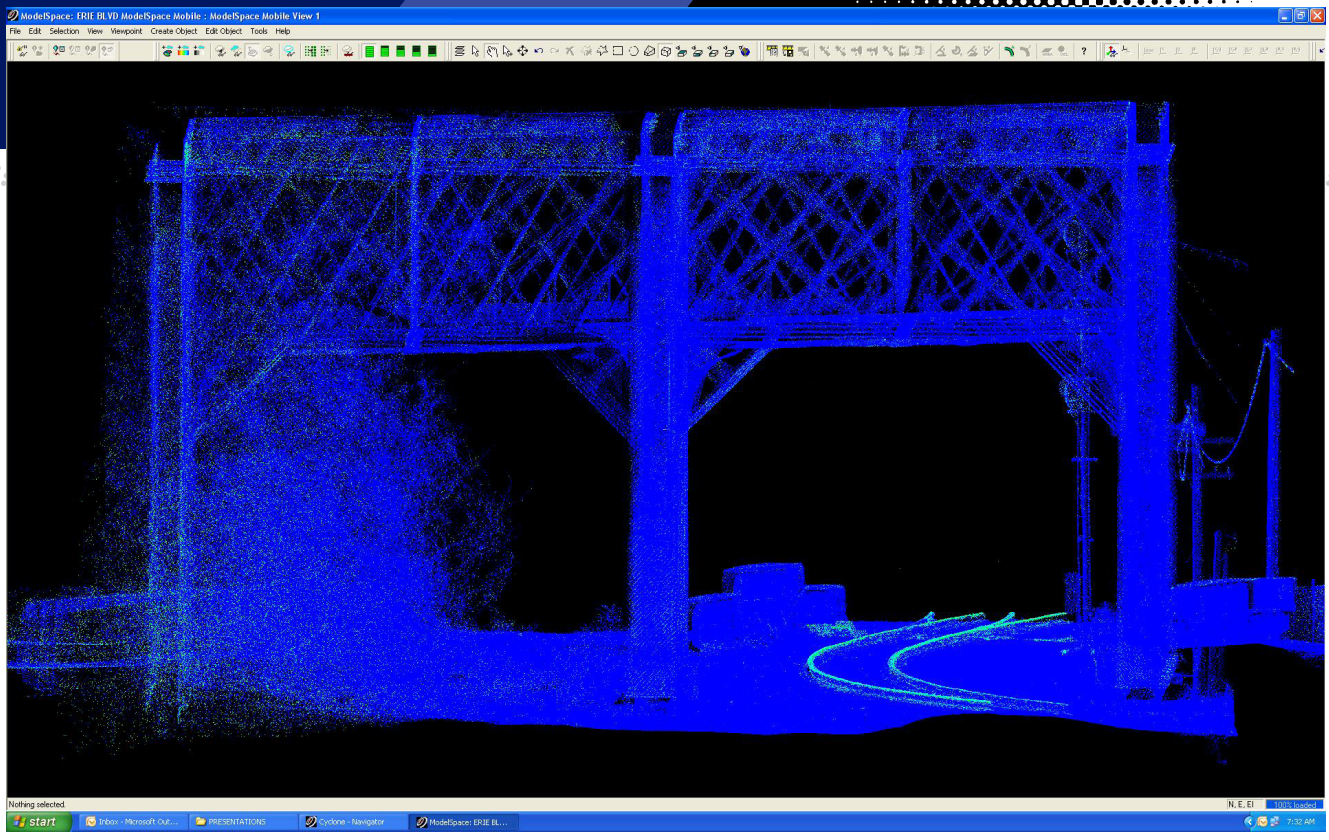


Bridge clearance data utilized for design

Leveraging Mobile Laser Scanning Services

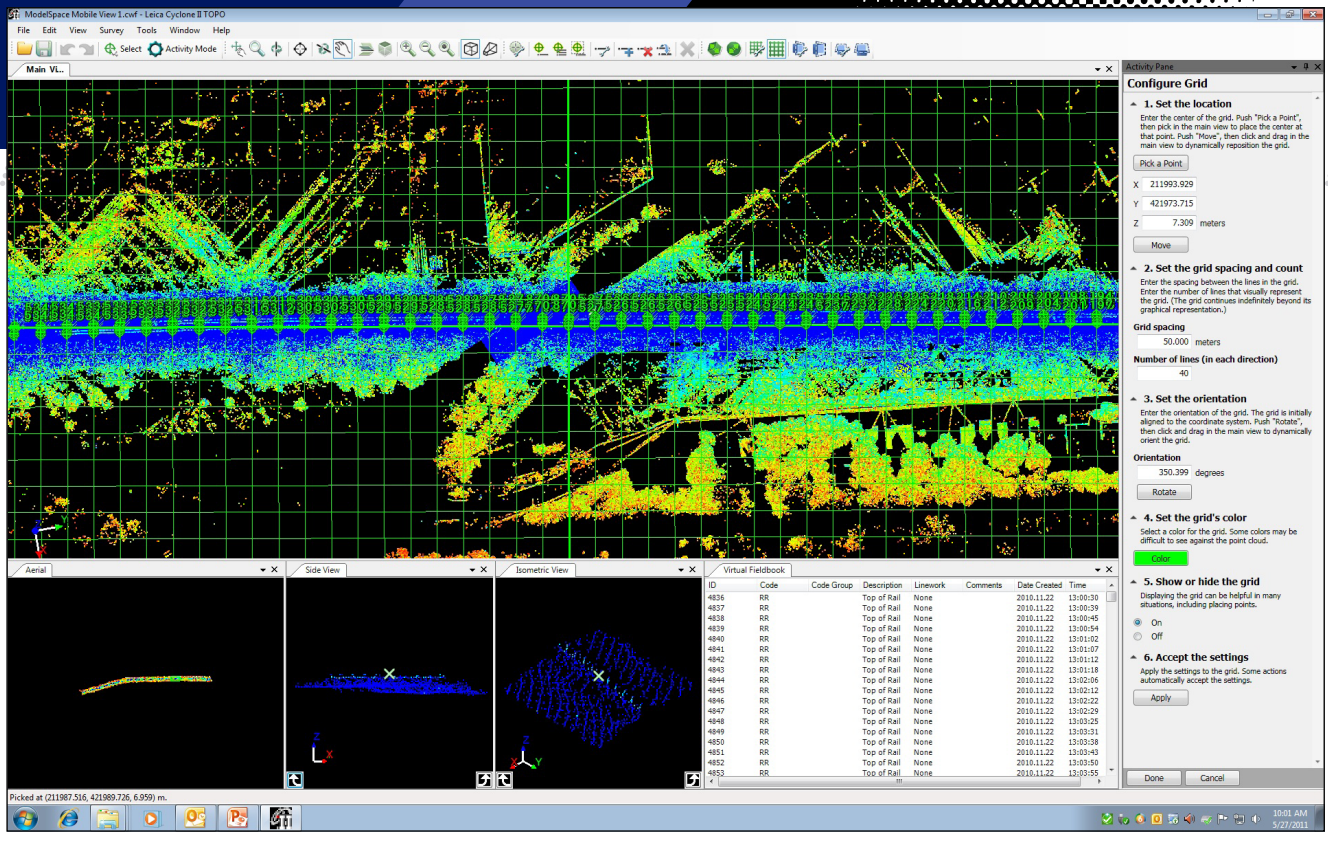
This article will present a case study on how teaming can allow companies to leverage their technology investments to add value to complex projects. In this case, we will examine the integration of mobile laser scanning (MLS) with static data collection methods into a large, multi-platform survey project.

CHA is a 1,400 person multi-discipline design firm with offices worldwide. Our 50 plus person Survey & Geomatics group is equipped with the latest equipment and software including fathometers, time of flight and phase based 3D laser scanners (3DLS) , GPS, reflector-less and robotic total stations (TPS), digital levels and deformation modeling instruments.

As with any firm, we battle with the cost of maintaining the correct location on the technology curve. We are always looking for ways to evaluate the latest technology, and try to incorporate it whenever an opportunity presents itself. In the spring of 2010 we were presented with an opportunity to incorporate mobile mapping into a large rail corridor project we had been awarded. The 34 mile project required the integration of data from multiple sensors including aerial mapping, static and mobile scanning and conventional survey.

CHA and our survey sub-consultant were responsible for establishing the primary survey control pairs and performing the photogrammetric control survey, existing track survey, field edit and supplemental survey for the entire project. CHA established 13 azimuth pairs along the corridor that would serve as the basis for the project survey control and the location of the 184 photogrammetric control points. During the field effort to establish the survey control it

BY JODY LOUNSBURY



Survey shot interval in Cyclone II Topo

became apparent that the train and work schedule would not allow us to perform the conventional track survey within the required time frame.

The design process required the top of the rails to be surveyed for use as vertical control. The design team requested shots at 100' intervals on the tangent sections and 50' through the curves. When we were estimating the time required to complete this level of survey along an active passenger rail corridor, we quickly determined that conventional data collection procedures were not going to allow us to meet the project schedule.

