Case Study:
Autodesk® Infrastructure Modeler During the Early Design Phase of a Large Rail Project in Norway

Åge Langedrag – Multiconsult
Philip Hon – Multiconsult
Cathrine Mørch - Multiconsult

CI2572
This case study will show how Autodesk® Infrastructure Modeler (AIM) is used to visualize 450-500 km double-track (high speed?) railway, passing the whole of southern Norway. You will see how available data quickly brought up a detailed model, rich on information, of the whole of southern Norway with 450-500 kilometers of railway and the topographic and difficult climatic conditions there are here. An AVI-movie was created directly from AIM, following the railway from Stavanger to Drammen (Oslo). We modeled some of the more than 180 bridges more detailed in Autodesk® Revit and Trimble Sketchup imported this into AIM. We will show how we easily exported the parts of the Infrastructure Modeler model over to a third-party application for more detailed and realistic visualization.

Learning Objectives
At the end of this class, you will be able to:

- Describe how Infrastructure Modeler is used to create conceptual designs
- Describe how to migrate data from other Autodesk® products and third-party applications models into Autodesk® Infrastructure Modeler
- Create images and videos of the project directly inside Autodesk® Infrastructure Modeler
- Create export from Infrastructure Modeler to third-party applications for more detailed visualization
About the Speakers

Åge Langedrag
Aage.langedrag@multiconsult.no
Aage is working in Multiconsult, where he is now documenting and implementing best practices in how Multiconsult can use software in large, multidisciplinary projects. One important task is to get all the disciplines within the transportation and infrastructure to work in 3D and BIM. Aage is a trained architect of the Oslo School of Architecture and Design from 1999. He has experience as a designer of film and theater, architecture, landscape architecture - urban design and transportation projects. In 2004 he began using Autodesk Autodesk® Revit. He has been carrying out several missions which he has used Autodesk® Revit for landscape architecture from the early phase to the finished project. He has several years of lecturing on the creative use of Autodesk Autodesk® Revit. Aage has worked with several multi-disciplinary BIM projects in Multiconsult since 2008 to the present day.

Philip Hon
Philip.hon@multiconsult.no
As a Road Engineer, Philip Hon is also responsible for the BIM-coordination, 3D modeling and visualization. He enjoys his career in one of the leading worldwide company in the BIM industry and technology. With a high creativity and passion, he has made a several impressive conceptual models for highway planning by using Autodesk products in combination with 3rd party technologies. He is also involved to implement new technologies to upcoming projects.

Cathrine Mørch
Cathrine.moerch@multiconsult.no
Cathrine is currently working as a project manager at Multiconsult. She has the past years been travelling around Scandinavia demonstrating BIM do’s and dont’ s. She has worked with a wide variety of clients on their implementation of new software and methodology, aswell as developing innovative solutions to everyday challenges in different projects. Cathrine is also a skilled educator and trainer in a variety of "BIM" software. She has been "BIMing" her whole professional life.'
This class is intending to show a methodology on how to use Autodesk® Infrastructure Modeler to create conceptual designs. We will show you how Multiconsult was able to answer the visualization demand in the contract on the study on a high-speed railway passing through the whole of southern Norway. By combining our knowledge on Autodesk® Revit for modeling railway and landscape, and handling huge amount of data in large infrastructure projects, we were able to get a good overview of the project as well as fantastic visualizations when introduced to Autodesk® Infrastructure Modeler.

We will show a workflow in which we used to meet the visualization demand in the contract, please note that some of the things we will show were not a part of the delivery and may also be added to Autodesk® Infrastructure Modeler in later releases.

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**Project Background**

The High-Speed Railway Study was a cooperation between Multiconsult and WSP.

The study was divided into two parts:

- A route report in which pathways and technical solutions for four different options are documented through text, maps and illustrations.
- An environmental report that documents and compares the impact of the various options in relation to landscape, natural environment, cultural heritage, community and outdoor recreation and natural resources.

