Learning Objectives

- See how the modeling of an intercity rail project in a collaborative stakeholder environment reduced approval obstacles
- See how a model is used many times over to gain acceptance for unique historical, cultural, and rights-of-way approval
- Learn how the concept of proposals is used for different design alternatives for both technical and nontechnical audiences
- See how a model supports RAMS principles (reliability, availability, maintenance, and safety)
Description
How can 120 diverse stakeholders shape the design of a complex infrastructure project and gain community consent and agency approval—all in record time? Using InfraWorks 360 software as a collaboration tool, the owners, engineers, environmentalists, historians, regulators, news agencies, and local townspeople all worked together to affect design changes in a democratized and efficient working relationship. Using InfraWorks 360 software, we overcame the obstacles that typically plague rail projects, such as connecting villages and towns, crossing bridges and tunnels, using and repurposing existing corridors, and establishing new alignments. This was done using the ability to rapidly view, navigate, query, and create design alternatives in a real-world context. The project model provided a single source of truth for both technical and nontechnical review, assessment, and “what if” proposals.

Your AU Expert(s)
Atle Høidalen is a Building Information Modeling (BIM) coordinator for Sweco. He has 9 years of experience implementing advanced model-based workflows for large-scale building and infrastructure projects in Norway. His experience spans from IT and software development to construction engineering, infrastructure planning, and virtual design. Since 2015, Høidalen has worked closely with the Norwegian Rail Administration as a BIM coordinator for the InterCity Dovrebanen project, capitalizing on the use of InfraWorks 360 software as the main tool for model coordination and communication in the preliminary phases of the project.

Kristin Lysebo is the Building Information Modeling (BIM) deliverables manager for the InterCity-project in the Norwegian Railway Administration, and she is a key leader in the Nordics for BIM standardizations and initiatives and infrastructure. She is a firm believer in common standards for road and railway modeling, and in the benefits of model-based projects. Prior to her work with the Railway Administration, she was an infrastructure engineer and training manager at a large infrastructure software company in Norway for more than 20 years.
Jernbaneverket

The Norwegian Railway Infrastructure Managers, Jernbaneverket (J BV) is the government office for all railway activities in Norway, including building and maintaining all railway infrastructure.

Background for the InterCity-project

Challenges:

- Strong growth in population expected in Oslo area
- Fastest growing capital in Europe
- Affliction in the city areas
- Little space for roads

Solution:

- Modern railway and wise use of hubs

The InterCity project in Norway and population in major cities
The InterCity strategy was developed in the early 1990s. Some sections are finished, and some under construction. 270 kilometers double track railway and 22 new or changed station areas remains.

Concept study for the InterCity corridors was completed 2012.

Success criteria:
- centrally located stations and development of surrounding areas
- comprehensive service upgrades, not small improvements of existing services; much shorter journey times, frequent services, high punctuality levels, predictability
- Investment costs: Approximately € 12.5 billion
- IC Project Organization established

Plan phases
The InterCity-project follows the Norwegian planning law that defines three major planning levels, and that the municipalities have authority to approve the plans. Some parts of the InterCity-project go through two or three municipalities, which give an added complexity.

The InterCity-project is divided into seven subprojects. The first four subprojects is planned to complete in 2024, and the rest in 2030.

All seven subprojects are awarded to major Norwegian and Nordic consultant companies based on tenders. The contracts is open in regards to hours but are fixed on hourly rates.
The InterCity-project organization
The InterCity-project is a separate project organization directly under the assistant railway director, and today employs about 65 people.

In addition to the administration and communication departments, each of the seven subprojects has a team of 3-7 persons with a total of 24.

Two larger departments, Technique & Concept and Hub & Architecture, employ about 25 persons and include lead personnel for all railway technical disciplines. These two departments work for all the subproject to standardize all technical and practical requirements – to help make the decision process for each project easier.

3D modelling in JBV
J BV approved a handbook for all digital projects in 2012. This handbook sets the requirement for all model based projects as well as drawings.

