Infraworks 360: Seeing the Real World of Transportation in 3D

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

• Gain knowledge about how Infraworks 360 can be utilized in the context of real world transportation projects
• Gain knowledge on how the use Infraworks 360 can greatly enhance the public outreach aspect of a project
• Learn how to efficiently bring data into Infraworks from a number 3D software including AutoCAD C3D & Microstation Inroads.
• Learn how to optimize the interaction of data between Infraworks & Civil 3D

Description
Join in on this roundtable discussion where you will get a detailed look into the implementation of Infraworks 360 on three entirely unique transportation projects at various stages of the design process. The first project is a full-blown multi-million dollar roadway, bridge, & drainage project through an active rock quarry that chose to utilize Infraworks 360 at the advanced design stage of the project in order to enhance the public outreach process. The second project will provide a peak into an LRT & BRT 14-mile corridor alternatives analysis where various segments of the corridor were brought to life in Infraworks 360 in order to incite agreement amongst various jurisdictions & stakeholders. Lastly, you will get to see how Infraworks 360 was used to develop 3 concepts for a parking lot and trailhead relocation at popular local hiking destination. These 3 unique real world examples will give you great look into how Infraworks 360 can be utilized in the world of transportation.

Your AU Experts
Dan Iliyn, P.E. has quickly become one of David Evans & Associate’s most trusted and creative young civil designers in the transportation field. His experiences have been focused primarily on roadway and transportation projects with an additional focus on multi-use trail & LRT design. He is one the leaders at DEA when it comes to the 3D design and realistic visualization renderings of projects that provide interested parties and stakeholders a unique perspective and help bring clarity to the decision making process. Dan’s primary focus the past couple years has been integrating the design-based visualization capabilities of Infraworks 360 on a long list of projects ranging from concept level LRT alternatives to detailed full-scale roadway projects. His approach to design blends technical skill with collaborative, solutions-oriented concept designs to address complicated transportation issues and find agreement amongst divergent stakeholders through the selection of alternatives that provide the greatest benefit and value.
INRODUCTION

In this Roundtable discussion, we will take a detailed look into the implementation of Infraworks 360 on the following three real-life transportation projects and how those models were developed and eventually utilized to aid the project decision making process:

- **PROJECT #1: 124th Ave Extension Project**
  - Final Design project
  - Infraworks model developed at 60% design from Microstation Inroads
  - Roadway, Structures, Utilities, & Drainage project

- **PROJECT #2: Southwest Corridor BRT/LRT Alternatives**
  - Corridor based alternatives analysis phase of project
  - Jurisdiction approval of alternatives the primary goal
  - Infraworks model base file exported to 3DS Max for final renderings
• PROJECT #3: Mirror Lake Trailhead & Parking Lot Relocation
  o Alternatives analysis for parking lot & trailhead relocation
  o Multiple site alternatives and parking lot configurations
  o Primary goal is to select a preferred alternative (site & configuration)
PROJECT #1: 124th Ave Extension Project (Roadway, Structure, Drainage)

Project Background
This project is a $30 million dollar transportation project for Oregon’s Washington County: the extension of 124th Avenue through unincorporated county land between the cities of Tualatin and Sherwood. The project includes over five miles of new and improved rural and urban roadways, with extensive drainage features and a five-lane bridge spanning a railroad. The following are some of the details & design components of the project.

- New 2-Lane arterial through active rock quarry & BPA corridor
- New Arterial RR Bridge crossing
- Realignment of existing roadways
- Large 20-30 foot walls & rock cuts
- Extensive water quality features
- Challenging construction staging
- Heavy public involvement with multiple open houses due to significant neighboring house and business impacts
- Project is designed in Microstation Inroads
- The move to Infraworks 360 was not initialized until more than 60% of design was complete.
Development of Infraworks model

At 60% design, a decision was made to develop a full Infraworks model of the design. The biggest initial challenge was how to take a Microstation & Inroads design and import it into Autodesk Infraworks 360.

