

CI124423

BIM on Rails

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Learning Objectives

- Gain better insights and control with extended functionality of Infraworks.
- Identify best practice regarding information management in large scale infrastructure projects.
- Define value in gamified design and decision making.
- Understand the necessity of innovation, game-changing workflows that disrupts the industry.

Description

The class will take you on a journey through the innovative design process in large railroad projects to show what we are doing and how we push things beyond regular with help of Autodesk Infraworks and Unreal Engine. Information flow, live feed and efficient collaboration between hundreds of people per project involved, where everybody meets in virtual gaming environment. Join us, be part of the game.

Speaker(s)

Thomas Angeltveit is civil engineer specialized in railroad technology. Beyond technical expertise he is a technology enthusiast that has BIM Coordinators role in multiple large scale infrastructure projects.

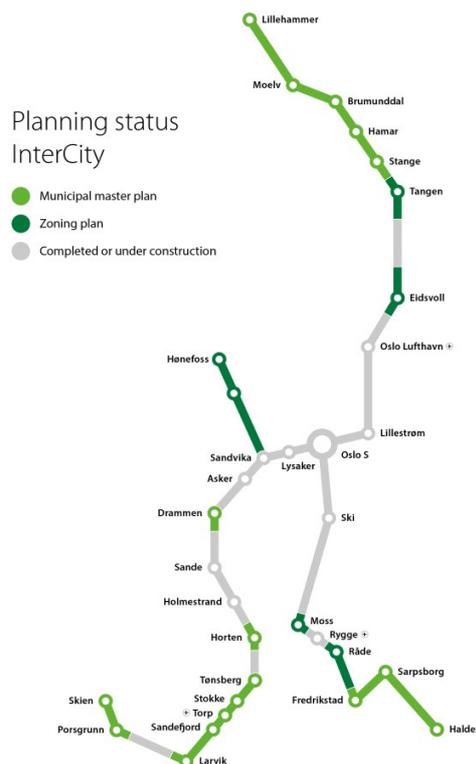
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- The InterCity strategy was developed in the early 1990s. Some sections are finished, and some under construction. 270 kilometers double track railway and 22 new or changed station areas remains.
- Concept study for the InterCity corridors was completed 2012. Success criteria are: 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
 - o Investment costs: Approximately € 12.5 billion
 - o National Transport Plan 2014-23 approved by Parliament, June 2013.
 - o InterCity-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 subprojects 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 2034.

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.

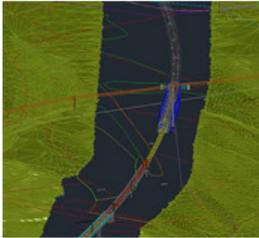
BIM in Bane NOR

Bane NOR has recently approved a BIM strategy that states that all large projects is to be model based projects for planning, building and documentation. Project management shall be an integrated part of all model based project and Bane NOR shall take an active part in developing methods, routines and requirements as well as standards for the infrastructure industry.

Bane NOR is currently working on revising the requirements and handbook for model based projects. The handbook was developed and approved in 2012. This handbook sets the requirement for all model based projects as well as drawings. The handbook:

- do not specify witch 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 that the coordinated model and the presentation model must be in a license free software defines all object is described both as a volume object with the stake out data as points, lines or volumes
- states that all object are general, none supplier specific in early plan phases. As soon as a supplier is chosen in the construction phase all object are redesigned with the specific objects and the inter discipline conflict control is updated
- has resulted in a 3D object library that is open for all
- defines that all existing data is modelled as base models, data both above and below the ground level
- states that all disciplines shall model their new objects in 3D
- states that the coordinated model references both the base models and the discipline models and is updated with project defined intervals. 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.
- states that a presentation model is based on the coordinated model. This model is primary used for visualization and communication within the project organization and with all external stakeholders in the project.
- states that the contractor must use the discipline models to export stake out date directly to machines and updates the models to as-built status

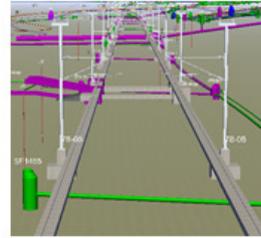
Existing situation is modelled. Base models



New situation is modelled: Discipline models



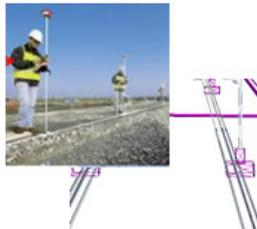
The decision process: Coordinated model / visualization model