- We do not specify which programs to use, but the primary format for all models is DWG format
- States the types of models to be used and the contents of each type of model
- The coordinated model and the presentation model must be in a license free program
- All object is described both as a volume object and the stake out data as points, lines or volumes
- All existing data is modelled as base models, data both above and below the ground level
- All disciplines shall model their new objects in 3D
- The coordinated model references both the base models and the discipline models and is updated with a project defined interval. This model is the base for all conflict control between disciplines. The primary goal is to fix all inter discipline conflicts before we start building the project.
- A presentation model is made based on the coordinated model. This model is primary used for visualization and communication within the project organization and with all external stake holders in the project.
- The contractor uses the discipline models to export stake out date directly to machines and updates the models to as-built status

J BV is currently working on a 3D strategy for all future projects.
THE WORKFLOW IN MODEL BASED PROJECTS

3D modelling in the InterCity-project

The InterCity-project has taken this a few steps further and has defined an overall 3D strategy.

- All subprojects in the InterCity-project shall be planned and designed in 3D from the earliest plan phase to the completed built projects using the handbook “Håndbok digital planlegging i Jernbaneverket” and the «BIM manual for the InterCity-project»
- Discipline models and a coordinated model is created adapted to the necessary detail level for each plan phase
- The 3D models will seamlessly go from one plan phase to the next while enriching and updating the detail levels of each base and discipline model
- The contractor will build the project using the models, update the models to the state of as-built model
- The as-built model will be used to export all objects and lines to JBVs maintenance database and the technical archive for maintenance documentation

We have created a discipline reference group for BIM with participants from all the subprojects. Together we work to include all necessary specification and details we need to include models in all aspects of the project.

The types of models used in the InterCity-project are:

- The existing situation (terrain, infrastructure over and below the ground surface, subsurface layers as rock and soft clay) are modelled as base models
- All new objects, lines and volumes are modelled as discipline models. A discipline model includes all elements for that specific discipline. Each element is described as a volume object and stake out point or line.
- The coordinated model is a combination of the base models and the discipline models. This model is used for inter discipline conflict control and communication within the project organization.
- The presentation model is used for communication both within the project organization and with all external stakeholders.
- The as-built model is a documentation of how the project was really built.

**Environmental themes and RAMS**
The InterCity-project in addition to physical disciplines has set the standard for creating and delivering discipline models for non-technical disciplines such as RAMS and several environmental themes. These are not traditional 3D disciplines and the theme is in some cases presented as 2D data draped over the terrain surface. An example is protected areas and building, flood analyses, areas with possible danger of landslides, endangers species and plants and so on.
The RAMS (Reliability, Availability, Maintainability, Safety) process in JBV is a clearly defined process analyzing all aspects of a project from the earliest plan phase clear through the maintenance phase. The result is defined actions points in an excel spread sheet. These action points are now implemented in the 3D models with standard symbols with a link to the excel file. A large advantage is that the RAMS process now is visible to everyone in the projects organization.
Sørli-Brumunddal

This subproject is a part of Dovrebanen.

The project is a municipal master plan and the plan program defined three alternatives through the largest city in the area, Hamar.

The JBV have recommended the west alternative closest to the existing railway and the lake, Mjøsa. This project has a large local interest and goes through three different municipalities.

The timeframe of the project is approval of in the three municipalities in December 2016. As soon as the municipalities have approved the plan we move into the zoning plan phase and with a time frame of approval in the late 2017 or start of 2018. The project will be built in two parts, the first is from Sørli to the approach of Hamar which will be completed in 2024. The second part from Hamar to Brumunddal will complete in 2026.

Some of the major challenges are:

- Expansion of the station in Stange
- Crossing valuable agricultural areas between Stange and Hamar
- Crossing the RAMSAR (national protected area) area south of Hamar
- Choosing between the three alternatives through Hamar
The Consultancy - Rambøll Sweco ANS

Joint venture – 300 staff members.

