AUTODESK **UNIVERSITY** 2015

Field Data Procurement Using Unmanned Aerial Vehicles and Laser Scanning

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CA10829

This presentation will cover various methods and workflows to procure field data using UAV's (unmanned aerial vehicles), and laser scanning; the legalities of using a UAV and the final use of this data from a heavy civil contractor's perspective. Professional presenters will share their knowledge and experience about their quest for faster and more-accurate field data. They will share why the demand for this data has been fueled by the increase in computing power and the decrease of equipment costs for unmanned aerial vehicles (UAVs) and laser scanners. The democratization of both types of data procurement helps continue the growth in areas of heavy civil design, engineering and construction that were unthought-of a few years ago. From reducing risk on dangerous work to simplifying surveying and mapping tasks, we have yet to see the full potential. Laser scanning is very similar and was once thought of as an inaccurate science, but it has broken through this stigma and is now a common practice. The presenters will begin by covering the most current laws and regulations on UAV's and laser scanning, then share current uses of UAV's and laser scanning both on and off the job site, discuss various methods of data procurement as well as the limitations of UAV's and laser scanners. Other areas we will cover include, workflow, VDC with Autodesk software. See how these types of data procurement are being applied daily. The future is here.

Learning Objectives

At the end of this presentation, you will be able to:

- Discover the current laws and regulations on using UAVs and Laser scanning
- Explore the current uses of UAVs and laser scanners on a heavy civil construction site
- Learn about different methods for UAV and laser scanning data collection
- Discover the limitations of UAVs and laser scanning
- Understand the big picture of data procurement and virtual design and construction

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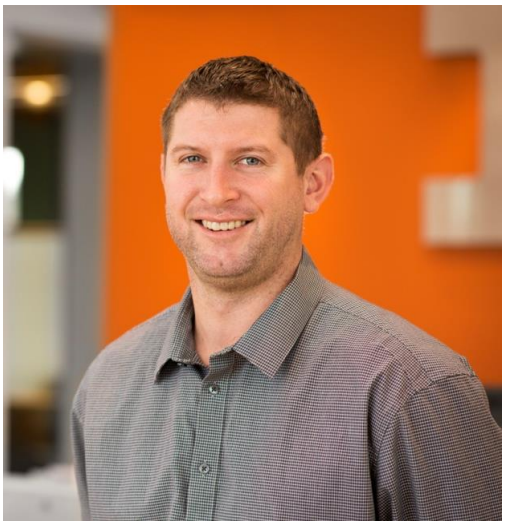
About the Speakers

Brian K. Smith



Sam Kloes

Brian Smith is the director of Technology at IMCO General Construction, Inc., in Ferndale, Washington. He oversees the VDC (Virtual Design and Construction), IT and GPS groups and specializes in VDC, 3D design, modeling, Building Information Modeling (BIM) coordination, and various data procurement methods including UAV photogrammetry, laser scanning and Lidar. Brian has been designing heavy civil projects for 18 years, including hydroelectric, water/wastewater, industrial, road, and bridges. He specializes in Autodesk, Inc., products and is proficient in AutoCAD Civil 3D software, Revit software, Revit MEP software, and Navisworks project review software. Brian is also an AutoCAD Civil 3D and Revit instructor at Washington Engineering Institute, and he presented at Trimble Dimensions and Autodesk University and HC4 2014. BSMITH@IMCOCONSTRUCTION.COM

Sam Kloes is the GPS and Survey Manager at IMCO General Construction, Inc., in Ferndale Washington where he has worked for the past 8 years. Sam Oversees 3D Surface and Utility modeling, site surveying activities, and a fleet of GPS Automated Machines.
He has 14 years experience in heavy civil construction and Sam has surveyed and modeled more than 80 projects over the past 8 years in the northwestern United States, Cuba and Guam. Sam is also a Robotic and GPS Survey instructor at Washington Engineering Institute, NCCER Certified Instructor and presented at Trimble Dimensions and Autodesk HC4 2014. SAM@IMCOCONSTRUCTION.COM

