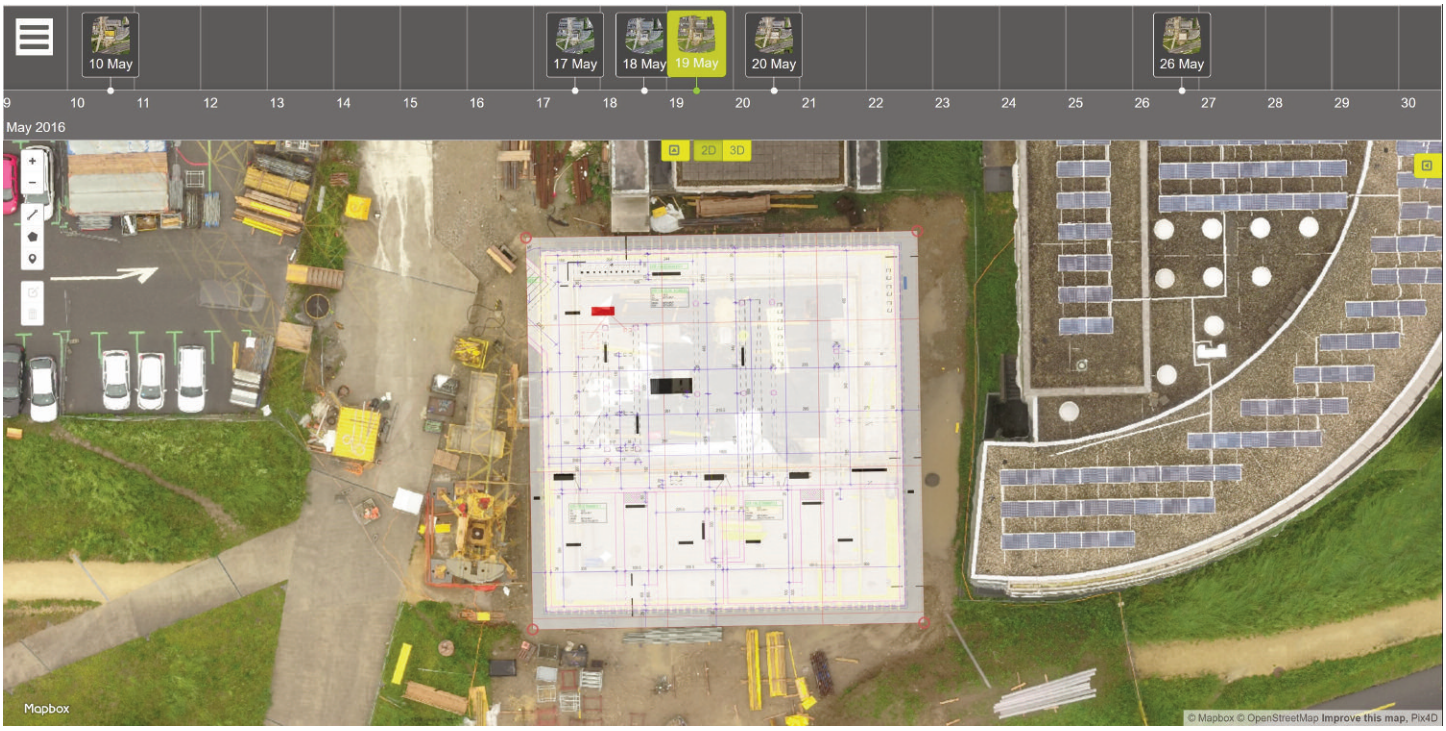
Five Valuable Business Lessons Learned About Drones in Construction

Finally, we have data points that show what works and what doesn't in the architecture, engineering, and construction (AEC) industry

By Chris Korody, Contributor/Advisor and Colin Snow, CEO and Founder, Skylogic Research



This is the first in a new series of Skylogic Research white papers intended to share lessons learned and additional resources that will help you maximize the value that drones can bring to your business. This year we are building on the analysis we did for the 2016 "Truth About" papers by incorporating real-world experience gained from businesses and drone pilots operating under the Federal Aviation Administration's Small Unmanned Aircraft Regulations (aka FAA Part 107). As of March 1, FAA data indicates there are more than 30,000 drone operators certified under Part 107 and 38,000 commercial drones registered in the U.S.

