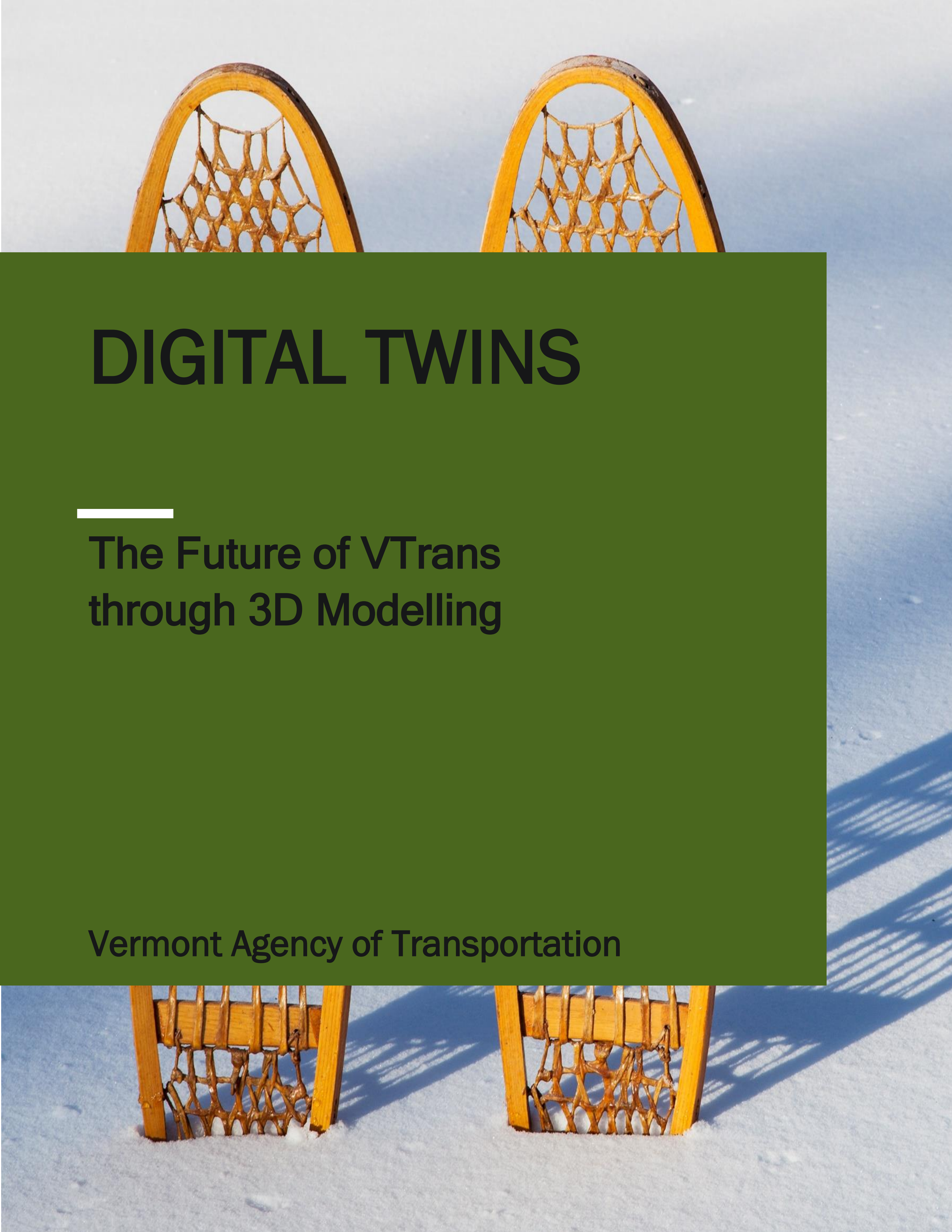


DIGITAL TWINS

The Future of VTrans through 3D Modelling

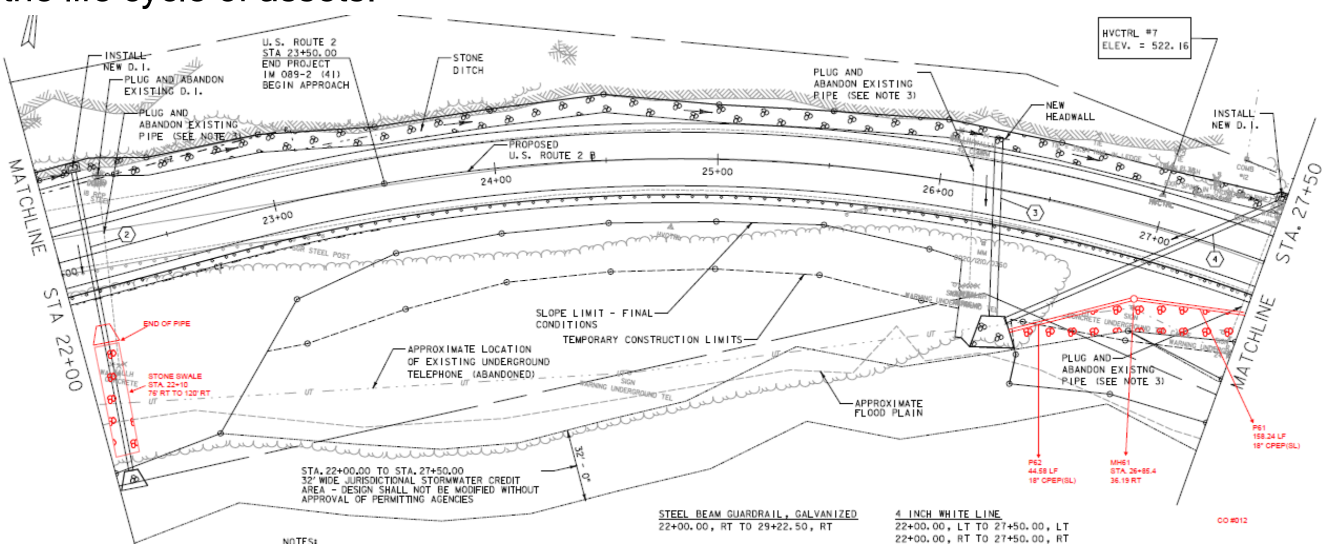
Vermont Agency of Transportation

VTrans As-Built Digital Twins

Civil Integrated Management (CIM) – A New Approach to Managing Transportation Infrastructure Information

CURRENT PRACTICE

VTrans currently tracks construction activities using various methods then transfers and overlays the "As-Built" information for record purposes. The construction tracking is done using fabrication drawings, change request documents, sketches, and drawings of various sources. These construction changes are then transferred and overlayed onto the Contract Document Plans using different methods but essentially results in redline markups. These As-Built electronic two-dimensional (2D) sheets are the official documentation of existing transportation assets such as bridges, culverts, signs, traffic signals, and other transportation related assets and information. These documents along with on-the-ground maintenance activities are used to maintain VTrans asset information and manage ongoing operations and maintenance throughout the life cycle of assets.