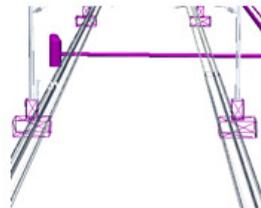
The contractor builds from the discipline models: Machin control



Approved changes are measured by the contractor and discipline models changes status to «as-built»



Data for maintenance database imported from the as-built models



THE WORKFLOW IN MODEL BASED PROJECTS

Motivation for using modelling in Bane NOR projects

Our main motivation for using models in Bane NOR is:

- Better control and quality will give us more cost effective projects
- Better focus on information for the existing situation in an early plan level makes it easy to re-use and enrich information through increased demands for level of detail all plan level
- Sharing data and knowledge with everyone within the project organization and all external stake holders
- Easier to visualize and highlight inter discipline problems and challenges for everyone involved in the project
- Building competence in BN, and be a leading organization for standardizing model based project and work flow in infrastructure projects

VDC – Virtual design and construction

Virtual Design and Construction (VDC) is the use of integrated multi-disciplinary performance models of design-construction projects to support explicit and public business objectives. Read more about VDC here: <https://cife.stanford.edu/node/187>

Integrated Concurrent Engineering (ICE) is one part of VDC and the goal is to make the meetings more productive and the plan process more efficient. Key success factors are good preplanning, clear agenda and objectives, and productive environment.

This session focus on BIM and Integrated Concurrent Engineering (ICE). How are we able to use the metrology in largescale multi-discipline infrastructure projects?

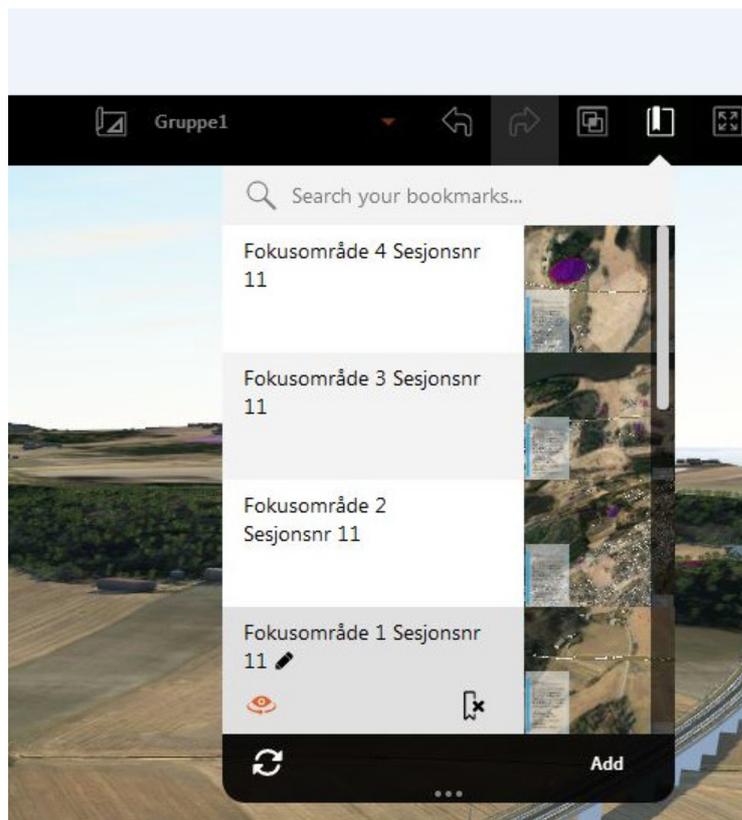


ICE-SESSION USING INFRAWORKS

Infraworks

How to use infraworks as an ICE-tool. Infraworks got several functions and with a bit creativity they can be used to make ICE-sessions more efficient.