Introduction

The $8.5 trillion global construction industry is both massive and far flung—there is no place in the world that does not build things. The industry's problems reflect an age-old tradition of architects and engineers throwing plans over the wall to be reworked by contractors and subcontractors. It's not that the system doesn't work—it's that the rework eats up increasingly thin margins, wastes huge amounts of material, and creates massive delays. And since much of it is on paper, trying to integrate and keep track of complex projects is no easy task.

In a June 2016 report, McKinsey quantified the problem: "Large projects across asset classes typically take 20 percent longer to finish than scheduled and are up to 80 percent over budget. Construction productivity has actually declined in some markets since the 1990s." Of the 22 industries McKinsey analyzed, the construction industry is second to last; only agriculture has made less progress digitizing its workflows.

The sheer scale of the problem led Goldman Sachs to write that the first large-scale use of commercial drones will be in construction. It makes perfect sense. Visual line of site (VLOS) works just fine on construction sites. A growing group of software vendors are targeting the space with increasingly useful solutions. And a new generation of drones is delivering much needed functionality.

So what have drone operators servicing the AEC industry learned about what works and what doesn't? What have construction companies learned about creating their own internal drone operations groups? And where do we go or what can we expect from here?

LESSON 1

Drones provide value on the jobsite daily

There is no longer any question that drones save time and reduce costs compared with traditional ground and aerial techniques. Aerial surveys of projects that were considered too small for manned aircraft operations are now commonplace.

To be clear, GIM International notes that "UAVs have their limitations. Piloting UAVs over construction sites in cities, urban districts, airport zones, or critical areas can sometimes be a real challenge due to flight permissions, weather conditions, legal restrictions, and job site obstructions."

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By definition, good data can only be developed from multiple data points. In our opinion, the real value that drones bring to construction is the ability to fly the exact same mission over and over. Once the initial flight plan is developed, any pilot can load a mission and replicate the original flight, which enables construction companies to take measurements and conduct inspections more frequently. This is especially important for companies that need to ensure they're meeting the schedule and build sequences they have defined in Building Information Management (BIM). One lesson already learned is that it is a whole lot quicker to deploy a drone for a "do-over," which is a familiar part of geospatial work in construction.

Another lesson learned is that there is a value in the variety of data that can be captured on a single mission. For instance, 2D orthomosaics, 3D point clouds, and digital surface models (DSM) can often be generated on one flight and used to meet the needs of multiple stakeholders.

Skycatch recently posted a case study about the Beck Group, a Dallas-based full service builder that has made a significant commitment to virtual building with various departments using a combination of 2D and 3D imagery.

- The 2D map provides photo documentation to track progress against the sequencing plan.
- 3D point clouds are used to compare progress with their 2D and 3D site plans.
- A variety of data types are used for customer reports—reducing the time and expense associated with onsite customer visits.

Today, companies primarily use photogrammetry for 3D work. There are a number of reasons, starting with the low cost of prosumer drones, the broad-based support from a range of software developers, and the convenience of a cloud workflow. LiDAR is slowly moving from the ground to the air for specialized uses. Right now, it is more expensive and the workflow is more complex. However, as we explain later in this paper, this gap is closing fast.

ACTION: For routine tasks, in-house pilots flying small prosumer drones seems to be a winning combination. We recommend that companies begin by assessing their routine needs and building upon that foundation first. There will be less sticker shock, and it will be easier to make the value case for future investment.

