BIM for Railway Signaling—from Laser Scanning to 3D Model and Gamification

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Learning Objectives

- Recognize how connected information can help to reduce the time it takes to gather relevant data from different systems
- Learn how to better judge the different areas that need to be considered when building large-scale solutions for infrastructure projects
- Discover how BIM 360 and Forge can be used to connect multiple data and share information within the extended team
- Learn how far automation could go to help efficiency

Description

Siemens Mobility GmbH developed a whole workflow from digital track capturing using laser scanner technique to the creation of an infrastructure 3D model containing all relevant signaling assets. One of the main businesses for Siemens Mobility is the design, construction, and installation of signaling systems. The solution shows how automated data-preparation processes and interfaces help to combine different data sets in a way that helps cross-project teams understand and make use of the information easier and quicker. The focus of this class is based on demonstrating the benefits and added value arising from this solution, as well as a high-level overview of the processes supporting the different required use cases: digital track capturing, 3D visualization of the rail track with all assets, documentation, and train driver simulation. These processes make use of AutoCAD Civil 3D software, InfraWorks software, BIM 360 Field software, BIM 360 Document Management software, Maya software, Unity, and Forge.
**Speaker(s)**

**Marc-Oliver Böckelken** works as a BIM implementation manager at Siemens Mobility GmbH in Brunswig, Germany. With 19 years of experiences in implementation of tools and processes for design and engineering for railway signaling projects. He started to develop a process to use Building Information Modeling in railway signaling projects end of 2016. Meanwhile he is rolling out the process worldwide within the Siemens Mobility for railway signaling projects.

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**Claudia Zeh** works as a Senior Implementation Consultant with Autodesk Consulting, based in Germany. With over 15 years working in the geospatial domain, she brings extensive experience from working on different types of infrastructure projects with customers in the area of AEC, construction, rail industry and utilities. With her broad technological background from designing and developing solutions, database management, requirements specifications, she provides consulting services to customers around BIM 360 and the Autodesk Infrastructure portfolio covering workflow assessment, customization and solution implementation.

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Introduction

Siemens Mobility GmbH

Within Siemens Mobility the business unit Mobility Management is providing solutions to control different types of railway infrastructure. Together with Turnkey Projects and Electrification all other needed infrastructure parts of a complete systems can be provided. In addition to the infrastructure of a railway system the Rolling Stock can be delivered by Siemens Mobility as well. To close the loop Siemens Mobility is also able to take over all service and maintenance activities. This is the business of the Customer Service unit of Siemens Mobility.
Motivation

One of the main areas Siemens Mobility is responsible for is the design and installation of signaling systems for ETCS - European Train Control Systems. As part of the overall digitization initiative Siemens Mobility set its goal to develop new solutions for their main workflows.

ETCS

To operate a very high secure and reliable signaling system like ETCS with ATO – Automatic Train Operation – a very precise design is needed. It is absolute necessary to install all the assets with a very small installation tolerance.

Traditional way of working

At the beginning of the project, two main areas to work on had been identified, the geographical representation of the rail track with the signaling design and the onsite work along the track.

In the rail industry plans about the rail network design are most commonly based on schematic plans, working with mileage. The signaling design is based on clear rules, there are constraints that define for example how far each object needs to be placed at maximum from each. Designing this on a schematic plan is very accurate but needs verification before being built on site, to make sure that the desired location allows to install the object exactly at the designed position.

For the installation tasks along the rail track, there are clearly defined processes, based on regulations and guidelines. Traditionally many of those tasks are paper based, filling out spreadsheets and forms, which in consequence need a subsequent task of transferring the input data into another system.

The installation and maintenance personnel along the track depend on having the right information at hand when executing the work. Storing data in many different systems make it a task of being good organized to not forget gathering all relevant data, necessary for efficient execution. Storing information in different systems, makes it a more time-consuming task to gather all relevant information.

Caused by the big distances (between office and work location) and by the work in areas with no "net connection", the transfer of information is difficult and slow. For Reporting, the classic approach is to work a week onsite and to start the official reporting the week after when every team is back in the office. In consequence the results and maybe the information that some assets could not be installed because of collisions, is available in the design office a few days later. … after that the next cycle of design, engineering and installation starts.
Start of the Journey

The start of the journey looked quite neat, two clear goals have been stated:

- Creation of a 3D model of the existing rail track
- Replace the existing paper-based workflows for Onsite activities by a digital workflow

As soon as we started to work on those two work packages, it became clear that there is much more to it, that was not all obvious in the first place.