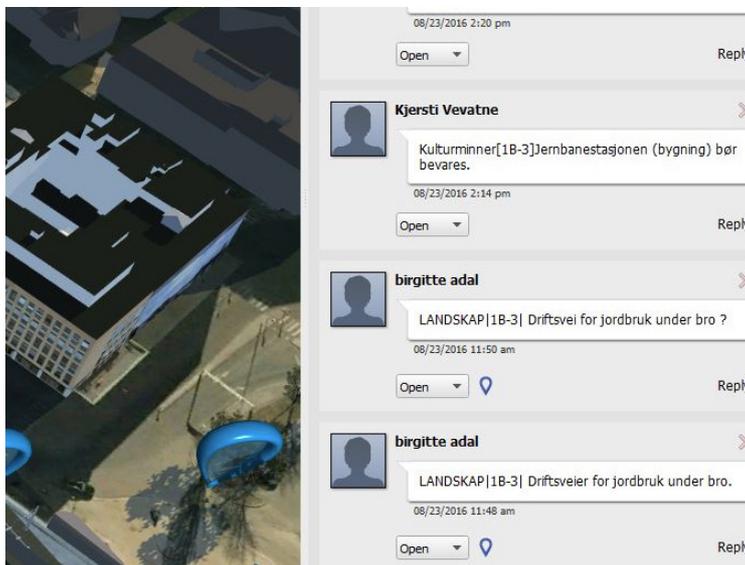
- Watermark
 - Use the function to inform the project group about upcoming sessions
 - Tell about the goals and connect this with bookmarks to show focus areas
 - Other information can be distributed as well
- Bookmarks
 - Show focus areas
 - Use bookmarks to quickly check if decisions from previous sessions have been fixed



BOOKMARKS

- Design feed

- The design feed can be used for collaboration and to prepare for sessions
- Standardize the use with for example a watermark. How should they comment and use special symbols
- Standardization let you export the design feed to excel and have a decision log quickly



DESIGN FEED

Proposal	Fag	Kommentar	Opprettet av	Kommentert dato	Status	Svar	Besvart av	Besvart dato
1A3	KONSTRUKSJON	Hva skal være fylling og hva er bru?	Thomas Bauer Sousa	29-01-2016 12:52	opened			
1A3	KONSTRUKSJON	Hva skal være fylling og hva er bru?	Thomas Bauer Sousa	29-01-2016 12:52	opened	AKSJON: Holder ICE-sejson for å lande løsning	Thomas Bauer Sousa	29-01-2016 12:53
1A3	KONSTRUKSJON	Hva skal være fylling og hva er bru?	Thomas Bauer Sousa	29-01-2016 12:52	opened	AKSJON: NN kaller inn til ICE-sejson	Thomas Bauer Sousa	29-01-2016 12:54
1A3	KONSTRUKSJON	Hva skal være fylling og hva er bru?	Thomas Bauer Sousa	29-01-2016 12:52	opened	FRIST: Fredag 05.02.2016	Thomas Bauer Sousa	29-01-2016 12:54
måster		Sjekk Reguleringsplan	Arne Moe Lysaker	03-11-2015 15:44	opened			
KorridorB		test til Arne	Christine Handstanger	13-11-2015 12:15	resolved			
KorridorB		test til Arne	Christine Handstanger	13-11-2015 12:15	resolved	fikset dato		
KorridorB		hva er dette?	Christine Handstanger	13-11-2015 12:21	opened		Christine Handstanger	13-11-2015 12:17

EXPORT DESIGN FEED TO EXCEL

Gamification, Unreal Engine

For nearly 2 decades we have felt that something has been lacking in engineering 3D/VR models compared to video games. The last few years there has been a change with the rise of high-end open source game-engines, HMD's, computing power and web frameworks. At long last we have reached the point when there is nothing holding us back from creating VR content that was earlier only seen in AAA gaming titles with powerful collaboration platforms.

The open API's and export possibilities of the Autodesk suite give us complete freedom over model files and we are able to work in an optimal way.

With a combination of engineers, 3d designers, and programmers you can design powerful collaboration platforms with AAA graphics that can be utilized all the way from early design phase to completion and public information phase.

Engineering workflows start with design creation in tools like AutoCAD, Revit etc. When the time comes to visualize those designs we have traditionally used tools like Solibri, Infracore, and Lumion.

What if we use a game-engine to extend the use of the models beyond just visualization and create new products?

A Game-engine offers endless opportunities:

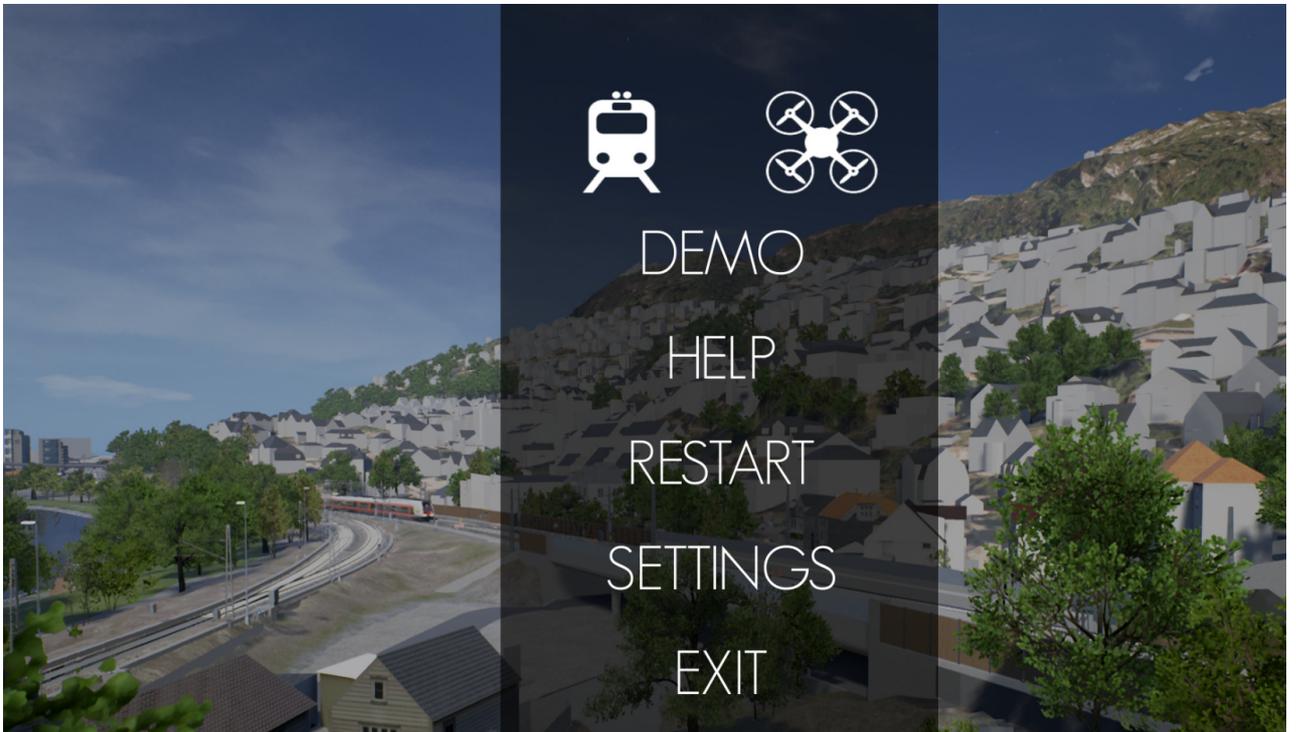
- Understand and feel the design in a new way thru an interactive first-person experience
- Enhance the first-person experience through the use of immersive VR
- Illustrations and animations at real time speeds
- Safety
- Maintenance
- Training
- Simulation
- Interaction design
- Emergency departments
- As built

- Preliminary plan
 - Involve the young generation
 - Communication needs with government and administrations
 - Dynamic photomontage





ILLUSTRATIONS



MAKE A GAME – DRIVE A TRAIN OR BE A DRONE

Be Creative



LASERSCANN

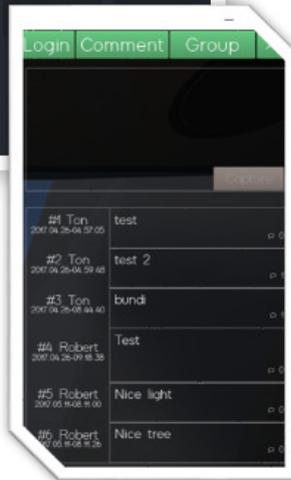
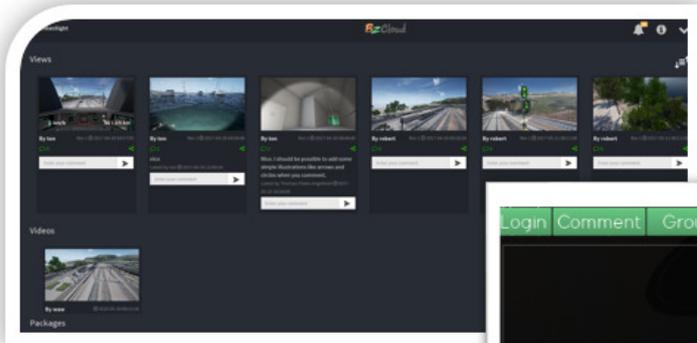


LASER SCANNED COCKPIT



MAKE YOUR OWN SIMULATION TOOL USING VR

Make your own collaboration-platform in the game
and invite the community to try your design



Wow.....