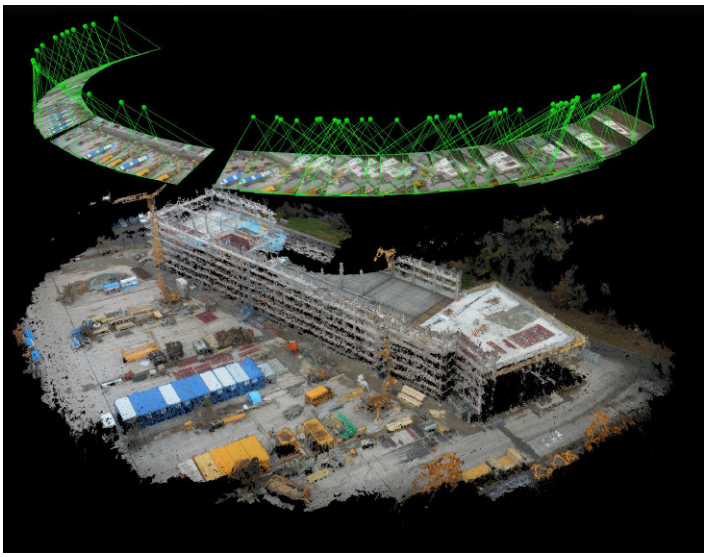
LESSON 2

Using drone data in BIM requires pilot projects

For the past 10 years, the concept of BIM has generated tremendous interest because, when rigorously applied, it can relieve many of the industry's pain points.

The big idea is to provide a central project management repository where 3D building models can be linked to time- or schedule-related information (called BIM 4D), plus cost estimates and budgets (BIM 5D), plus ongoing maintenance after construction is completed (BIM 6D). As Scott Widmann from DPR Construction put it, "One model, one map, one link."

BIM offers enormous gains in cost and time savings; much greater accuracy in estimation; and the avoidance of error, alterations, and rework due to information loss. But adopting BIM itself—outside of incorporating data from drones—involves much more than simply changing the software you use.



Remember the part about how far behind the construction industry is in digitizing its workflows? "The Truth About Drones In Construction" put the problem into sharp focus: "To achieve all the benefits BIM offers, everyone in the architecture, engineering, and construction industries will have to learn to work in fundamentally new ways." Put another way, BIM requires a culture of collaboration—the exact opposite of throwing the plans over the wall to the team downstream.

Last year, KPMG International conducted a Global Construction Survey to explore the impact of technology on the industry. They found that only 20% of the 200+ companies they surveyed have what KPMG terms a "PMIS"—a "single, fully integrated Project Management Information System in place across the enterprise." KPMG also reported that while 61% of those surveyed used BIM, only 42% of them used drones to monitor construction status. Clearly, it will take time for the market to catch up to the hype.

ACTION: Plan ahead. Take small steps when implementing a BIM/drone data project. Choose which steps are appropriate for your firm and tackle them one at a time. Do a test run on a pilot project. See how your firm does, and then use the pilot project to prepare for wider BIM/drone data implementation.