Some of the new topics we had to address when developing and working on the new workflows were related to unforeseen challenges that came up when applying the new way of working. Also, as soon the first prototypes became concrete, it was clear that other areas should be part of the whole solution right from the beginning.
Autodesk InfraWorks

Autodesk InfraWorks as a visual 3D design and communication platform has been chosen for the 3D rail track model creation. It allows to build large models covering a wide area of the rail track with near realistic visualization.

An InfraWorks model is generated by loading different data sets (terrain, aerials, road, rail network, landuse, …) to build the existing condition model as a first step. Next the actual project or design data is imported into the model, to view it in context.

A simple but important fact, the model is just as good as the quality of the imported data allows.

Questions and follow up tasks that arose:
- Where to get better quality data for the existing condition model creation (especially terrain and aerials)?
- How to place signaling data and the rail track, with real world coordinates?
- How to create content to enrich the model with additional project related data (signal box, station building, …)?
BIM360 Field Management

For the digitization of the paper based onsite activities we decided to implement BIM360 Field Management. The possibility of creating customized checklists to include all relevant questions and tasks that need to be executed when doing the installation along the rail track, helps to capture all information in a standardized way. A big plus is the possibility to take pictures for documentation, used for information as well as for proofing a task. In using the BIM360 platform, the question of providing all necessary documentation and guidelines for the execution onsite, has been addressed with BIM360 Document Management. Setting up a folder structure with permissions allowing only the relevant team members to access the right information, helps the onsite team to have exactly the necessary information onsite at hand.

Questions and follow up tasks that arose:
- How to automate the creation of checklists?
- How to connect data captured in the field with other in-house systems?
The Solution

When developing the solution two overall requirements were stated:
- Introducing BIM to avoid creating data silos and reduce rework of already existing data and information
- Implementing data automation processes to avoid manual and error prone steps

BIM @ Mobility Management

A main driver to create an existing condition model, representing the actual environment is to reduce the number of onsite trips, that are necessary to verify the onsite conditions. By scanning the rail track, a point cloud and images are generated representing the current situation along the track. Not just the teams who are responsible for the installation of the signaling but also other teams now benefit from this data, as they can access it and in the same way reduce the number of onsite trips by checking the most important environmental information already inhouse.
This is one of the many examples that came up during the project how shared data can help multiple teams to improve their workflows as well.

Working on Large Infrastructure Projects

The type of projects the mainline team usually work on are spanning parts or even a whole rail network of many 1000s of kilometers. This leads to very large data sets that need to be well structured and organized. Data storage as well as band width is a topic not to underestimate. As one part of our solution is the creation of point cloud data, we need to make sure that not just data storage but also providing the data within the extended project team is covered.
Automation

Right from beginning all tasks had been investigated under the stipulation of automation. Of course, there are always manual steps necessary, but where possible and rational, tools to facilitate automated processes have been created.

As stated above, the crucial part for the generation of a 3D InfraWorks model is to have good quality of input data. This gets combined by a custom tool based on Autodesk Civil 3D that makes sure this data is synchronized efficiently in a standard way. The tool leverages data from different sources, the engineering database, the rail track scan and other input data to create a standardized basis for the 3D model creation.

Having a 3D model of the existing track including the Signaling design, instantly raised the question whether this could be used for train driver simulation processes. As a 3D model for Visualization and a 3D model for a driver simulation is based on different requirements regarding model generation, a separate workflow has been implemented. Still, the same source data gets fed into the process. Content has been modeled with Autodesk Maya and the Gamification has been generated with Unity.

Autodesk FORGE

Autodesk FORGE is a set of web service APIs that allows to integrate Autodesk products (for ex. BIM360 Field Management, Document Management, ....) into your workflows, to build interfaces with other systems. FORGE takes components from Autodesk’s powerful library of software and delivers them as cloud-based building blocks for companies to create their own new solutions. FORGE helps to implement automation processes, as well as building combined applications gathering data from different systems.
To go one step further, after having all data on one platform, we created an application – The Project Information Viewer – that combines data from the 3D InfraWorks model and the onsite field data (BIM360 Field Management) into one dashboard. This enables the user to see the most relevant information at a glance. With the help of FORGE a viewer has been developed, that allows highlighting signaling objects based on the BIM360 Field status, within the InfraWorks model, so that it can be viewed in context.

This shows that sharing and re-using data, connecting multiple systems, creating interfaces driven by standardized data automation processes, helps to leverage data in a more efficient way and reduce time spent on rework or information gathering processes.

This journey has definitely not yet reached its final destination, there are already new areas in mind that could become part of the whole solution.