Our delivery to the Norwegian National Rail Administration, contained services regarding:

- Development of rail routes
- Station Location
- Evaluation of ground conditions and soil conditions
- Assessment of bridges and other large structures
- Flow Calculations for cost model
- Environmental impact
- **Visualization / 3D**

The High-Speed Railway between Drammen and Stavanger would be a large and challenging project, but the report concludes with a suggestion that does not demand new bridge or tunnel concepts, on the contrary it is possible to build this railway without introducing any new/larger/longer construction concepts. The railway is fully visualized in Autodesk® Infrastructure Modeler.

[http://www.multiconsult.no/Forretningsomraader/Samferdsel_infrastruktur/hhu/](http://www.multiconsult.no/Forretningsomraader/Samferdsel_infrastruktur/hhu/)
The report concludes that the project would be a challenging project considering the environmental consequence of a High-Speed Railway, but no more than a regular railway passing through the same route. Some of these assessment studies would be able to do in the more recent releases of Autodesk® Infrastructure Modeler, which is shown in this document.

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**Average Ranking**

|               | 1.43 | 2.80 | 2.50 | 2.83 |
Describe how Infrastructure Modeler is used to create conceptual designs

Demands from the customer – using our Autodesk® Revit railway experience

The customer demanded a visualization of the railway in the final report. By being over 450 kilometers long, the study was different from other projects Multiconsult had visualized. The first plan was to use some of the experience we had from another railway project, projected in Autodesk® Revit, in this High-Speed Railway Study. This was proven to be difficult because of its size. The Autodesk® Revit model became detailed and the area of the underlay was too big for Autodesk® Revit to handle (the 30 miles limitation.) The solution was to divide the model into smaller parts.

Railway testing in Autodesk® Revit

We tested different ways of handling railway in Autodesk® Revit. By using native Autodesk® Revits own possibilities with railing, we found out that this is a perfect way of quickly making an 3D visualization if the heights are constant og the rise of the railway is constant.

Test A: Using different railing families for different profile types for railway, bridge and tunnel

We tested Autodesk® Revit with a combination of Siteworks and LandCADD. Railing and toposurface made of the centerline of the railway to place the railway. By making new railingprofiles compatible with the LandCADD ad-in to Autodesk® Revit, we got to put as many objects as we wanted into the Autodesk® Revit family which gave us an advantage. By hosting the railway to the toposurface we had already made, the railing family now placed the “railway-railing” on the correct toposurface following the centerline of the railway linked in as an DWG using “Pick Line”. We got it all very detailed in Autodesk® Revit, but what about the surroundings?

The 30 kilometre limitation in Autodesk® Revit also gave us some challenges, and we divided the southern Norway into 13 pieces and made one Autodesk® Revit model for each piece. Then we linked these files together in Autodesk® Revit for visualization purposes.

Southern Norway divided into 13 pieces in Autocad. (.shp)
Autodesk® Infrastructure Modeler During the Early Design Phase of a Large Rail Project in Norway

Linking the 13 models into one made the file impossible to maneuver

After linking the pieces together the file was difficult to maneuver, we exported the file to Navisworks to visualize the railway there. The challenge was that we in this release of Navisworks were not able to open .rvt files directly, and the railing were selected as one solid. Therefore the materials were difficult to apply on the different parts of the railing family.

Adding materials in Navisworks were proven challenging.