LESSON 3

Choose autonomous, integrated drone solutions wisely

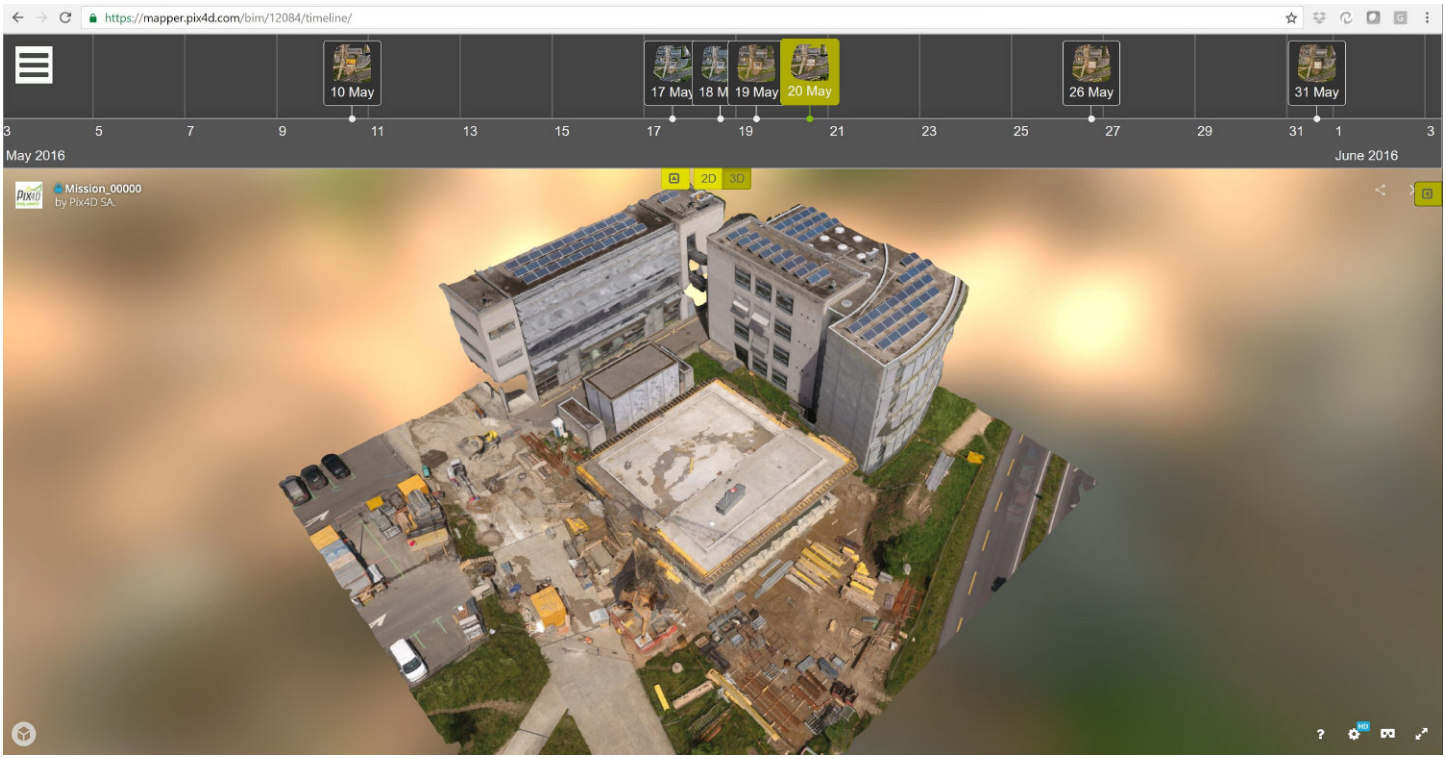
A large segment of the construction market has bought into the concept of "push-button" or autonomous drone operation. An autonomous drone operation is generally considered an operation in which a remote pilot-in-command (RPIC) inputs a flight plan into a ground control station program which sends it to the autopilot onboard the drone. Once uploaded the operator pushes the "go" button and the drone executes the pre-programmed flight to capture data. During automated flight, flight control inputs are made by components onboard the drone, not from the ground control station.

After the flight, the captured data is then processed by software that creates usable, actionable information. The hope is to use this kind of software to get around skill and training issues in order to ramp up more operations, more quickly. A large number of companies, many backed by venture investments, are vying to meet that need.