The Project:
- High-speed (250 km/h) and freight in shared railway tracks.
- 70 km double track
- Contract basis: +15 Mill EUR
- Options: + 60 Mill EUR
- Construction: + 3 Bill EUR
- Horizon: Year 2024/2030
- CSS: 4,6
- Municipality plan (technical) within 3 months for 12 different alternatives (normally within 1 year)
- Impact assessment study within 5 months

Project BIM Strategy

Our BIM Strategy is based upon the requirements from the JBV and adapted to Rambøll Sweco ANS strategies to achieve an effective and productive workflow in our project. We have broken down our strategy in three levels to ensure the implementation in our organization.

The BIM Strategy follows these steps:
- Identify long term BIM-goals
- Break down goals to short-term tactical plans
- Define action plan including necessary methods to reach the long term goals
- The BIM Strategy makes the framework for our BIM Manual. All principles are based upon the requirements from the JBV.

Project BIM Goals

Effective Communication
- The BIM Manager coordinates training for workmethods and use of tools for the project participants.
- Communication through maximum 1 multidisciplinary model and 1 presentation model
- Standardized file formats and easy to use user interfaces
- Frequent updates of the BIM model so that the model at any given time represents the correct progress in the project
- The BIM model is used as a common communications platform in all meetings, both internally and externally
- The BIM model is the basis for the production of all drawings, illustrations, and videos that makes the basis for the decisions made by internal and external stakeholders
Increased Quality

- Designs will be developed and improved successively through the use of the model actively in meetings and discussions
- Base models is established by using quality ensured data for existing conditions, including all necessary elements for consideration
- Perform multidisciplinary design review of the BIM model before every milestone delivery
- All models will be designed in accordance to the principles and classification of the JBV’s requirements so that they can be transferred into and used in future planning phases
- The level of detail is adapted to the specific planning phase.

Reduce Total Cost

- The different disciplines will consider replacing parts of their traditional 2D drawing production with the use of their 3D models
- Design conflicts that can cause significant consequences will be addressed early in the planning process
- Rough calculations of mass and cost will be produced from the 3D models

Innovation

- Establish methods to include abstract and non-geometrical objects and data such RAMS (Reliability, Availability, Maintenance and Safety) and SHW (Safety Health and Working environment) in the BIM-model.

Project BIM Organization

The size, complexity and timeline for the project forced us to establish a robust BIM organization. Three separate teams lead by the same manager worked together within this organization. The Geomatics teams handled all the survey- and GIS-data that were used in the project. The BIM team handled all workflows connected to BIM and CAD, while the visualization team did the visualizations for the public interests.
InfraWorks 360

We needed a tool that could handle large amounts of data, quickly visualize the different proposals and also support frequent model updates. Based on the enormity of the project and the massive amounts of data needed to be both consumed and delivered, we determined that there were few, if any, other software applications that could serve as a central platform for all disciplines and stakeholders.

It became clear to us that the best tool was InfraWorks 360 because it:
- Handles enormous amounts of data
- Enables us to create a base model in 3D in a short amount of time
- Enables us to create and view multiple proposals within one model
- Has modelling functionality that enables us to work directly in the multidisciplinary model
- Supports import of a variety of file formats including GIS-data and 3D-models
- Has a clean and intuitive user interface
- Supports sharing and collaboration between multiple users through the cloud
- Easy to use – anyone can use it

One of our goals for the use of the InfraWorks 360 model was that “everyone” in the project should download and use it. In total we reached 120(!) project members using our model.

Tools and Data Exchange Workflows

*This figure illustrates the tools and dataflows in the project.*
Novapoint Quadri model server was used as the main tool for planning rail and road, all other disciplines was free to choose the software they preferred. All data including documents, GIS-data, models and media was stored in ProjectWise. Discipline models created in Novapoint, Revit, Civil 3D or other applications was uploaded here, and then imported in InfraWorks. InfraWorks 360 was used as the common multidisciplinary model.

