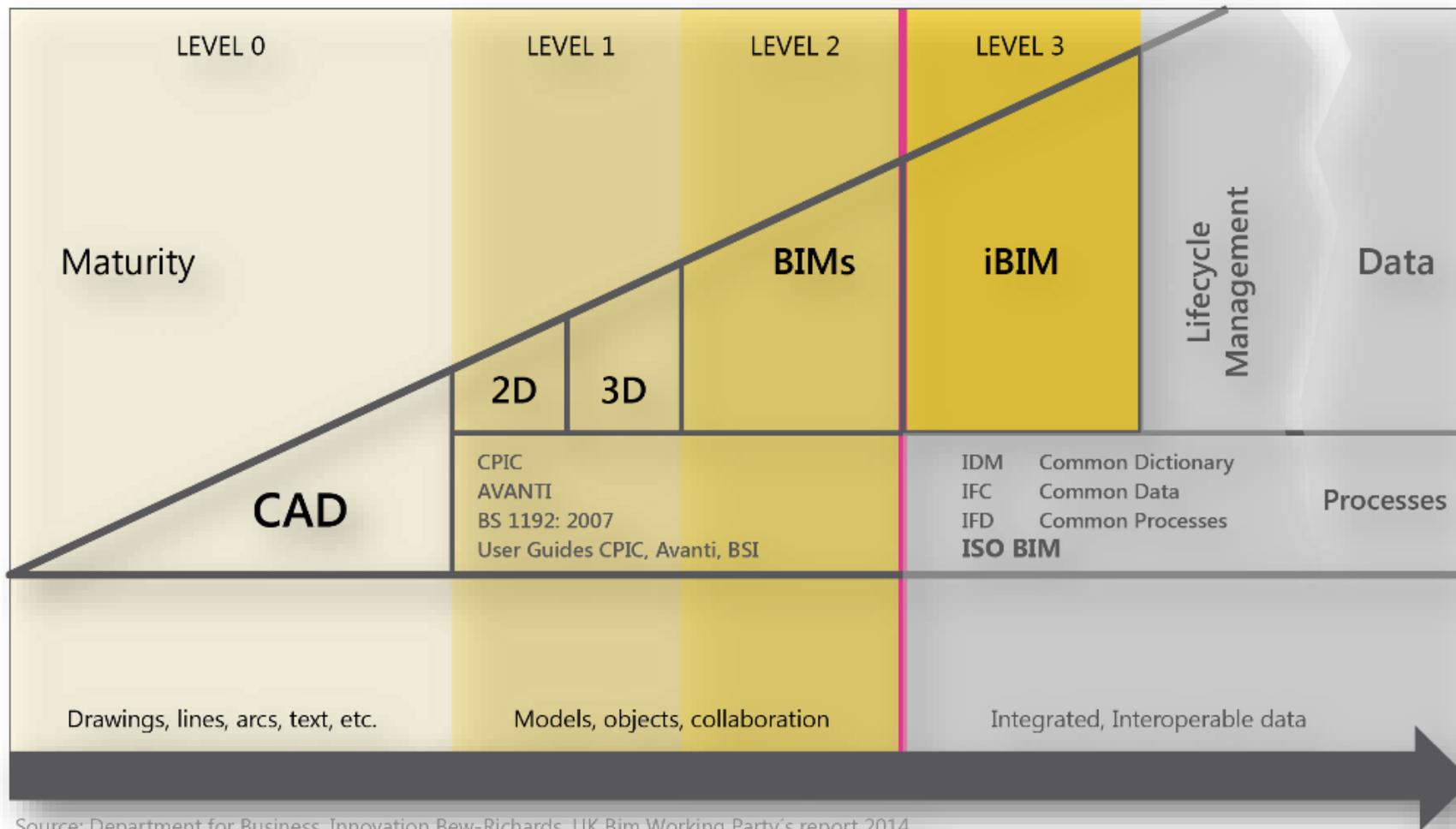
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# From 2017: The client, Nye Veier, require BIM Level 3