A classic positioning battle has broken out. A partial list of players and their promises in alphabetical order includes:

- 3DR – The Complete Drone Data Platform
- Airware / Redbird – As-built vs. as-bid comparisons
- DroneDeploy – The Complete Mapping Experience
- Autodesk Forge – Future of making things, meet proven foundation
- Identified Technologies – Never run late or over budget again
- Kespry – Aerial Intelligence Platform
- Pix4D – Generate 2D and 3D information, purely from images
- Precision Hawk – Empowering The Commercial Drone Industry
- Propeller – Effective and accurate site surveys and overall progress monitoring
- SenseFly – The Professional's Mapping Drone of Choice
- Skycatch – Turn your drone photos into 3D models. Fast.
- Trimble InSphere – Mobile workflows you can trust.

Each of these companies offers its own take on an end-to-end solution that integrates flight planning, mission control, and post-processing. Some companies include a drone and even sensors—in most cases ones that they designed and built



themselves. To meet the challenge of differentiation, there are key differences on export file formats, price models, service agreements, and support.

That's a big list to wade through. There are a few things to keep in mind when you evaluate solutions.

ACTION: When the drone returns to terra firma it is not uncommon to discover that the data is not perfect. While capture can be automated, registration and control can be extremely demanding. There are no standards for processing. Much is hidden in the cloud—where a premium on throughput can result in significant differences in how data is processed by various suppliers.

While this is not the place to get into it in detail, with so many hands in the work flow, there are real issues with the chain of custody and other legal concepts. If this is an area of responsibility, you might find this article in the National Law Review to be a real eye-opener. "But the conversion of that data into a file type that can be imported into another software platform, such as AutoCAD or a BIM platform, for design or analysis may be a tedious, multi-step conversion that could introduce user errors. What party in the collection, design, and construction process takes responsibility for those incompatibilities?"

Altavian recently published an excellent post, The Fallacy Of A "One-Button" Survey, that highlights how all too often drones are portrayed as quick and easy survey solutions for collecting data. The post states: "There are still too many variables involved in most surveying jobs to fully automate the entire process and expect perfect results every time." Turns out a drone's impact boils down to how the professional uses them—not as a one-size-fits-all surveying solution.

LESSON 4

Drones require that you adopt more safety protocols

Inspection is an integral part of construction and plays an even bigger role in operations when the proud owner takes on the task of maintaining the building for 50-plus years.

> ***"In 2015, OSHA stated that there were 4,379 worker fatalities across the United States, of which 927 (21%) were in construction. Of these, almost 40% were from falls…"***

At a recent conference, representatives from companies like AT&T, Southern Company, and BP unequivocally stated that their primary reason for using drones was not to save money but to protect their employees and contractors—whether surveyors on the ground, someone in a bucket, or workers hanging off the skids of a helicopter or in plane thousands of feet above the ground. The numbers are stark: "In 2015, OSHA stated that there were 4,379 worker fatalities across the United States, of which 927 (21%) were in construction. Of these, almost 40% were from falls…"

We spoke with Richard Lopez, VDC (visual design construction) Manager at Hensel Phelps, a $3.1B 80-year-old construction company in Greeley, CO. He explained that it took three years to gain approval from the legal department to fly on the jobsite.

While they initially did some outsourcing, Richard quickly came to the realization that Part 107 made it possible to train their own people to operate in the fast-moving site environment. In his opinion, a safety incident is the only thing that could set the program back. "Everyone sees the value. Now it's about following protocols and implementing them across the company as the program grows," Lopez said.

ACTION: While a programmed drone can fly a more precise mission than a pilot, the FAA under Part 107 requires a licensed RPIC to oversee every flight. The pilot is responsible for ensuring that the aircraft is properly maintained and flight ready, that conditions are safe, and that the pilot has any necessary waivers. And while every drone has fail-safes like "return home," the pilot must be ready to take over if the drone "flies away." Given continuing reports of problems with various mapping programs, the prudent RPIC will be the one who uses sectional maps to double check online maps when plotting a mission.