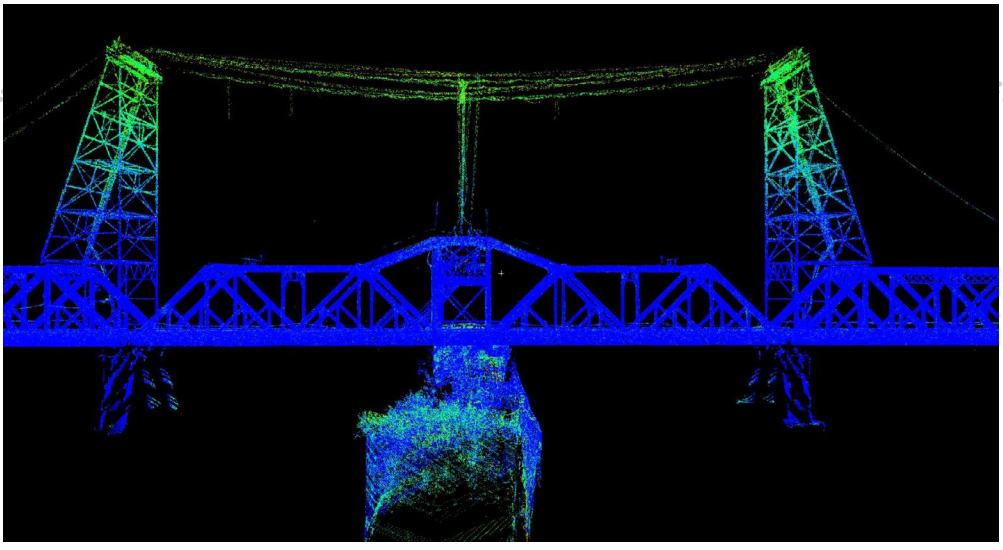
At this point we started to look at alternative data collection options, including MLS. Having a wide variety of static 3DLS experience with transportation projects, we determined that mobile laser scanning would be the optimal solution. We also wanted to leverage our static experience and capabilities to allow us to use the MLS point cloud throughout the entire design process.

Realizing MLS was in its infancy at that time, we began to search for an experienced service provider with hardware that could meet the design accuracies. We started discussing the field procedures and control requirements for the MLS systems available at the time to achieve the required accuracies. We knew from our experience with the advance control work that there were sections of the corridor where GPS lock would be lost during the data collection. We needed assurance that we would meet all of the project requirements with the MLS data collection option.

Another concern was the vehicle that the MLS system would be mounted to, since the railroad required a thorough inspection of third party vehicles prior to use on their tracks. As we searched for a service provider that could meet all of the project requirements, we started to see the variation in the systems that were available. Not all of the firms contacted offered design grade data.

Ultimately, we chose Terrametrix and their Street Mapper MLS system for our project. After selecting them, we discussed all the potential areas of concern with our project including schedule, track time, additional control, targeting and GPS dead zones.

Our primary control work throughout the site provided us with a very good idea of when and where we would have GPS lock issues throughout the 34 mile corridor. Having this knowledge in advance was a big advantage when we initially coordinated the effort with Mike Frecks, PLS., the President/CEO of Terrametrix. We were able to lay out where and how dense the additional control would have to be in order to achieve the project's required accuracy. We were also able to estimate the amount of time we would need for each MLS collection run through the corridor. Once we had spoken with the client to determine available time slots for uninterrupted access, we could



Sample MLS data

MLS data collection vehicle

then adjust our data collection speed to ensure the proper data density.

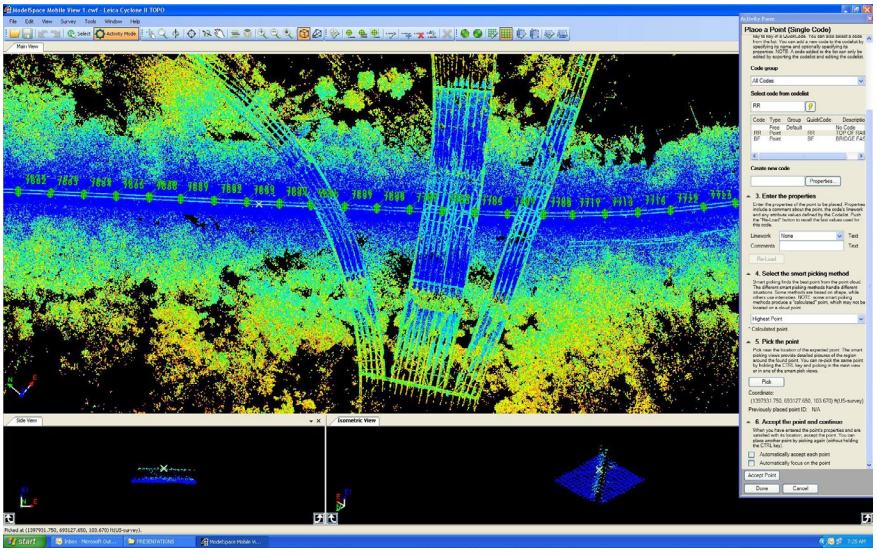
The last and most time consuming hurdle was the inspection of the Hi-Rail rental vehicle. After many conversations, it was decided that Terrametrix would mount their MLS system on a vehicle owned by our client. This development really made the entire data collection effort easy. I would say the biggest disappointment with our MLS effort was that due to the early morning and late night track access windows, we were unable to take advantage of the video/photographic component of the Street Mapper system.