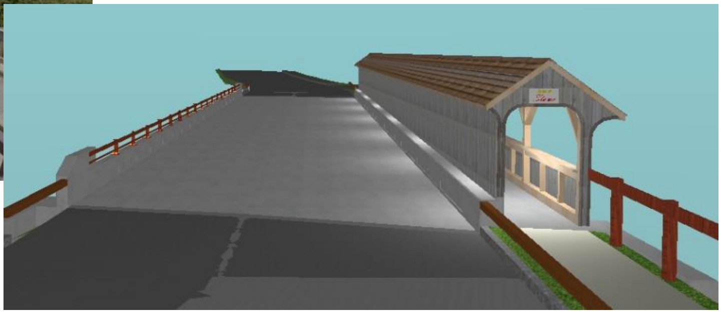


FUTURE = CHANGE

There is a fundamental change in the transportation infrastructure construction contracting and construction methods underway. Project across the country and around the world are being constructed without 2D sheet-formatted documents. This introduces an opportunity to upgrade “As-Constructed” record plan information transfers. The current redline overlay method lacks the necessary technology for its information to be shared electronically and doesn’t represent best practice. Future methods for delivering “To-Be-Constructed” asset information are to build a three-dimensional (3D) Engineered Model of the project, referred to as a **B**uilding **I**nformation **M**odel (BIM). This method involves making an accurate digital simulation model. That digital model, referred to as a“Digital Twin”, contains relevant information needed for construction. This includes analytical, dimensional, geometrical, geospatial, material, quantitative and other information needed for construction.

This change in construction documents changes how “As-Built” record plans are completed. There will be little or no paper trail to mark-up and reflect what was constructed.