Every drone operator and mission should be operated within the rules and regulations stipulated by the governing bodies applicable to you and your specific equipment. Safety plans should encompass not only the drone aircraft airworthiness itself but also the following:

- Area and environment – hazards, weather, airspace restrictions, bystanders
- Mission plan – contingency planning for safe exit routes in the event of a system failure, degraded performance, or lost communication link
- Public awareness – notification of nearby property owners of your intentions (permission)
- Preflight / run-up – verification that all ancillary equipment is operating to specification
- In-flight – proximity of other aircraft and pilot intensions to land

LESSON 5

More standards will be required for widespread adoption

Here's a valuable business lesson. It is not regulation that is keeping the AEC industry from achieving fantastic forecasts like this one from Goldman Sachs, which predicts drones will provide $11 billion in benefits. It is the lack of industry standards.

The recent article Why Standards Will Be Critical To UAV Adoption references the work of Geoffrey Moore and his Chasm Theory. New technologies must cross the Chasm before they will be adopted by Pragmatists—the mainstream corporate buyer who represents about 30% of the market and is the gatekeeper for another 40%.

Pragmatists in the construction business don't care about "cool"—they care about ROI. They care about integration, ease of use, service and support. They care about making incremental improvements to existing ways of doing things. They do their research online, and they buy what their peers like and recommend. In short, they are conservative.

Digitization offers huge opportunities to build better projects faster and make more money doing it. What's not to like? Yet according to the UK 2016 National BIM Report, "65% of respondents believe that BIM is not yet sufficiently standardised." And while there are lots of good intentions moving forward, at the time of the survey only 54% of the respondents

were actually using BIM. We believe that is because Pragmatists will not buy until there are standards.

ACTION: Look around the industry, and you will see that there is a lot of work to be done to define standards for hardware, software, training and services. Be patient, it takes time for standards and best practices to be developed and ecosystems to evolve. As that happens, the winners will cross the Chasm and adoption of drones in construction will take off.

What's next?

DJI and Moore's Law are both hard at work making things faster, lighter, and cheaper.

One of the most exciting developments for the construction industry is explained in a SPAR3D interview with Lewis Graham, the president and CTO of the GeoCue Corporation, which develops a variety of solutions for UAVs, LiDAR, and point cloud analysis.

Graham explains that in many cases the ideal solution is to pair a LiDAR sensor with a camera because "really high-resolution data [say resolutions greater than one meter] can be tough to gather with aerial LiDAR. The ideal scenario is to use imagery for context and LiDAR for the 3D component."

The next giant leap will be focal plane array (FPA) LiDAR, also known as flash LiDAR or solid-state LiDAR—LiDAR on a microchip. Graham predicts, "Within the next three years, FPA LiDAR supplemented with a camera will be the standard kit on a mapping drone."

The CAD Trends 2016 survey also identified a number of trends. It's an interesting list including augmented/virtual reality, which is already finding its way into some AEC firms—see for instance the Beck Group site. Mobile access to CAD is another theme that is also explored in the KPMG survey (pps 14-15)—the goals being to provide access to 3D models at the jobsite and streamline reporting from the field.

At Skylogic Research, we are tracking the development of intelligent inspection. Aerialtronics recently demonstrated this capability with Neurala running their deep learning software in-flight on an NVIDIA Jetson onboard processor. Aerialtronics also announced a partnership to leverage the IBM Watson IoT Platform to analyze images. Imagine smart real-time overlays, intelligent inventories, and perhaps even auto-estimating and scheduling.

As for Richard Lopez, the VDC Manager at Hensel Phelps, he wants stuff that works. That makes day-to-day operations more efficient—improved reliability, better battery life, quicker FAA approvals, and an unrelenting focus on safety.

That's our look at the valuable business lessons learned since Part 107 went into effect. There are plenty of opportunities, plenty of competition, and plenty of reasons for construction companies to use drones in every phase of the construction process. Those that do will save time, make more money, and increase customer satisfaction. More important, they will not get left behind as the global construction industry continues to digitize.

Images courtesy of Pix4D