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Software</th>
<th>File exchange format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Railway Design</td>
<td>AutoCAD/Novapoint Quadri</td>
<td>LandXML and DWG</td>
</tr>
<tr>
<td>Road Design</td>
<td>AutoCAD/Novapoint Quadri</td>
<td>LandXML and DWG</td>
</tr>
<tr>
<td>Stormwater Design</td>
<td>AutoCAD/Novapoint Quadri</td>
<td>DWG</td>
</tr>
<tr>
<td>Electrical Design</td>
<td>AutoCAD/Novapoint Quadri</td>
<td>DWG</td>
</tr>
<tr>
<td>Railway Overhead Line Design</td>
<td>AutoCAD/Novapoint Quadri</td>
<td>DWG</td>
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<tr>
<td>Geotechnical Design</td>
<td>AutoCAD/Novapoint Quadri</td>
<td>DWG</td>
</tr>
<tr>
<td>Railway Signaling System Design</td>
<td>AutoCAD/Novapoint Quadri</td>
<td>DWG</td>
</tr>
<tr>
<td>Landscape Design</td>
<td>AutoCAD Civil 3D</td>
<td>LandXML and DWG</td>
</tr>
<tr>
<td>Environmental Impact</td>
<td>ArcGIS</td>
<td>Shape</td>
</tr>
<tr>
<td>Bridge and Culvert Design</td>
<td>Revit</td>
<td>DWG and IFC</td>
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<td>Railway Station Design</td>
<td>Microstation and Revit</td>
<td>DWG and IFC</td>
</tr>
<tr>
<td>Architectural Design</td>
<td>Rhino and Sketchup</td>
<td>FBX, Collada and DWG</td>
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<td>Sketchup</td>
<td>FBX, Collada and DWG</td>
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<td>Geological</td>
<td>ArcGIS</td>
<td>Shape</td>
</tr>
<tr>
<td>GIS</td>
<td>Multiple</td>
<td>LandXML, shape and GML</td>
</tr>
</tbody>
</table>

OVERVIEW OF THE MOST COMMON USED TOOLS AND FILEFORMATS IN OUR BIM WORKFLOW.

The majority of the models were delivered as dwg. For road, rail and landscape design we used both dwg and landxml and shape. GIS-data was delivered mainly as shape and for the architectural disciplines the most common format was fbx and collada.

Customizing the InfraWorks Model

We did quite a few customizations to adapt InfraWorks so that it’s functionality would meet our requirements. This class will not dive into the specific details about the customizations, but the main speaker is more than willing to answer any questions either directly after the presentation or by mail after AU is finished. There has also been held several excellent classes about this subject in previous AU arrangements. Here’s an example:

CI10693: Tips and Tricks – 10 Ways to Increase Your Productivity with InfraWorks 360

Here’s a brief overview of the adaptions we did:

- In order to comply to the JBV’s requirements we had to create a large number of custom categories in the model. Creating custom categories has been covered in several earlier classes here at AU and can be a tedious task. Normally the way to do it would be to manually editing the custom schema file. In our case, we were lucky to be provided with a Custom Schema Editor tool by our contact at Autodesk. Using this tool enabled us to quickly edit the schemafile in an easy to use environment.
- We used automated scripts to import multiple files and include metadata in the models.
• This metadata was shown by using standardized tooltips for each model.
• We created custom styles and content inside the model.
• We included embedded web content such as Google streetview and links to external sources such as the RAMS database.
• We used script to export the design feed content into Excel for documentation and archiving purposes.

The Base Model

As part of our strategy for increased quality, our goal was to create a base model based on quality ensured data for existing conditions, including all necessary elements for consideration. The model was built up based on aerial and ground scanning of the terrain, AEM scannings and test drilling of subsurface rock, high resolution aerial imagery, GIS-data and 3D-models of existing buildings and structures and lots of other input. Most of the models also included tooltips with metadata. Actually, the NNRA was so happy with the result that they hired us to create a video describing the process so that they could use this for educational purposes internally and externally.

