### Learning Objectives

- Understand how a VDC approach can mitigate risk and ensure project success
- Understand how Autodesk’s AEC Collection works together to provide a seamless solution for VDC methods
- Understand how to migrate data between Autodesk products for different project intents
- Understand how collaboration at different levels can make an overall difference on a project

### Description

Autodesk’s Architecture, Engineering & Construction Collection provides an extraordinary range of capabilities and tools that, when integrated, create incredible insights and make easy work of complex design and project problems. This class will explore the potential and power of digital construction and project management with the AEC Collection. In this class, we will dive into the complex installation of several large tanks in a highly confined facility, utilizing drone technology and reality capture with different software integrations. Some of the software this class will explore is AutoCAD Civil 3D software, Vehicle Tracking, ReCap software, ReCap Photo software, Navisworks software, Infraworks software, and more. With the integration of all these programs, the project was able to succeed as planned, utilizing found vehicle and building clearances as well as logistical confirmation of the project’s ability to succeed. This class will demonstrate the effectiveness of the AEC Collection as well as the virtual design and construction (VDC) methodology.

### Speaker(s)

**Tony Sabat** Tony Sabat is a consultant and VDC Specialist with SSOE Group out of the Southwest Michigan office in Kalamazoo. Tony began his career studying architecture and civil engineering where he first started for a civil engineering firm. He discovered this incredible tool that was like AutoCAD but just for civil engineers, called Civil 3D. He realized what a powerful tool it was and began customizing templates to expedite existing workflows. From there, he realized this technology and coordination could be extremely powerful when coordinated with other disciplines during construction. He put this into practice and ran the underground portion of a construction company’s VDC group where many different technologies were used to
capture and coordinate above and below ground information to ensure a project’s success. It was at this stage, he realized his affinity for technology and transitioned into consulting for the Architecture, Engineering, and Construction industries. From there he began training companies on different software tools out there for design, coordination, and simulation as well as training clients on Reality Capture solutions such as High Definition laser scanning and drones (UAVs). Today, Tony currently supports the civil engineering group for software and technology needs, coordinates and runs UAV operations, consults for different Reality Capture adoption and implementation methods, as well as dabbling in VR, AR, and any other technology he can get his hands on that hold the potential to create new or expedite current workflows.

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Collaborative Approach

Much of this project revolves around the collaboration between individuals and project stakeholders. One of the main issues with implementing new technology is not the understanding of how a new workflow can benefit a project, but who or how do I go about utilizing such a technology so that my project can stay ahead. Identifying key technology leaders in an organization, someone you can go to, to even question is this a good solution for my project and can this work.

Technology Initiatives
Understanding what technology efforts your company is investigating and actively using is incredibly important if you are a technology champion. It is even more important for those who will be looking to implement such a technology on actual projects. A technology will generate the ROI or Value Promise it was designed to if it sits dormant in a closet or on a secondary desktop. Once these efforts are well known throughout a company, the next important step is to clearly communicate resources or champions of that technology to invest current opportunities.

Campus Coordination Efforts
The project we will be talking about today was not captured within the specified scope of the initial project. This project was an added effort that was close in proximity that added minimal effort to capture adequately to then utilize the data downstream for further projects.
This holistic approach to campuses has proven valuable to not only us, but also to our clients for coordination and well informed master planning goals.

**Virtual Design and Construction**

The Virtual Design and Construction process, better known as VDC, integrates many sub technologies and workflows to better deliver a project on time and on budget. Most are familiar with virtually designing a project with tools such as BIM and 3D modeling, but VDC entails simulating the construction process even down to scheduling and logistics. This project we will be walking through today is not entire building, but is a remove and replacing of equipment that comes with many conditions for success.

**Reality Capture**
To make the VDC process and project successful, the use of reality capture tools was essential. The primary project to be captured utilized several techniques to do so. The first of which was high definition laser scanning. The primary project dealt with very dynamic walkways connecting multiple buildings at different levels and over existing truck paths. The main tie points and potentially affected areas were scanned to ensure the design would be constructed without issue. The next level of reality capture was with the use of photogrammetry and a UAV or better known as a drone.

