

MJ4D, An Agile and Platform Agnostic Digital Twin

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Key words: digital twin, LiDAR

SUMMARY

A digital twin can be leveraged to help government agencies and local communities with some of their most vexing information management challenges. In addition to reduced budgets, minimized staffing, and deferred maintenance, municipalities and aging facilities are often faced with outdated mapping, incomplete asset inventory and insufficient existing conditions of vital infrastructure.

The digital twin serves as an infrastructure data management tool which can integrate with other digital information sources and supports community infrastructure maintenance activities. The modern basemap is no longer a static image or plan set, but rather an immersive collection of datasets from multiple sources that leverage the efficiencies of the latest technology to provide rich datasets which maximize value and make the data accessible to non-traditional user groups.

This paper examines the latest technology used to create the digital twin including 3D laser scanning, mobile LiDAR and UAV imagery. This paper is based on real-world case studies in the development of a variety of digital twins that have been assembled for AEC design teams, agencies and municipalities throughout the United States.

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1. Creating MJ4D for the AEC Industry

M.J. Engineering and Land Surveying, P.C.'s (MJ) in-house team of surveyors, engineers, and GIS experts developed MJ4D to fulfill the need for a web-based digital twin viewer tailored to the AEC industry. MJ4D harnesses the power of reality capture technology in a web app that is readily accessible and easy to use.

Viewing reality capture data like LiDAR pointclouds previously meant managing large files and installing specialized 3D software on an expensive and powerful workstation. MJ4D removes those roadblocks, giving an entire project team secure access to a digital twin directly from a web browser without installing software.

MJ4D is ideal for project teams working together remotely. Team members can be virtually immersed in a real-world project site from anywhere. A manager can review site conditions with their staff via high-resolution panoramic photos. A technician can take detailed 3D measurements in conjunction with their familiar CAD or GIS design software. MJ4D enables the whole project team to benefit from the rich existing conditions information that only a digital twin can provide.

The MJ4D data acquisition team's expertise is collecting reality capture data using the latest LiDAR and imaging technologies – on foot, attached to a vehicle, aerial, or by boat. Our team has completed digital twins ranging from a single building to an entire city. Additionally, users can incorporate their own pointcloud or imagery data into MJ4D.

Modern design teams and community leaders increasingly require digital twins to stay agile and make data-driven decisions.

2. Broadway Junction, New York City Transit Authority – Supporting a Large, Geographically Diverse Team in Collaborative Design

This digital twin was created for the large-scale project to renovate Broadway Junction, a New York City subway station complex located in Brooklyn, New York. More than 100,000 commuters enter the station complex each day, which serves five subway lines and connects to the Long Island Rail Road.

The project was administered by the Metropolitan Transit Authority (MTA) which is part of the New York City Transit Authority (NYCTA). The project was awarded to WSP, and involved a complex design effort that involved a geographically diverse design team. WSP hired MJ to provide a digital twin of the Broadway Junction Station.

Through the use of a digital twin, the project team was able to explore the site and collaborate together on design solutions. The digital twin incorporated point cloud data, high resolution photos, CAD drawings as well as specific equipment features and external documentation to become a single all-inclusive spatially aware existing conditions model of the station.

”For its’ Broadway Junction Station Complex design project awarded to WSP which required a 360 degree photographic imaging database, WSP contracted MJ to perform this work. MJ performed laser scanning at this station complex in 2020 employing it’s LiDAR web-based imagery system. The results were presented by MJ to MTA on August 14, 2020. The system is easy and fast to use and provides the engineering and architectural team and MTA users a means of viewing its facilities in the station and in the track tunnels in great detail and resolution. Everyone at MTA who participated in this demonstration expressed great satisfaction in this database.” - Baris Imamoglu, Project Manager WSP

The MJ4D digital twin contains both LiDAR and photo imagery, to allow the design team to walk through the project areas remotely. This project required a very large design team and at one point, the digital twin had more than 200 users. Using MJ4D, team members were able to collaborate on the project without physically being on-site and without physically being in the same room as each other.

Based on the successful results of the digital twin on this project, WSP has contracted with MJ to provide a digital twin for several additional projects for NYCT.

3. Town of Halfmoon Digital Twin - Townwide Mobile Mapping and Asset Inventory for a Rapidly Growing Town.

The Town of Halfmoon was looking to increase the accuracy of their assets. MJ mobile mapped town roads to have consistent street view imagery, and GPS surveyed select utility features including water main valves, hydrants, and cross-culverts to accurately capture new development in the town.

MJ provided the town with a digital twin that included a highly detailed GIS database that can be used across departments as a resource for engineering projects moving forward.

”The MJ4D digital twin makes my job much easier. It makes the crews job much easier.” Frank Tironi, Director of Water, Town of Halfmoon.

Once the digital twin was established, the town was able to use the MJ4D software as a planning tool to assess the visual impact of a new water tank. MJ imposed a 3D model of the

tank at each location. Through layers, MJ4D shows existing tank locations as well as the proposed sites of the future tank. Users can view the existing and proposed water tank from several key vantage points throughout the Town of Halfmoon.

4. State University of New York at New Paltz - Creating a Multi-Faced Digital Twin of an Entire University Campus

A wide array of reality capture technology was used to create a digital twin of the State University of New York at New Paltz. The technology included mobile mapping with truck and ATV, flying the site with UAV, and GPS surveying of utility features.

Additionally, MJ set up a custom map and data entry form in ArcGIS Online to easily collect data in the field with tablets. This data was used in the investigation and inspection of approximately 800 storm and sanitary structures on campus.

MJ created an Infracore 3D model of the campus and utilities as well as an up-to-date, campuswide, CAD base map of topographic features and utilities. All data was compiled into a comprehensive digital record of existing conditions that is also informing the study and assessment of the storm, sanitary, and potable water systems carried out by MJ's water engineer.

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BIOGRAPHICAL NOTES

Michael Koterba is the chief technology officer and geospatial services manager at M.J. Engineering and Land Surveying, P.C. (MJ). For the past decade, he has been pushing the limits of technology to increase the speed and accuracy of GIS, and mapping capabilities. Michael led the effort to incorporate laser scanning, mobile mapping and UAV technology into MJ's mapping process. Most recently, he spearheaded MJ's in-house initiative to develop MJ4D, a web-based software that offers users the ability to remotely explore a digital twin directly via a web browser.

An expert in asset management and existing conditions documentation, Michael has implemented the use of laser scanning, mobile mapping, UAV technology, ArcGIS and MJ4D to create a digital twin for a variety of projects. He has successfully used this powerful suite of technology on a wide variety of transportation projects for the U.S. Federal Highway Administration (FHWA), New York State Department of Transportation (NYSDOT), New York City Transit Authority (NYCTA), and several municipalities, colleges and universities.

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