*Microstation Inroads to Infraworks Workflow*

3D Data types available from Microstation Inroads:
- Alignments
- Profiles
- Surfaces

**Workflow used on 124th Project**

Export data from Microstation Inroads to an XML format. Import XML alignment, profile, and surface data into a Civil 3D drawing.
From Civil 3D, there are 2 ways to get the data into Infraworks model:

1. Utilize IMX export/import from Civil 3D (Method used on this project)

   - Import IMX file into Infraworks and Configure data
   - Alignments/Profiles imported as part of IMX
   - Surfaces imported as part of IMX
2. Utilize Civil 3D Import capability within Infraworks
   a. AutoCAD Civil 3D 2015 or newer required for this function
   b. Civil 3D file dynamically linked to Infraworks model
      i. Roadway Import (Alignment/Profile)
      ii. Surfaces (Design & Existing ground)

Here are some snapshot images of the imported design Alignments/Profiles utilized in this 124th Ave project with an assigned roadway style:
**Design Road/Surfaces Infraworks Workflow**

There are a number of challenges with taking a transportation project that has been designed in another software to an advanced level (60-70%) and developing a detailed design visualization in Infraworks. The primary challenge on this project was getting the Infraworks design road features to model intersections and roadway transitions accurately per the design.

It became apparent quickly that the best way to develop an accurate Infraworks model is through a “mixed workflow.” The mixed workflow utilizes both Infraworks design roads (imported from Civil 3D) and imported design surfaces with materialized coverage areas.

The following images show the difference between solely design roads & a mixed workflow:

Intersections & Lane transitions were difficult to achieve accurately with Infraworks design roads. There are limitations currently with the ability to effectively control transitions between design road styles and at intersections.
The following image shows the change from a design road to imported surfaces/coverage areas (mixed workflow):

Importing Civil 3D alignments/profiles is as simple as attaching a Civil 3D file or IMX file (as shown previously). From there, roadway styles can be assigned to each alignment.

Let’s take a look at the workflow for utilizing design surfaces/coverage areas:

- Attach Civil 3D file or IMX
- Configured surface paste into Extg. Infraworks DTM
- Export AutoCAD polylines for coverage areas:
  - “mapexport” comment in AutoCAD
  - Save as SDF (Spatial Data File)
  - Select desired polylines
  - Check “treat closed polylines as polygons on Options Tab
- Import SDF files into Infraworks model as “Coverage Areas” to drape on imported FG surfaces
This surfaces & coverage area method is easy to update throughout design process. Surfaces attached from C3D file automatically update with Right Click >> Refresh on data source in Infraworks.

Polylines can be re-exported from C3D to overwrite original SDF files and then Right Click >> Refresh on data source in Infraworks.

This workflow can be streamlined utilizing attachment of Civil 3D corridors and defined Coverage Rule styles within Infraworks. For this project, that workflow did not make sense since the project was designed entirely in Microstation/Inroads.

**Utilizing project design & existing data**

Transportation projects at every stage (planning, preliminary design, final design…) typically have a wealth of available information that can be effective in enhancing an Infraworks model. For the 124th project, I utilized an extensive amount of available data used in the design process in order to enhance the Infraworks model. The following is a list of the data that was available on this project and how it was utilized in the Infraworks model:

- Existing ground Surveyed DTM (surface in Civil 3D) | Pasted into Infraworks Surface via IMX or Civil 3D attach

- Design alignment/profiles | IMX or Civil 3D attach
- Extg basemap linework/points
  - Building footprings
  - GIS Utility pole/transmission line points
  - Georeferenced project aerial imagery
  - Tree survey (forrest boundary/tree points)

This is just a very limited list of data types (used in this 124th project) that can be used to enhance a design model in Infraworks.
**Effectively utilizing Infraworks model for public outreach**

On typical roadway projects, the primary reason for utilizing Infraworks for design visualization is to provide the public, client, or other interested parties with an easily understandable presentation of the project design. That was most certainly the case on the 124th project as there were a number of open houses and IPG (interested party groups) meetings scheduled throughout the course of the project design.