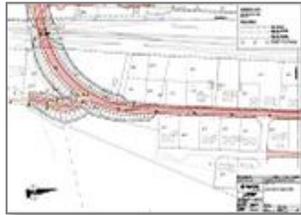
UK BIM Working Party's 2014 report

Source: Department for Business, Innovation Bew-Richards, UK Bim Working Party's report 2014

# BIM Evolution



2D Drawings



Single discipline  
Manual and CAD  
Discipline

3D Models



Single discipline  
Limited intelligence  
Discipline

3D Collaboration Models. Level 2



Multi-discipline  
VR visualization  
Project collaboration

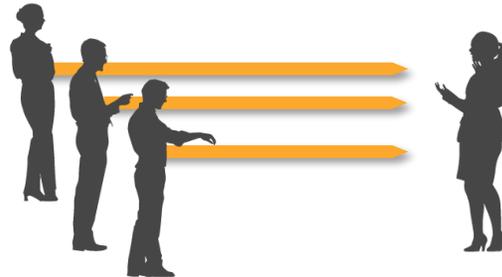
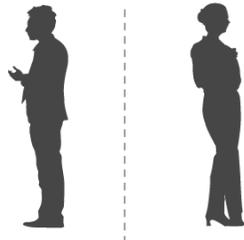
BIM for Infrastructure. Level 3



Multi-discipline and workflow support  
Intelligent object model

**Quadri Level 3**

- Quadri Easy Access use web services
- Quadri support IFC standards,
- Quadri is a collaborative, multi discipline model server





# Nye Veier - require a BIM hub

“The BIM hub should be the one, updated source of information throughout the whole lifecycle”



# Nye veier - require a "BIM hub"

IFC

LANDXML

CITYGML

Both people and machines should be able to extract and share information from BIM hub

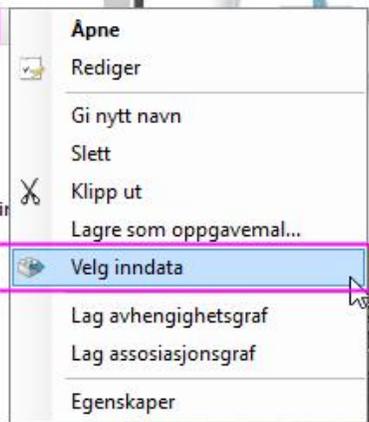
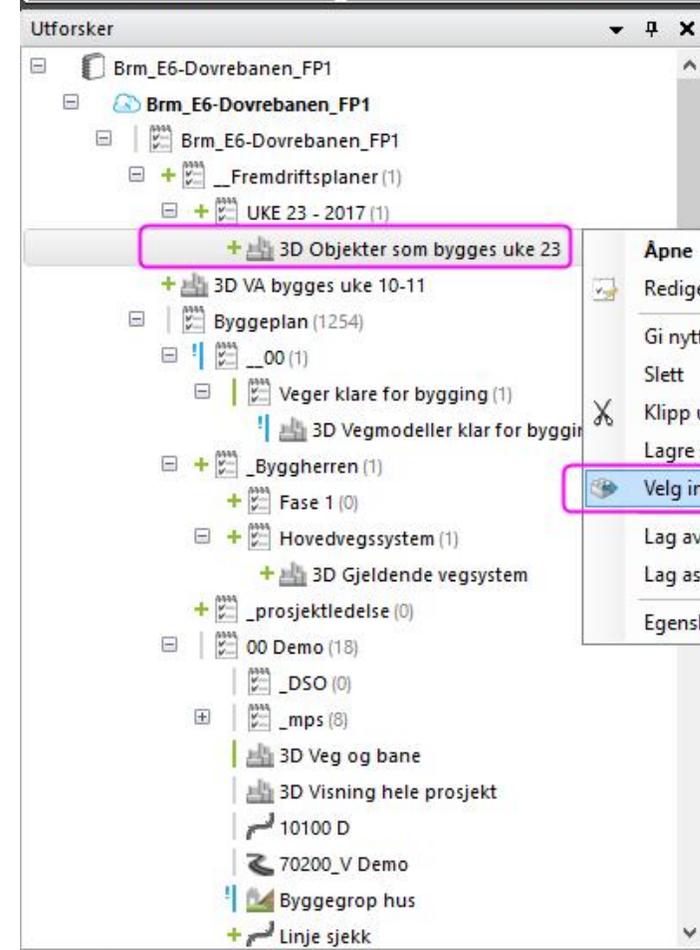
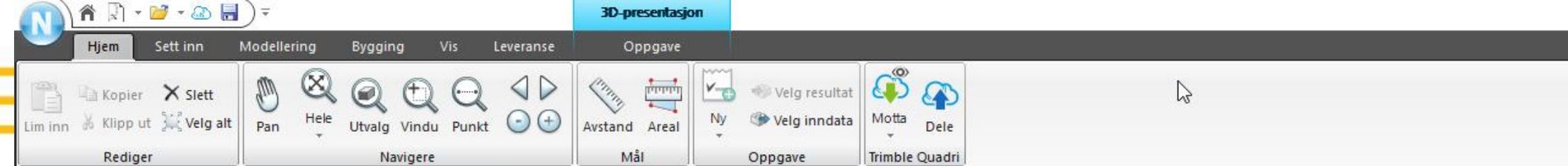