Introduction

Data procurement is and will always be part of the planning, Engineering and construction world. Now that we are able to democratize data procurement the quality and speed is increasing as the costs associated with the data collection process are decreasing. The popularity of UAV's and Laser scanning is growing fast and the ease of integration of these types of data procurement in the existing daily work flow is one reason why. The types of filed data procurement vary greatly from planning, studying, documentation, engineering, safety to name just a few. How many other tools do you know of that are so versatile? We will cover current regulations and legislation of field data, the various methods to collect that data, and how a $100M+ heavy Civil contractor leverages these tools on a daily basis. Now that 3D models have becoming the staple, the thirst for faster more accurate data is here to stay. I hope this presentation will help you appreciate the complexity of collecting UAV and laser scanning data, incorporating that data into 3D models, the technology behind them and give you a better understanding of how a civil general contractor can include this data to be use in 3D models.

Regulations and Legality's of UAV's and Laser Scanning

UAV's (unmanned aerial vehicles) have been around a long time primarily used for military applications, until 2012 when UAV's size, complexity and cost came down. Laser scanning on the other hand was invented in the 60's, but did not get much attention until technology caught up with the idea. In the late 90's laser scanning began to get noticed but was out of the price range for most companies, until 2010 when the price and complexity began to come down. The sudden dramatic growth in UAV's has led to necessity for the FAA to govern more strictly the airspace of which they fly. Unfortunately, nothing happens quickly in the government and now we are stuck using out dated laws that don't directly relate to the UAV's intended use. The FAA is working with an advisory board to put in place a formal set of rules for the Commercial UAV's. Until these formal commercial rules are adopted the registration and exemption path will be long, messy and bumpy. If you plan on flying a UAV commercially you better understand the regulation that is in place and why. For commercial operations you must have an FAA Section 333 exemption or an air worthiness certificate. (That is a whole different can of worms.) For the presentation we will focus on the Commercial UAV application. The underlying mission from the FAA is to keep everyone safe. The operators need to have the knowledge and training to make decisions quickly and this will also protect the citizens. While Laser scanning doesn't have the government regulation from the FAA, the point could data collected is the same. Like any form of data procurement from static survey to Lidar, the quality of the data post processed is the true art. How this data is collected begins with the knowledge of the survey and typically working with surveyors.

Current uses for UAV's and Laser Scanning

The applications for UAV's is still being explored as we are able to adopt new forms of data collection. Many of the noted uses in the civil and commercial applications are security, search and rescue, monitoring, disaster management, agriculture, communications and survey.

The use of UAV's for security is mainly local law enforcement and used for security and crowd control. For search and rescue the portability and ease of deployment make the UAV a great tool. Monitoring pretty much anything and everything, from construction sites, waterways, Oil and gas pipelines, forestry and pollution control. Disaster management is not something we think of every day and this is a tool that can be used to aid in the management, rescue and cleanup operations, as well as providing a damage estimate. Agriculture has been using UAV's with great success for years to increase production, assess bug infestation and minimize crop dusting. Communications like cellular and power companies use UAV's for inspection, relays and signal coverage. Survey is probably the most adapted to UAV's and can be used for mineral exploration, physical topographical surveys, stockpile and production analysis.