The following are the two primary methods in Infraworks utilized in the public outreach effort:

- **Still shot snapshots**
  - 3D images are effective for stripmaps & printed exhibits

- **3D flythrough videos ("storyboards")**
  - Set resolution up to improve quality
  - Imbed images & text in video
  - Add camera path to storyboard
  - Control speed or time between key frames
  - Assigned camera paths
The storyboard creator can be utilized to develop a wide range of fly-throughs of an Infraworks model. A wide range of easy to use camera paths is available:
- Import camera path from .shp or .sdf file
- Create a video following a “design road”

Export completed “storyboard” to a video (.wmv or .avi format)

The completed fly-through videos are an effective tool for presenting the project to the public and client and providing a platform for constructive conversation about the project.
PROJECT #2: Southwest Corridor BRT/LRT Alternatives Analysis

Project Background
This project is a BRT (Bus Rapid Transit) and LRT (Light Rail Transit) corridor analysis and alternatives development project for a 14-mile corridor in Southwest Portland, Oregon. There are over 100 different alignment/segment concept alternatives for both BRT & LRT throughout the various segments of the 14-mile corridor. The following is an exhibit with a comprehensive layout of the alternatives:

In the 100 plus alignment alternatives, we were tasked with developing a visualization for 10 of the main alternatives at critical segments of the project in order to achieve the following goals:

- Elicit constructive conversation with local jurisdictions on relative concept alternatives
- Provide a clear representation of various alternatives to non-engineering local and public officials
- Begin to narrow down the range of alternatives.
- Provide the public with an accurate representation of the proposed alternatives
Infraworks workflow

This project was unique in that we had a sub-consultant (different company) on the project that was initially tasked with developing all the visualizations (utilizing primarily Google Sketchup & 3DS Max). We pitched the use of Infraworks as a way to provide more efficient and context-laden visualizations to help spur the decision-making. We agreed to use a combination of Civil 3D, Infraworks 3660, & 3DS Max for the visualizations, utilizing the following workflow:

1. All design alternatives were developed in AutoCAD Civil 3D with the following level of detail and available data:
   - Plan view layout with concept linework (cubs, sidewalk, walls, striping.....)
   - LRT/BRT alignment & profile
   - 2’ Lidar contours
   - Detailed project aerials
   - GIS building footprints

2. A simple surface was developed in Civil 3D utilizing alternative linework & alignment/profiles
   - A single corridor developed utilizing designed alignment/profiles (simple assemblies)
   - A composite design surface developed from corridor
3. The linework and surfaces were utilized to develop “base” Infrwarks models

- All linework exported out of AutoCAD to SDF
  - Layer separated objects based on textures desired in Infrwarks
  - Each layer exported to separate SDF for import into Infrwarks

- Surfaces imported into Infrwarks via IMX/Civil 3D import
  - Finished grade surface
  - Existing lidar surface

- A “base” Infrwarks model developed using the “mixed workflow”
  - Utilized surfaces & SDF’s for most Roadways & intersections
  - All bridges/tunnels modeled with Imported alignment/profiles & Infrwarks design roads

4. Export the “base” Infrwarks model to an FBX for use in 3DS Max

- Once the Infrwarks base model was developed for each option they had to be exported to a format that could be utilized in the software 3DS Max.
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Export model from Infraworks

Select model extents for export

Define coordinates

Export all features to a single file (select .fbx format)

List of feature types being exported

Maintain materials/textures

This is an example of the resultant exported FBX files
5. **Import FBX files to 3DS Max and finish detailed modeling**

The finalized FBX files were then provided to our sub-consultant to use as a base within the 3DS Max environment in order to finish the detailed modeling and develop renderings from the model to use in public outreach and meetings with public agencies:

This workflow was utilized on this project for all 10 of the visualizations which were instrumental in aiding the client and the public in determining preferred alternatives. The following are few additional images from the finished models:
**PROJECT #3: Mirror Lake Trailhead Relocation**

**Project Background**
Unlike the first two projects which were heavily roadway/corridor based, this 3rd project is focused on an analysis of a site design. The Mirror Lake Trailhead Relocation project was an alternatives analysis transitioning into preliminary design for relocating an existing parking lot and trailhead for a popular hiking destination (Mirror Lake) near Government Camp, Oregon. The relocation is required because the existing trailhead parking area is located immediately adjacent to a state highway and on the outside of a curve.