See the video: INTERCITY SORLI LILLEHAMMER — ESTABLISHING BASE MODELS

Some examples:

SUB SURFACE ROCK, EXISTING PIPES AND CABLES, PLANNED NEW SHOPPING MALL AND TEST ROCK DRILLINGS.
**RED LIST SPECIES.**

**EMBEDDED GOOGLE STREETVIEW IN THE MODEL.**
The Discipline Models

- Road and rail as alignments in early stages
- Landxml, IMX and shape for road and rail for more detail
- 3D-models as dwg, rvt, ifc, fbx, skp, 3ds and collada
- Non-geometrical objects imported as shapes and points and assigned to either 3D-objects or coverages
- Tooltips with metadata for each discipline model

In the early stages of the project, the roads and railways alignments were imported as sdf-files and assigned to InfraWorks road and railways. As the design progressed and need for more accurate geometry was needed, the import was changed to the use of landxml. The landxml files were then imported in Civil 3D to create IMX-files for the corridor terrain and shape-files representing the different materials. These files were then imported in InfraWorks as terrain and coverage areas.

For 3D-models, a variety of file formats were used. Softwares such as AutoCAD, Revit, Microstation, Rhino, Sketchup, 3ds Max all delivered native formats when this was possible. Our model also contains different types of non-geometrical information. This can be drilling plans, recorded endangered species, construction site borders and so on. These types of information were imported as shape and assigned to either 3D models or coverage areas which then carried the information as tooltips.

The import of updated models was streamlined and standardized by scripts and common work methods. Tooltips with metadata was added to all the discipline models. This metadata would contain information about when the model last was updated, the name of the discipline lead and the name of the person responsible for the design. Normally, between one and two work days were needed for updating all models in all proposals. Syncing of all proposals were done through the cloud model. This was a workflow that worked perfectly well, even with these large models.

Using Proposals

- Update every 14 days
- Over 350 datasources in each proposal
- InfraWorks team of 5 persons
- Standardized workflows
- 1-2 days work for each update
- Cloud collaboration

During the optimalization phase of the project, in addition to the master proposal (base model), a total of 12 different alternatives for the three different corridors were established and updated in InfraWorks 360. The different proposals were used frequently in daily discipline meetings, in multidisciplinary meetings and in public meetings. A team of 5 persons worked exclusively with the different proposals during every update, each member were responsible for one or more proposals. Each proposal holds over 350(!) data sources!
During the municipality plan phase the number of alternatives was shortened down to 4 main proposals starting from Sørli, through Hamar and all the way up to Brumunddal. The master proposal (base model) and the four main proposals:
Proposal #2 – Corridor West, Alternative 3b – Culvert under Bay of Hamar

Proposal #3 – Corridor Center, Alternative 1a – Station at Hamar City Hall
Some of the proposals also included multiple design options for a discipline. Instead of splitting up the proposals we created custom categories for the different design options. In that way, we could easily switch between the different design options without leaving the current proposal.
PROPOSAL K2_1A, OPTION 2.

PROPOSAL K2_1A, OPTION 3.
Communication through Design Feed

Before each multidisciplinary meeting all the disciplines would download the updated version of the InfraWorks 360 model and do their design review inside the Design Feed.
The comments from the design feed was used to create action points during the multidisciplinary meetings. Since the Design Feed does not have much functionality for adding metadata to the comments we had to create our own standard for creating, answering and assigning tasks. This was done by adding a certain prefix to every comment.

After every multidisciplinary meeting, the Design Feed was exported out to a csv-file and then imported into an Excel template for archiving purposes.

**The BIM Cycle**

Multidisciplinary interaction in this project was parallel as opposed to sequential planning. Work phases were broken up into 14 days cycles. Work tasks were set up for a period of 14 days at a time.

Before the end of each 14 day cycle the models for each discipline were controlled according to the quality assurance plan for the project. The multidisciplinary control was done in InfraWorks. Before each multidisciplinary design review meeting, all disciplines did their preparations by adding their comments in the InfraWorks design feed.
ICE – Integrated Concurrent Engineering

Integrated Concurrent Engineering (ICE) was implemented as a tool to speed up processes for design, planning, decisions and approval. This along with the model-based workflows enabled us to simultaneously design and develop the model during each ICE-session.