# Nye Veier require Lean and VDC Process

Design and construction should be performed, following the principles of Lean and VDC. The tools used, have to support this



Concurrent engineering, Nye Veier, Tønsberg project



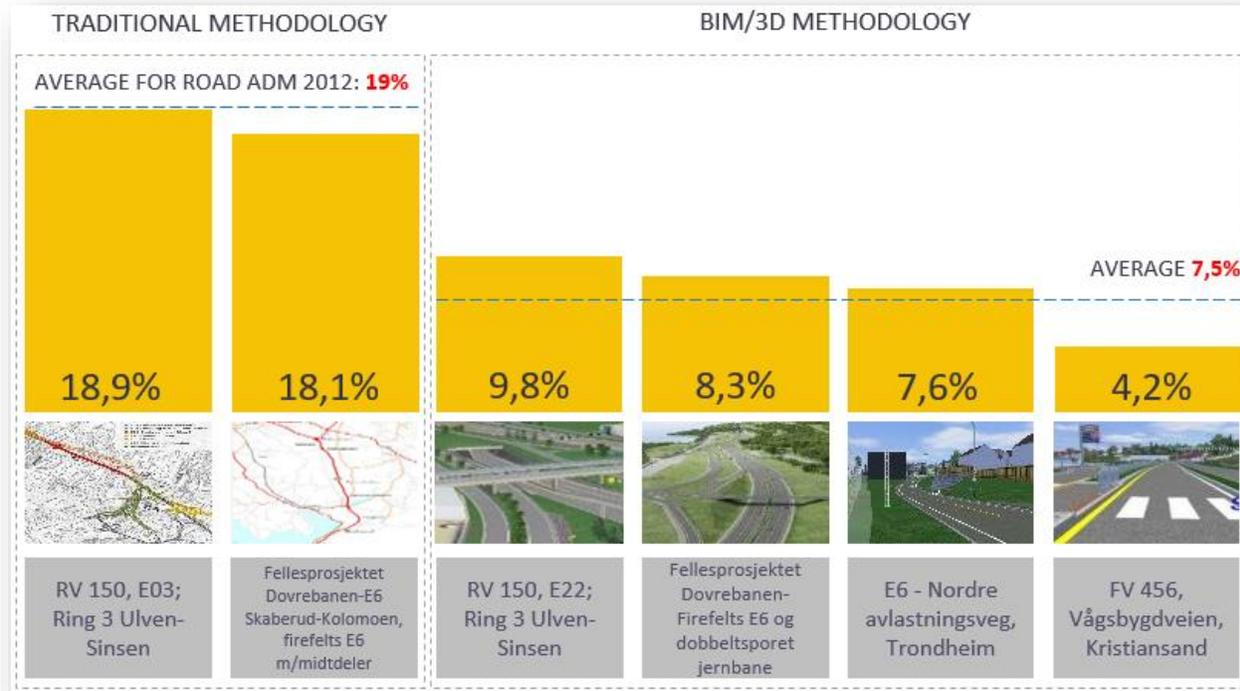
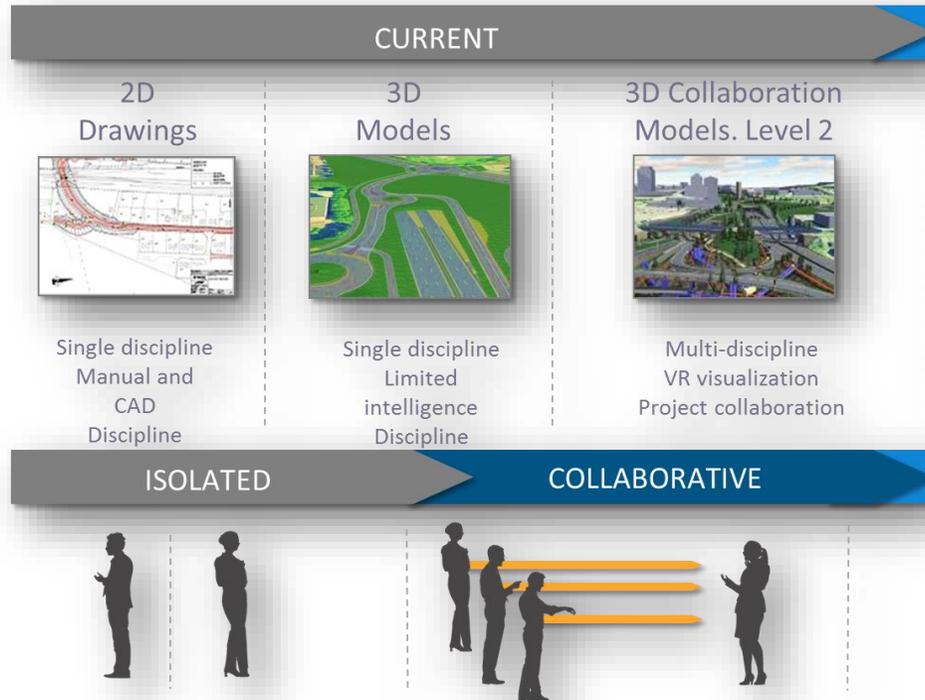
To be constructed in week 23

# Value of BIM maturity step – From Level 1 to 2

Going from 2D and single discipline 3D to collaboration models. Level 2 BIM



Value: Reduction from additional 19% on contract cost to 8% additional on contract cost



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# Value of BIM maturity steps - From Level 2 to 3

Going from sequential 3D collaboration model, to Integrated, multi discipline, object information modelling