<-Actual Asset



Digital Model ->

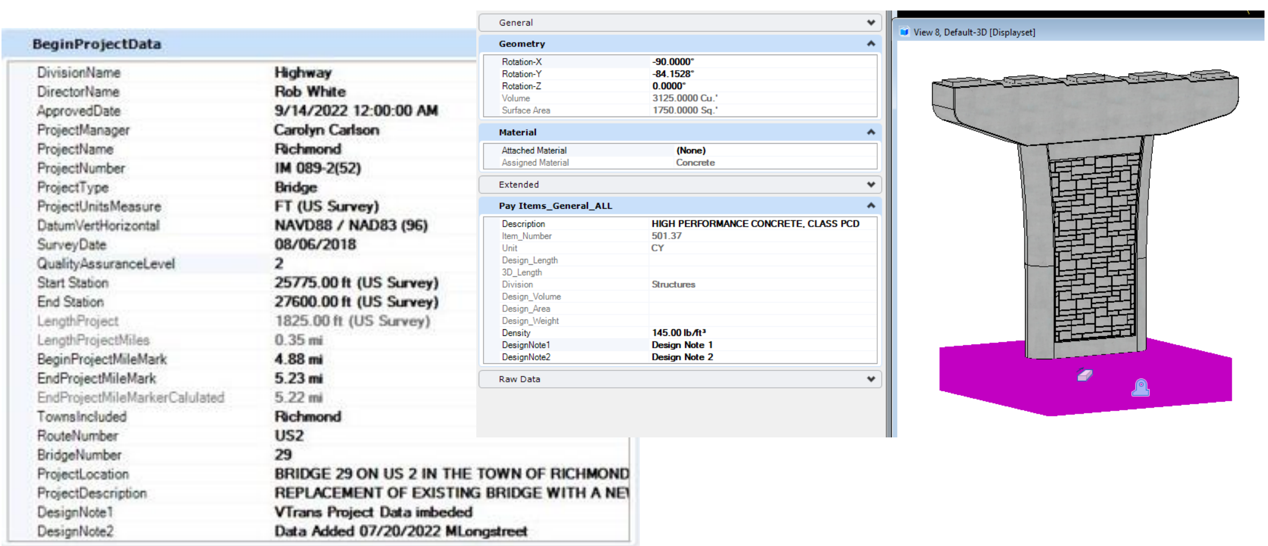
Can you spot the differenced between the Digital Model and the Actual Asset? There are a few.

3D DIGITAL AS-BUILT MODEL

This concept of 3D model encompasses a multitude of formats and information. There are multiple names applicable to this “data set” but it is essentially a collection of data pertaining to physical objects. The BIM can go from Design to Construction can be modified and appended to include “As-Built” information. Additionally, this BIM can be appended to include maintenance and operation activities over time. The BIM can be redefined to encompass Civil Integrated Management (CIM), required to represent the full life cycle of an asset. The model, when integrated with other asset models, becomesa repository of information related to the entire transportation infrastructure network.