The ICE-sessions was lead by a dedicated ICE-facilitator and followed a pre-planned agenda with selected multidisciplinary issues that needed to be resolved. During these sessions all stakeholders including the project owner, project manager, discipline leads and designers worked together to solve each issue. InfraWorks 360 was used frequently during these sessions, displaying proposed design options created “on the fly” by the designers.
One of our strategic goals for innovation was to include RAMS in the model. Normally, the RAMS log would be an Excel sheet or an online database containing information about the different issues along the railway line. Our RAMS Engineer created the different issues as geographical markers with metadata in ArcGIS.

The JBV established common guidelines for the use of RAMS in 3D-models. In addition to this, they also provided us with a library containing 3D-objects that would illustrate the different status of the RAMS issues.

Based on the models provided by the JBV we created a library containing objects for RAMS inside InfraWorks.

Initially, our RAMS engineer then exported his RAMS issues from ArcGIS to a shape-file. The shape-file consisted of points with metadata representing each RAMS issue. We then imported this file into InfraWorks as points of interests, using a script to map the different metadata to available attributes in InfraWorks. The script also made sure the correct 3D-symbol was selected based on the status of each RAMS issue.

This workflow enabled us to include updated RAMS issues in our InfraWorks 360 model, but the workflow was not very dynamic.

We have now changed the workflow by creating draw tools for RAMS inside the model. This will be implemented in our workflow in the next phase of the project. Here’s how we did it.

How to create your own draw tools for RAMS within InfraWorks 360
First of all, you need to create a custom schema file that contains the RAMS Classes and Attributes.
- Go to the folder `<model>.files/unver/DrawTools` and create a copy of the file “POI.json”. Give the name RAMS-logg (or any other name you want to be shown as the name for the tool”. (Repeat this procedure for each draw tool you want to create).
- Inside the “RAMS-logg.json” file, change the parameter “MarkupStyle/BaseAssetType” to the table name for the custom asset’s table name.
- Create your own RAMS-library with 3D-objects within InfraWorks 360
- Place out a couple of RAMS objects in your model.

**TOOLS FOR CREATING RAMS ISSUES WITHIN INFRAWORKS 360**

How to add coordinates for the RAMS objects

It can be useful to be able to include the coordinates for your RAMS object in the properties. This way, you can export them out along with the other attributes for use in Excel. This can be done by using the following script:

```javascript
function getCoordinate(feature) {
  var vector = feature.GEOMETRY.Centroid2d;
  var vector2 = feature.GEOMETRY.BBox3d.Center;
  if(vector == null) { return; }
  vector = app.ReprojectPointDbToLL84(vector);
  if(vector == null) { return; }
```


```javascript
var longitude = vector.X;
var latitude = vector.Y;
var elevation = vector2.Z
return latitude + "," + longitude + "," + elevation;
}
var db = app.ActiveModelDb;
var classID = db.TableIndex("USER_RAM-LOGG");
var poisTable = db.Table(classID);
var poisRow = poisTable.GetWriteRow();
poisTable.StartQuery();
var row = poisTable.Next();
while(row){
    poisRow["USER_KOORDINATER"] = getCoordinate(row);
    var featureId = row.ID;
    poisTable.UpdateFeature(poisRow, featureId);
    print("Feature "+featureId+" was updated.");
    row = poisTable.Next();
} 
poisTable.EndQuery();

Notice that the classID and poisRow must correspond to your Class names and Attributes in the custom schema file. Repeat the script for each draw tool you have created. Now, you can easily export your custom RAMS POI's out to a csv-file using the data table in InfraWorks 360.
```
Visualization – Gaining Public Consent

Throughout the planning process, the communication and presentation of the different design alternatives and their consequences was a key factor in gaining the consent of the public and local agencies. The use of InfraWorks 360 to show the visually rich dynamic project model enabled all parties a clear vision of the project and enabled them to provide feedback which could be incorporated into the model. This ability to not only visualize the project but to affect instant change resulted in a significantly shortened timeline during this critical phase.