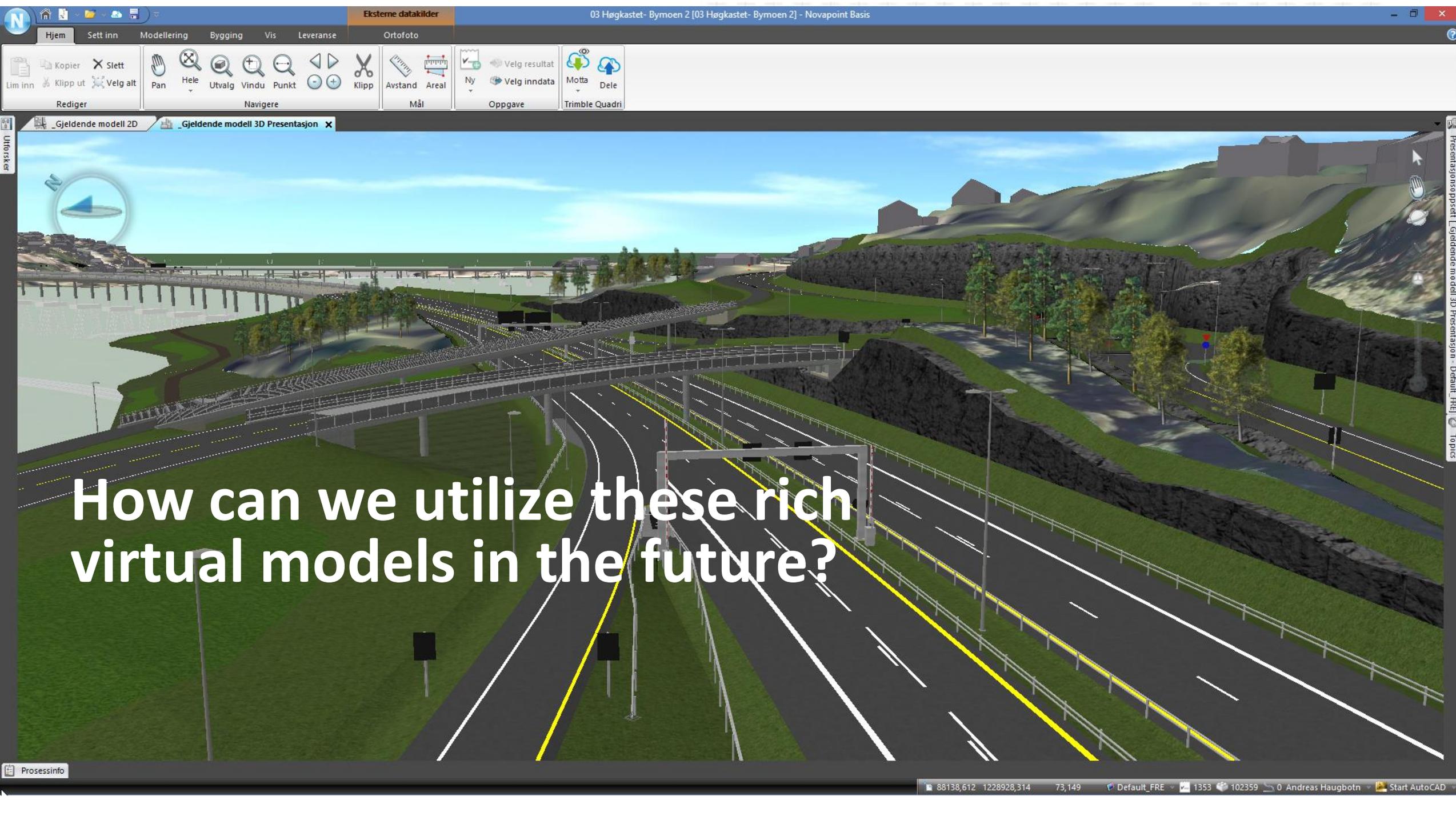


Value:

Still early. We don't know all the value of this step yet, but we see that

- ⇒ The contractor can start to build earlier, with this integrated, simultaneously design and construction method
- ⇒ Designers mark objects ready for construction, instead of complete model files or drawings
- ⇒ Contractor extract the data he needs, not getting it delivered (shortens the cycle from design to machine to less than an hour...)
- ⇒ One ongoing DBO project, claims they will be able to design and build a project in 2 years that normally would have taken almost 3 years





How can we utilize these rich virtual models in the future?





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