**Phase 1: Site Alternatives Analysis**
The first phase of the project required a thorough analysis of the following 5 separate potential sites for the new parking lot:
Infraworks was utilized at this stage of the project to merely provide some vertical and spatial context of each potential site without going into any design or modeling detail.

Since this project is high level planning with no existing topo or ground survey, we utilized the Infraworks “Model Builder” feature to develop a basemap.

From the base model, we simply added trees and a schematic parking lot shape; the following 3D images were developed and used in reconnaissance report and to aid in discussions about the site alternatives with the client:
Importing Infraworks into Civil 3D

At this planning stage of the project, we had very little to no available data for the area surrounding the proposed sites. We were able to leverage the data gathered by Infraworks in the models above by importing the model into Civil 3D:

For this project, we utilized both the existing surface & the GIS road centerlines imported into Civil 3D (and eventually moved to Microstation/Inroads) to being our preliminary site analysis design.
**Phase 2: Parking lot Configuration Analysis**

Upon completion of the reconnaissance report in phase 1 of the project, we moved into the 2nd phase of the Mirror Lake Trailhead Relocation project. The original 5 sites were narrowed down to a preferred site (Site #2_Skibowl West) and we were scoped with developing three parking lot layout alternatives within the selected site.

These were some of the goals & reasons for utilizing Infraworks at this stage of the project:

- Show the visual impact of parking lot to surrounding forested area
- Provide an easily understandable product to the client/stakeholders in order to arrive at a quicker decision
- Develop fly-through videos of each model to show at scheduled open house meetings

**Preliminary Design Phase Workflow**

Similar to the 124th Ave Extension project discussed previously, this project was also scoped to be designed in Microstation/Inroads. As such, the workflow for developing the design visualizations for the three parking lot alternatives was similar to the 124th Ave project:
Snapshots of parking lot layout alternatives:

- Parking Lot 1_No Walls
- Parking Lot 2_Optimized Circulation
- Parking Lot 3_Maximum Spaces

All three alternatives were developed primarily utilizing Inroads/Civil 3D developed surfaces along with SDF files for materials (processes shown previously)
Critical Existing Data:

This project had a lot critical existing environmental boundaries and features that impacted the design alternatives. These critical features included:

- Barlow Trail (Archeologically sensitive trail)
- Riparian Buffer Zones
- Significant forested areas
- A.P.E. (Area of Potential Effect)

It became critical to show these features in the Infraworks models to visually show potential impacts:

These critical features started as polyline/boundaries in AutoCAD/Microstation. They were effectively brought in to Infraworks like this:

- Each feature exported out of CAD to separate SDF file
- SDF imported as Coverage Area in Infraworks
The imported features were draped on top of the surface in order to visually show where the critical features were with respect to the surrounding design features.

The other critical feature to show was the heavily forested areas. Rule Styles were heavily utilized in order to develop realistic looking forests with variety of trees:

- Under color style, Alpha channel provides transparency to feature
- Buffer width represents coverage area as a “line”
- Add tree varieties with assigned probability of displaying
- Add expression TAG=’Forest’
- A rule style can help control how features are displayed in the Infraworks model
The “Forest” rule style developed above can then be applied to a “stand of trees” in Infraworks as follows:

Once the “Forest” tag has been assigned to the appropriate trees, simply “Apply Rule Style” in order see varying trees assigned to “stand of trees”