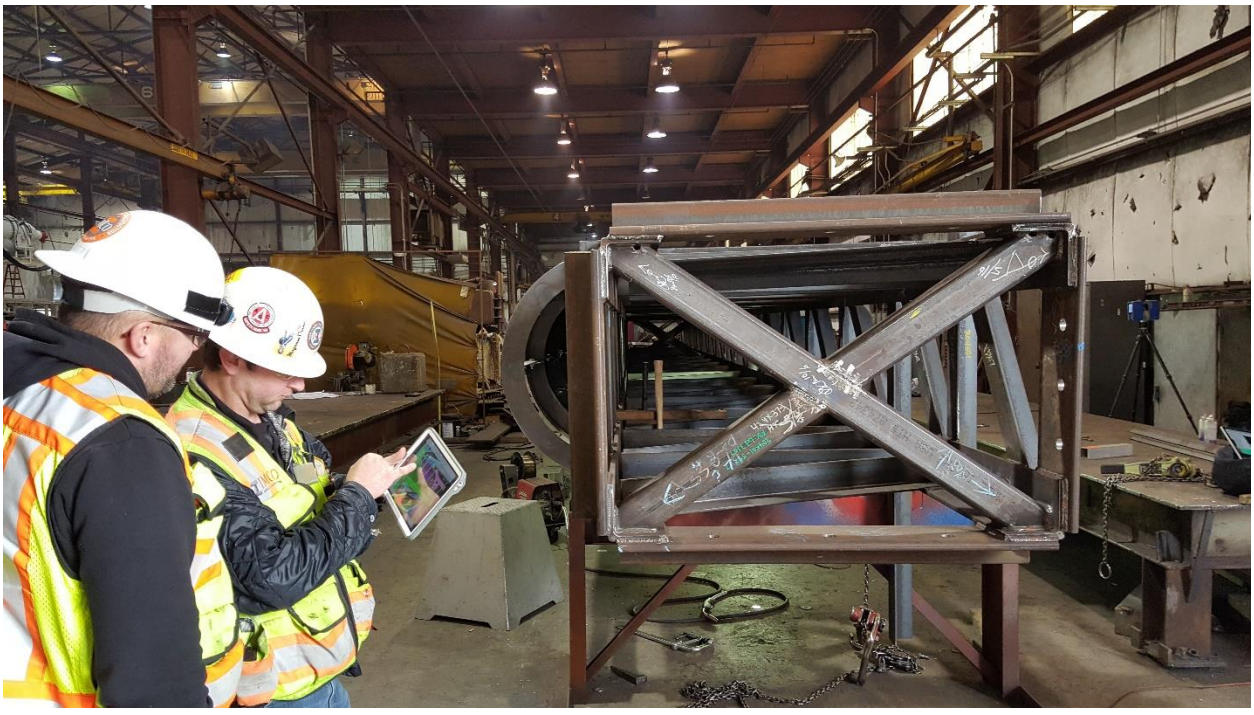
Data collection methods using UAV's

It is important to note that there are many different types, sizes, shapes, uses and level of quality for the peripheral devices used to actually collect the field data. The ones mentioned today are only the ones currently in the market place but I would anticipate many more peripherals to be added in the future which increases the UAV's demand.

Current data collection methods are divided into three types of sensors: optical, acoustic, and laser. Included in those optical sensors are, still cameras, video cameras, photogrammetry cameras, thermal and infrared imaging.

Acoustic sensors are used for identification of an exact location of a noise, in particular a gun shot and can pinpoint the geographically location of where the sound originated.

The area of sensors that has the most growth opportunity is the Laser, current uses are range finding and Lidar imaging. Lidar/ laser scanners are getting smaller and more accurate. The post processing of flight data with the data recorded during the flight is quickly going away and is being processed in flight with high speed processors. This helps with the production and ease of implementation.



Limiting factors for Using UAV's & laser scanners

UAV's and laser scanning are a great tool to have in your bag, but they are not the one tool that will get the job done. For example, with photogrammetry you need to have survey control on the ground marked with high precision, otherwise the data collected could be out and there is no way to back check the data set published.