Mommy, I can see into the future



How to get started

Workflow

Working with Autodesk CAD products like AutoCAD(Civil 3D), Navisworks and Infraworks in collaboration with a DCC(digital content creation) application such as 3D studio MAX gives us a vast amount of options for modelling, optimizing, texturing and animating our models. We then utilize Epic Games Unreal Engine 4 (UE4) to create a visually stunning interactive experience.

The first order of business is to get the CAD geometry into the engine. UE4 only accepts polygons/mesh and therefore 3DS MAX with its comprehensive polygon modelling tools allows you to check the geometry from CAD for suitability for real time use and adjust/fix the mesh accordingly.

Even before we start importing from CAD the first challenge arises which is the huge coordinate values that CAD software often has in its models due to storing all values with double floating point precision. As both 3D Studio MAX and UE4 only use single floating point precision values, the easiest solution to this problem is to simply move all models close to the origin. There exist varying degrees of automation for this task but the important thing is to keep track of this translation so all models are moved correctly in relation to each other.

The trick to making a CAD model work inside a game engine is clever optimizations. This means we usually only export the geometry we will actually see and omitting the rest, unless one desires to see infrastructure that is hidden behind walls and underground.

Also, controlling the amount of detail in the geometry is important to make the models as light as possible. Thankfully UE4 has the ability to generate LOD's which is a huge time saver and can make a huge difference in the real time performance. For those unfamiliar with the concept, LOD(level of detail) it is basically reducing the amount of geometric detail in a model in concrete steps. UE4 accepts 5 LOD steps where each one is more simplified than the next one.

The engine then automatically determines when to switch between the LOD's based on the amount of screen space each object occupies as we move away or towards it. The default values work quite well, and the transitions are smooth so there are no sudden pops as the models are switched.

Next step is to determine what objects the player/user in the game world will bump into. As in CAD viewports, one can simply walk/fly thru geometry unless one explicitly specifies what objects block the player's movement. It is therefore useful to think of the geometry from CAD as a visual representation of what will be built. It has no other properties such as mass or even volume. This is where the concept of collision geometry comes in. Think of it as invisible meshes surrounding all the objects that block our movement. This typically includes all the floors, walls and ceilings in addition to any other solid objects in our scene. UE4 has the ability to use the visual/rendering mesh as the collision mesh as well, but this will be more computationally expensive than creating optimized custom meshes in 3D MAX. Due to budget constraints it is probably best to strike a balance between using the visual mesh for collision and creating simplified collision meshes around the more geometry heavy objects. Remember, the more polygons UE4 has to test collision checks against, the poorer the performance will be.

When it comes to materials those are best created within UE4 as it has a robust and advanced editor able to generate physically plausible materials. The process of creating materials is closely linked to texturing and the creation of UV coordinates, which one can think of as the coordinate system that determines the textures placement on the geometry. 3D MAX has robust tools for creating UV's and packing them efficiently.

Creating the textures themselves which define the materials is a process of acquiring the appropriate photos and processing/editing them for real time use. There are many different workflows and specialized applications available for this type of work. It is also viable to buy texture libraries that give you the most commonly used surfaces.

Recently we have seen the emergence of entire online libraries that have photo captured materials ready for use within UE4. These are high quality assets conform to what is called PBR(physically based rendering), which ultimately result in very realistic materials.

A second set of UV's need to be made for baking lighting information that is later calculated by UE4's global illumination engine called Light Mass. Once again this is a task that the engine can handle automatically but if one desires control over the process it is certainly possible to do this within 3D MAX for maximum precision and quality. Budget and deadlines once again determine the approach.

If one decides to use only dynamic lighting inside UE4, there is no need for lightmaps. This of course also means that the lighting will cost more in terms of performance and not be as high quality as pre-processed and baked lighting. Again, what one uses can vary with project requirements and the physical size of the game level.

Once all the geometry is inside UE4 and looking good we can start to create the interactive part of the presentation. UE4 gives us the ability to utilize C++ programming for complex functions. At the same time our 3D designers can use the GUI based Blue Prints scripting language to make simpler functions on the fly. This give us an unprecedented flexibility and the possibility to work with large scale complex models and functionality. Combined with our web and server-support systems for cloud sharing and collaboration that is directly integrated in to the game package.

Proof of Concept (POC)

To be able to create and explore opportunities in a game-engine you normally need to convince the customer of the benefits and get funding. Our experience is that it's hard to convince them with just words. Our clients don't usually know much about gaming technology and therefore have problems understanding how gamification can be useful. To inspire them we make small "proof of concept" scene which we present to our customers to make them see the endless possibilities. Once the customer is sold on the concept the real time nature of the gaming technology usually leads to us developing a great product together with our customers.

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