A dialog between the project and the public was established by arranging community meetings at regular intervals during the planning. An important element in these meetings is the use of the InfraWorks model together with visualizations created in 3ds MAX to ensure that both professionals and laypersons understand each other and the consequences of the planned design.

Basically, we operated with three levels of visualizations:

**InfraWorks:**

InfraWorks was used to create a visualizations early in the project. At this time the 3ds Max model was not entirely ready and the JBV needed a visualization earlier than the model could be rendered in 3ds Max. Since the InfraWorks model was ready and updated, pictures and video from this model was used to create a movie presentation. This required very little rendering time and RS was able to deliver the movie within the deadline set by the JBV.
Lumion:
Lumion was used in two occasions when the JBV needed a more detailed and animated movie presentation. Again, the deadlines was very short, thus making it impossible to create the movie in 3ds Max. The first movie was created in only two days for a presentation for the Norwegian Commite for Transportation and Communication, while a later and more detailed updated version of the movie was created in only three days time for a public meeting at Hamar. To be able to deliver a movie in such a short time we simply exported the model from InfraWorks and imported it «as is» in Lumion. Lighting, materials and animations was added in Lumion.
Autodesk 3ds Max:
3ds Max was used for our high end movie presentations. In this case the model was created on the basis of the original base- and discipline models on ProjectWise. Since the 3ds Max model was created on basis of the same data as the InfraWorks model data, InfraWorks was used as reference model while working in 3ds Max. This way, InfraWorks was used as an important tool also in this work.

![ILLUSTRATION FROM 3DS MAX MODEL](image)

Lessons Learned from the project’s InfraWorks 360 users perspective

Improvements:
- The customization of InfraWorks 360 was neccessary to adapt it to our purposes
- Not possible to import 3D-models of large areas without distorted geometri and inaccuracy
- The use of coverages to present environmental maps required the model to regenerate when switching between the different maps.
- The use of terrain overlays lack support for coordinate systems and generates lots of data
- The design feed lacks functionality
  - Should be able to set status for comments
  - Should be able to assign to user
  - Should be able to click on marker and open comment
- Using web scenarios was not a success. No support for large models.
- No compatibility between versions made upgrading lots of work

Advantages:
- Visually appealing model, easy to understand designs, easy to use
- Handles multiple proposals and enormous amounts of data
- Easy to share through the cloud – 120 participants in our group!
- Free viewer with access to model viewer and design feed
- Supports animations
- Storyboard creator enables you to ease create and edit camerapaths and render them out to media files
- Fantastic tool for conceptual planning, does also work for more advanced phases
- The use of InfraWorks 360 as a design and communication tool was a success!
Challenges and advantages so far from the JBV’s perspective

Some challenges:
- Agreeing on level of detail for each discipline for each plan phase
- Getting everyone to use models (project managers, discipline leaders and so on)
- Using models in every meeting both internal and external
- Getting all discipline to deliver models in a very early plan phase, one example is surfacelayers

Some advantages:
- Communication, especially in meeting with external stakeholders. This is very important in all contact with properties owners and municipalities
- Gives us a better inter discipline concept
- Increased focus on base models and base information for design
- Reducing the numbers of drawings produced
- JBV now demands all data on both delivery format and original formats which gives us a great advantage in using the models as basis for tender documents and cost estimates
- The work on models in early plan phases will give us an direct cost effect in the building phase in conflict control, stake out data and building with machine control

Is the anything we would have done different if we had started over?
In the early plan phase the major benefit in using models lays in communication as we visualize the alternatives, and the consequences of each alternative.

If we had started the project again now we would clearly focus even more on getting the base models ready even earlier. Specifically the sub surface layers as rock and soft clay as well as the theme models for protected areas and endangered areas and species. This is essential information in the decision process.