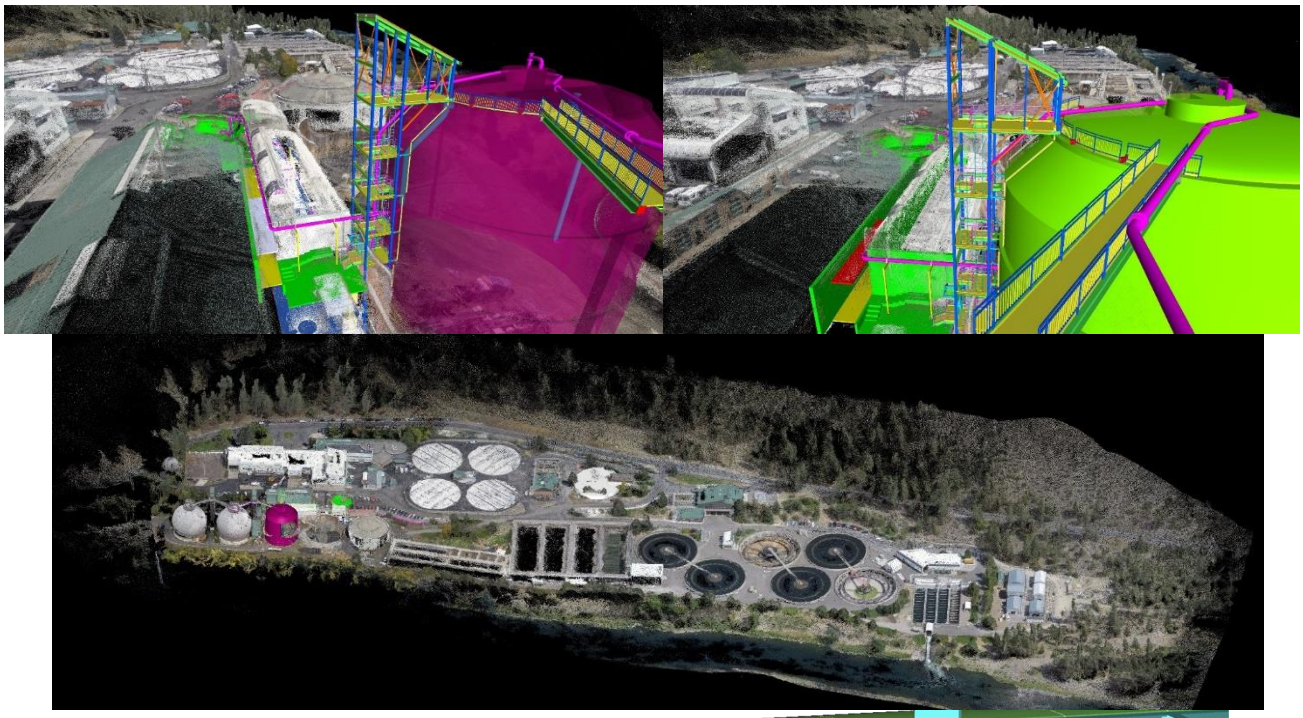
The greatest limitation to UAV's is not a technical limitation, it is the FAA's regulation. These rules will greatly impact the widespread use and limit the future use as the technology continues to grow.

There are many obvious physical limitations including, weather, day light flights only and debris in the air. On the technical side the limitations are revolving around guidance, or impacted guidance control through the use of GPS, poor signal, (PDOP) large buildings or indoor flight. The battery life is increasing but it is still a physical limitation. (typical rotary wing aircraft can fly for 20-25 min.)

The lack of intelligent sensors on UAV's, such as object awareness, and avoidance controls greatly increase the chance for an impact with affixed object.

Where is the Magic? How is the field data utilized as a heavy civil contractor?

At IMCO we model 100% of all our projects from bid to final delivery to operations. This means that the faster and more accurate we can get field data the better decisions we will be able to make. This is true across the entire company and touches every aspect. The utilization of UAV's creates a safer work place by procuring field data on steep slopes that might otherwise endanger the surveyor. The images captured on a daily basis help in planning our laydown yard and staging. The data collected both from photogrammetry and video help coordinate work in our BIM model. This helps trades see the whole picture not just the piece of the project they are working on. Seeing things in 3D helps everyone better understand their part in the project. Documentation of daily activities is recorded on the weekly production flights. Inspections can be recorded on video or still images. These can create a safe and more accurate environment for the inspectors and QA/QC. Daily flights track our earth work production and is used to asses our workload and equipment. Stockpile quantification is similar to production but is limited to volumes of piles identified in advance to automatically perform the takeoff. Lastly we use the data from both laser scanning and UAV photogrammetry for our VDC (Virtual Design and construction) model. Having quick accurate data allows us to make the most informed decision.



In conclusion

The idea of using 3D models throughout the entire project is more about data and data control. From UAV's to laser scanners there are many forms of data procurement but it is how you use the data that makes the difference. From building the initial model where you might need to collect additional data to the final deliverable there are many benefits. The use of Autodesk Navisworks is one tool used frequently to show all parties with one model how the yard piping might affect the existing utilities in the ground in a way that cannot be done with traditional 2D plans. The use of BIM 360 Glue allows the craft workers to see the big picture, stay connected with the office and comment directly to the Project Engineers. The VDC model allows for alternative design considerations and Value engineering. These changes can again be made quickly, accurately and then submitted to the engineer/owner in an RFI. All of the planning and modeling still will not completely remove all unforeseen conflicts during a project and once again that is where Data is King.