Once the data collection day came, the true advantage of MLS instantly became apparent to this long time static guy. Mike and his staff arrived in Albany, New York and went to work removing the Street Mapper system from their vehicle and mounting it to the Hi-Rail vehicle supplied by the client. I have to say, the ease by which this modular system of scanners, cameras, boxes, computers and wires was transferred was pretty amazing. The Terrametrix crew had the system moved and were beginning the calibration routine in about an hour and a half.

I was not able to ride along during the data collection; I was in a support vehicle that followed along the highways that paralleled the route. Having been a service provider in the terrestrial LiDAR industry since 2003, I was really amazed to see the MLS vehicle pass knowing it was collecting data at 15 miles per hour.

Once the data collection was completed, we provided Terrametrix with our control and QA/QC shots that we established along the project corridor. About two weeks later the hard drive filled with data arrived, and we began the importation process. When we began the MLS search, one of our biggest requirements/concerns was that the registered data had to be compatible with our in-house 3DLS software, Cyclone.

Our goal was to utilize the MLS point cloud in Cyclone and Cyclone II Topo to extract the top of rail shots and any other data required to support the design process. The error report documented that the registration to our control was under the 0.05' tolerance required for the project, and the reported RMS error for the project was 0.03'. After importing that



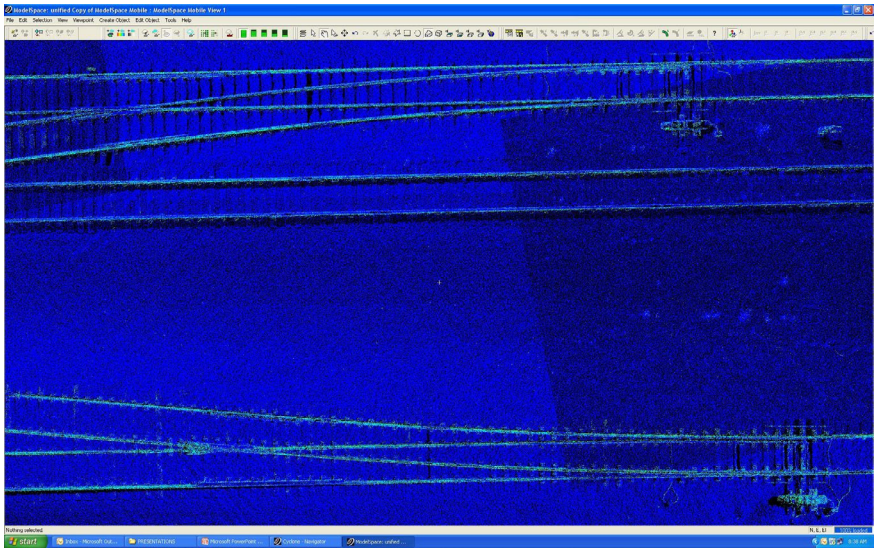
MLS data in Cyclone II topo for survey point extraction

point cloud data into Cyclone, we used our random QA/QC shots throughout the project to independently truth the data. We found that over 95% of the shots checked were within the 0.05' tolerance requested, which also backed up the findings in the registration report.

The interoperability between the Street Mapper and Cyclone was one of the key elements that made this project a success. Owning the LiDAR data on a project of this size was invaluable. This project started in 2010 and we are still extracting additional information from the point cloud weekly to support design activities. The initial LiDAR deliverable was the top of rail elevations and alignment for design. To date, we have harvested the point cloud for multiple additional features including bridge horizontal /vertical clearance, retaining and crash wall clearances, overhead sign/transmission line locations and countless additional information. The ability to answer critical design questions on a rail project without having to re-visit the field is an invaluable resource, saving time and increasing turn around.

The collaboration between CHA and Terrametrix on this project allowed us to collect the data in a small access window meeting the project schedule, while keeping a large share of the work in-house. This arrangement allowed CHA to leverage their in-house static LiDAR capabilities on a large scale mobile project. To stay competitive in today's consultant environment, you have to find ways to maximize your current expertise while incorporating new technologies. With the rapid advancements in technology in the market place, it is almost impossible to keep current. It is my belief that teaming arrangements such as this one allow everyone to stay ahead of the curve.

Mr. Lounsbury is the 3D Laser Scanning Manager in CHA's Survey Services Group. He has over 26 years of experience in all types of survey applications, including over ten years of experience with a variety of laser scanning applications.



MLS data in Cyclone