**Drones**
Now drones are another spoke of the reality capture wheel but deserves its own header due to the fact that it can cover a large amount of area with relatively accurate results. It was primarily used during the initial project to capture what the high definition laser scanning could not, but because of its mobility and ease of use, we were able to utilize for additional scope to be used downstream on this other project.
Simulation via the AEC Collection

Virtually constructing a project is one of the main ideas behind VDC and will be the main portion of the presentation where we detail the tools used and how they were used to achieve a specific result for the project. Now simulation can vary by level of detail as well. Basic logistics and “will this fit” studies are incredibly powerful for situations where such conditions must be verified. Other times full schedule and frame by frame movements must be simulated and studied. It is important to know the difference and to know what questions need to be asked for a successful project.

AutoCAD
The premise of the case study is to successfully install several large sugar tanks once the old ones have been removed. This must be done without interrupting the plants active traffic pattern. The first item to be represented and understood is, of course, the tanks. I am starting with this item because it will be the easiest portion and we’ll walk before we crawl. The tank will be simple to simulate because it is a cylinder that is 12’ diameter by 50’ tall.

Movement Simulation
The next step is to simulate the movement of the tank and how it will virtually move and rotate to avoid colliding with any existing infrastructure or construction equipment. This could be an area where over simulating could be counterproductive. The movement of the tank can be broken down into two movements, a rotation and a translation. The difficult part for the construction crew will be that this is a compound lift where the tank will have to translate while it is rotating.
Simulating the multiple stages of movement for the lift.

For this we need some existing dimensions to ensure proper simulation. We will be able to take the dimensions we need from our reality capture point cloud to then trace our movement simulation in AutoCAD.

**Navisworks**
Once we know how the tank will need to be moved to be successfully lifted, we will then need to coordinate this 3D model with the existing conditions to ensure the crane itself will be able to fit within the construction area. For this we will move our 3D model into our existing reality capture model. This was a great opportunity to use the measurement tools from Navisworks to generate measurements to relay to the field crew looking to enact the project. These measurements were even used in the contract to ensure proper execution of the staging.

**Equipment Simulation**
With the tank simulated and known as well as our existing conditions, we can now begin to understand if the construction equipment will logistically mesh with the project. The tanks size and weight is already known by the lift crew, so the next step is to model that crane. Now this will not be as easy as modeling the tank. If anyone is familiar with Levels of detail and modeling complex structures, you know that is not as simple as an extrusion. But with today’s day and age, we are developing more and more complex freeware models from sources like SketchUp warehouse and turbosquid and many others where models can either be purchased for $70 or modeled for $70/hour for a few days. Luckily for us, the crane model was found in the 3D warehouse and once we verified dimensions and sizes, we were able to use it. We were able to use it within Navisworks and isolate different groups of components to simulate how the crane would be maneuvered, how high it would need to boom up and what angle the arm would be at to lift these tanks.

**Vehicle Tracking**
Once the crane was simulated, we next had to simulate the vehicle shipping the tank to the site. With many constraints for the truck and trailer, the only tool for the job was Vehicle Tracking. Vehicle tracking has an extensive library again of pre-modeled vehicles for proper simulations.
We were able to tweak one of the models custom for our lengths and depths to determine a truck route around the site. Our scope was to determine how the truck would maneuver within the site. Off the site was not of our concern. As we began simulation though, it was clear to us that the current model would not work getting on site. We rebutted to the logistics crew that the current model would not work. They followed up with a simulation the physical way with their model and sure enough discovered the current model would not work and would need to investigate a different one with a shorter turning radius.

Simulating the multiple stages of movement for the truck and trailer.

**Infraworks**

Vehicle tracking proved incredibly beneficial in that aspect, but would need to be used again for not only horizontal clearances for vehicle tracking, but also for vertical clearances because the trailer will be working with 6 inches of clearance over 50 foot lengths. Unfortunately, we had no surface data for that area. Our point cloud was not focused on that area and therefore we did not capture it. In order for us to generate some terrain data, we would have to use Infraworks model builder to generate preliminary elevations to simulate. We used Infraworks model builder to capture this data and then export it into Civil 3D where we projected the surface to our vehicle tracking paths and simulated if we could successfully maneuver around the site. With this simulation, we discovered that the south entrance did not provide enough clearance and indicated the East entrance would be the most efficient path moving forward.

**Conclusion**

In conclusion, the many tools available within the AEC collection can all pose a powerful portion of a detailed simulation in a short time frame. Navisworks has been seen as the only simulation tool for such uses, but there are many different ways to accomplish such a task and understand if a project will be successful. The AEC collection in conjunction with other proven construction technologies and techniques enables intense simulations without intense learning curves.