After many discussions and a lot back and forth we were able to get a detailed model of the whole railway route from Drammen to Stavanger, but what about the terrain? The idea was to build a model in ArchGIS and try exporting this into Autodesk Navisworks. But we never made it so far. As this was a “different” Autodesk® Revit-project we were asked to hold speeches on the topic in different forums throughout Norway. In one of these occasions we met an Autodesk employee who told us about the new software Autodesk® Infrastructure Modeler. We were blown away by the opportunities that suddenly came across.
Available underlay imported into Autodesk® Infrastructure Modeler
Being acquaintance with technology like Autodesk® Revit, Autodesk® Infrastructure Modeler felt intuitively from the beginning. We quickly got brought up a model starting with this underlay:

- Terrain 10 m – DEM
- Aerial Photos (800x600): 6500 pieces - .jpeg
- Coverage areas (arable land, protected heritage area, protected nature areas) - .shp
- Points of interest (protected cultural heritages) - .shp
- Buildings (37000) - .shp

Autodesk® Infrastructure Modeler model of the Southern Norway
Describe how to migrate data from other Autodesk® products and third-party applications models into Infrastructure Modeler (Prosjektert data)

Projected underlay imported into Autodesk® Infrastructure Modeler
As we had used different software and methods to project differing constructions along the railway, we had to find the best process possible to get the data from third party applications into Autodesk® Infrastructure Modeler. We got the underlay for the railways in 3 different .shp-files. One for open sections, tunnels and bridges.

Railway
These shp-files contained the centerline of the railway line, in which we were able to place the railway geometry. The railway was projected in Bentley Inroads saved to DWG, imported into ArchGIS to export a shp-file to import into Autodesk® Infrastructure Modeler.

Bridges
Some of the bridges was downloaded from 3D Warehouse and opened in Trimble Sketchup for visualization purposes. The length and shape of the bridge was adjusted to fit the project. To get a more detailed railway on the bridge floor, the file was imported into Autodesk Autodesk® Revit and supplied with a railway track.

When importing the FBX-file from Autodesk® Revit directly into Autodesk® Infrastructure Modeler, the model crashed. The FBX-files from Autodesk® Revit are very large in size, which made the process difficult. After testing different solutions, we found a workflow including Autodesk 3D Studio Max to be the most efficient at this stage. Importing the FBX from Autodesk® Revit into Autodesk 3D Studio Max, “bake materials”, and exporting a new FBX file was the best process at this point. The FBX became a fraction of its original size.
Workflow for the bridge geometry:

- .skp
  - 3D Warehouse
- .skp
  - Trimble Sketchup
- .3ds
  - Trimble Sketchup
- Autodesk Infrastructure Modeler

Workflow for the railway geometry on the bridge floor:

- .rvt
  - Autodesk Autodesk® Revit
- .fbx
  - Autodesk 3D Studio Max
- Autodesk Infrastructure Modeler

Retrospectively we have also tested the newest versions of Autodesk® Infrastructure Modeler, which involves the possibility to analyse coverage areas (farmland, protected heritage areas, cultural areas etc.). Points of interest was also added to the model with protected cultural heritages amongst other things. These elements was added to the model with available .shp-files.

![Railways, bridges and coverage areas displayed in the model](image)

*Analysis possibilities in Autodesk® Infrastructure Modeler. 10 meters pr. Contour line color.*
Create images and videos of the project directly inside Infrastructure Modeler

Creating Images
When creating images inside Autodesk® Infrastructure Modeler, there are some settings that are important to pay attention to, in order to get a good output.

- Level of detail
- Shadows
- Ambient Occlusion
- Antialiasing

Bookmarks
The first step is to find a location you want to visualize. Bookmark this location by clicking on the “add bookmark” button. You can find your bookmarks under “Bookmarks” later on in the project.

Quality
Before exporting your image it is necessary to decide which quality your image should be exported to. Set the level of detail:

- From the general option. Set the highest level of detail. Remember if the model is huge, this will cause a continuously “ticking tile size” to generate all the details in the model.
- Recommended: go to Model Explorer and click on this icon next to the data type ( ), so it becomes like this ( ), it will automatically set the highest level of detail to that data type. This will make the model easier to work with.

Highlighting
You can also highlight your objects by marking the square next to the keylock, and change the color by right clicking and choose “set highlight color”.

Coverage area: farmland and cultural heritage areas highlighted with different colors.