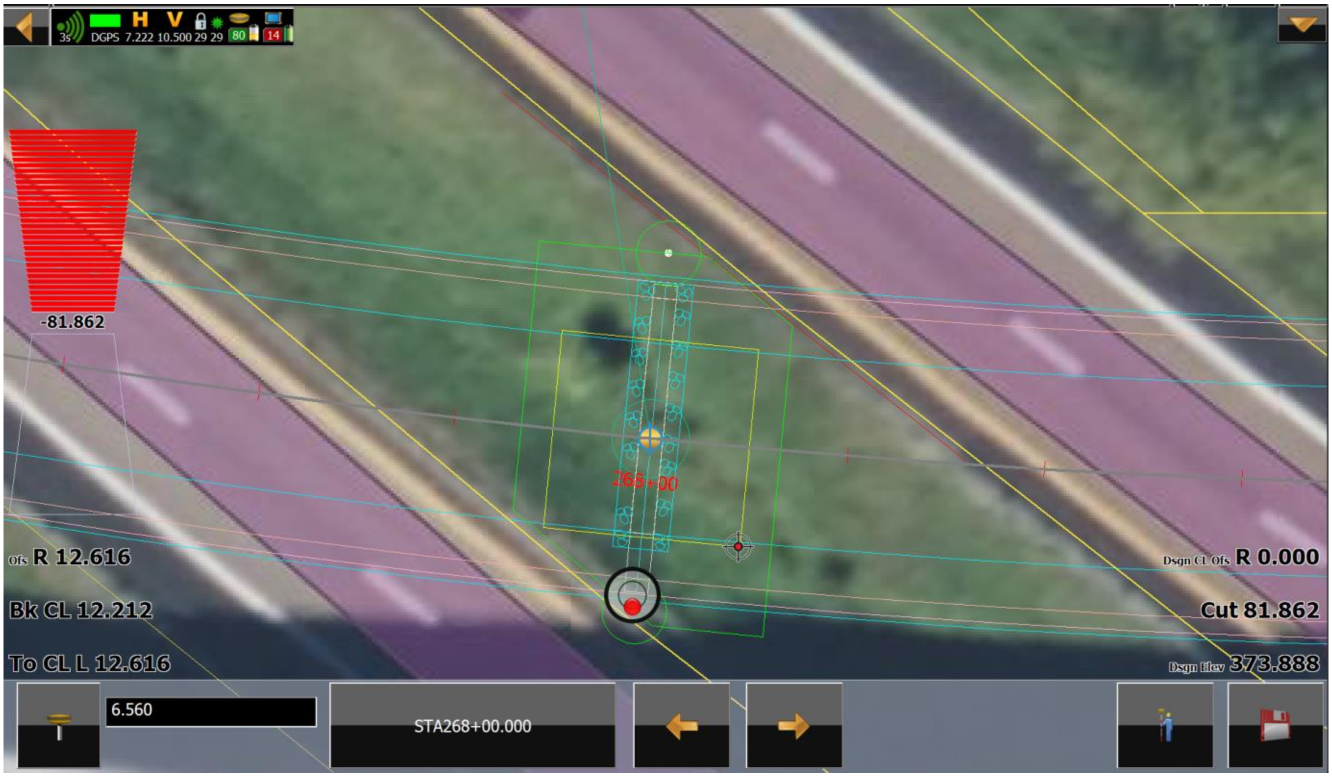
ENGINEERING

VTrans uses a suite of software to create engineering documents and models. Bentley MicroStation and OpenRoads Connect edition are the primary roadway design applications. These applications together generate accurate geospatial roadway and roadway component modes that can be used for BIM. Additional software like OpenBridge Modeler, OpenBridge Designer and ProConcrete generate detail bridge information.



CONSTRUCTION

During construction a few different software applications will be used to layout and construct the Roads, Bridge, Signs, and other Transportation needs. Survey software and Hardware from Trimble and Topcon are typical. The tool can import in Engineering Model data for field operations. They can also document “As-Constructed” geographic and geometrical measurements. These can be compared to the Design Model then using the Design software edits can be made to the model where necessary.



This image show Topcon Magnet Field in the Stake out mode. You can see the Red bullet icon located near the bottom right corner of the footing. The heads-up indicators show the current location to be 12.616 feet right of STA 268+00 currently being staked. Also indicated is the current location 12.212 ft back from the CL location. This makes sense since the abutment is 25FTx25FT. The user can find points from the design or create data points to locate actual in the field locations of asset information.

ASSET MANAGEMENT

Asset Management focuses on asset life cycle and uses data to inform decision making around which projects to do, and when to do them. “As-Built” information and data are significant to this process, and the Engineered model needs to be updated with all the **actual** data from construction to make that data-driven decision making possible.

There are many ways that data can be shared across the agency through the Engineered model The model can be exported to many formats that can be consumed by other sections with VTrans. This can include GIS information exported in the form of shape files. Also, the data in the model will be linked or exported to and from databases used within the agency, like VPINS for project information, or VAMIS for asset information.

HOW TO DO IT

This is a significant challenge and there is no one obvious way to do this. Technology is playing and important roll. The one constant in this is change. There are multiple challenges confronting FHWA and State transportation managers. Digital information has technological strings that must be addressed. There are also many software developers ready to partner alongwith educational partners as well. The infrastructure assets are always changing throughout all phases of their lives – planning, design, construction, and maintenance & operations. The Technology will change along with those assets. Assets generally degrade over time, while software technology is, in theory, upgrading. Any investment in Digital As-Built asset management must be flexible, and interoperability is one key consideration. Software used to create 3D Engineered Models generally create proprietary file formats. There are interoperability formats being created, but generally require export from the original files. This is fine, but exports from proprietary format never contain all the original data. Ideally, there needs to be a common export format with predefined data objects that can be read between various software packages.

Another challenge is training. There is a very specific expertise in creating 3D Engineer models. Even specific subsets of expertise - for example, Visual Bridge Model, Analytical Bridge, Roadway, utility modeling, traffic modeling, hydraulic modeling all requires expertise that is not necessarily common; each is its own discipline. This goes even further when we look at contractors,engineering, asset management, and maintenance. Not everyone is going to be able to edit and maintain a 3D engineered model, nor should they be expected to. Additionally, all these groups require different types of information and in different formats.

How do we create a data-centric model that can be used across multiple disciples and multiple location? This issue is at the core of CIM/BIM.