Antialiasing and Ambient
Set the antialiasing as high as you can, maximum 8x. As this will make the edges smoother but also consume more of your computer’s process power. You will see changes in the “smoothness” of details such as cables. Low antialiasing will may also reduce the quality of your image.

The ambient option could give you a more realistic look of the model. For long distance perspectives this may just give you a darker image.

If you want the colors to be brighter set the adjust the contrast. In some occasions you may want to show constructions underneath the terrain, adjust the surface opacity to make it more transparent.

By clicking the “Cast Shadows” button you can choose the desired shadow position by adding the date and time.
Creating videos
Being able to create motional videos in an essential part for telling the story of a project.

Storyboard
Use the Storyboard on the “Present” tab, a new window will be opened.

In this window there are possibilities to bring up the storyboard library, add a new storyboard or import an existing storyboard.

As when making images go to a start position. Click on this icon to add a keyframe. This will be the start position.
of the story. Create several keyframes by navigating to new positions. When having two keyframes you are able to click the play-button to have a look at the animation.

**Time and duration**
The preferences and settings for the keyframe are based on the settings of the first keyframe between two keyframes. The 1ˢᵗ keyframe control the animation between 1ˢᵗ and 2ⁿᵈ. 2ⁿᵈ keyframe control the animation between 2ⁿᵈ and 3ʳᵈ. Press keyframe1 to see the presets.

![Image](image1.png)
Change the time and duration. When to start can also be adjusted by clicking an item and drag it towards the right side of the storyboard.

The transition between the keyframes must be decided depending on the situation. Fading could be a good option when there are a movement from one place to another in the model. Other transitions may be better in different situations.

**Camera Speed**
The camera speed can be controlled in three different ways.

You can also decide to have a delay on keyframes, before it starts the navigation to the next keyframe.

![Image](image2.png)

**Texting and recording**
Add a new title by clicking this icon. It will appear a new box in the captions and title row. Transition of the title are similar to how it is for the keyframe.
Choose the decoder, we choose the Windows Media Video. Bitrate should be 8000 kbit/s or higher. Set the destination of the exported video and leave the frame rate at 25 fps if the encoding system PAL is used in your country. Set the HD resolution to 1920x1080.

Use this icon to record your animation. It will take some time to generate the video.

http://www.youtube.com/watch?v=UGXtgW6yQyM (Autodesk® Infrastructure Modeler – High Speed Rail)
Create export from Infrastructure Modeler to third-party applications for more detailed visualization

There are many different ways to make a more photorealistic visualization of the project. We choose to use the third party application Lumion® based on the expertise we had available in the project team. Lumion® is a real-time 3D architectural visualization tool for architects, urban planners and designers.

Export from Autodesk® Infrastructure Modeler

It is possible to export either IMX og FBX from Autodesk® Infrastructure Modeler. The FBX is a well known format, which is mainly used for visualization purposes. The IMX file is a format in which can be imported to Autodesk Civil 3D or Autodesk MAP 3D where it edited further.

**FBX**

Define the area you want to export, select coordinate system and choose to export one single file or multiple files. Check the box “export material/texture” to ensure that the materials are included in the FBX.
Import in Lumion®
We choose Lumion® as our visualization tool, where we were able to make great animations, renderings and videos using a workflow which saved us both time and effort compared to the methods we have used before.

When importing the .fbx from Autodesk Infrastructure Modeler all the materials were included, and the adjustments in Lumion® were minimal. Because of the size and some material challenges with the .fbx from Autodesk® Revit the .fbx was first imported in Autodesk 3D Studio Max. We “baked the materials” and exported a new .fbx which was seamlessly imported in Lumion®.

Here are some results:
Trees added, water and skies are options to play with inside Lumion®
Autodesk® Infrastructure Modeler During the Early Design Phase of a Large Rail Project in Norway

http://www.youtube.com/watch?v=n2hP8ySy_TQ (Lumion – Autodesk® Revit Landscape)