

Use of Drone Technology on Commercial Construction Projects

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Every successful construction project is an intricate symphony of project management, jobsite operations, and skilled laborers doing what they do best. While traditional means and methods have proven themselves to be reliable and effective, companies must now look into new and improved approaches to expedite their project delivery and maintain their competitive edge in this booming and demanding market. Furthermore, as expectations for new commercial projects grow, the risks of taking on these projects increase alongside them. Skyscrapers are expected to be taller, buildings more efficient, and company campuses vaster and more state-of-the-art than ever before. With technological innovations such as drones being gradually introduced into the world of construction, companies are now able to perform tasks in ways that save more time, more money, and even more lives. Especially in commercial construction, where projects such as the Salesforce Tower and Apple Park are much bigger and more complex, the use of drones allows builders to affordably see their site from an aerial perspective, which enables better documentation of work progress and provides a superior, holistic understanding of the job in general. This paper will examine the experiences of a commercial builder in the central coast that has recently incorporated drones into their company operations, as well as other commercial builders who are paving the way to making drone usage in construction the norm. Through their brief introduction of drone use, we determine that there are many benefits to be acquired including increased efficiency and unique, creative marketing strategies.

Keywords: Site Surveillance, New Technology, Commercial Construction, Drone, Project Delivery

Introduction

The construction industry has always been a battlefield of traditional versus new, security versus risk. The belief that ‘if it ain’t broke, don’t fix it’ rings true for a majority of the means and methods still used in the industry today. For this reason, even the most modern of construction methods do not stray far from traditional practices that have been used for hundreds of years. When compared to other industries in the global marketplace, construction tends to stand out as being behind the curve for integrating and adapting new technologies to its processes. However, with the commercialization of drones in the last decade, industry professionals are discovering and creating new ways to bring jobsite security, project documentation, surveying, and communication into the 21st century.

Due to the nature of construction, means and methods have not seen much change or development relative to other industries such as medicine and manufacturing. While such industries are able to replace human labor through mechanization, many construction processes require manpower and workers getting on their hands and knees to accomplish. Fortunately, there are aspects in construction in which technology can marginally replace human labor while simultaneously increasing productivity and safety. Drones are able to affordably provide a vast amount of information otherwise unattainable without spending copious amounts of money and time. From the air, drones can provide information regarding the progress of work, locations of certain objects on larger sites, and even survey elevations and topography of the prebuilt land (Higgins, 2017). Various construction companies, many with significant industry influence, have already utilized drones as an integral part of their project delivery. With so much progress already achieved in such little time, the opportunities created by drones are seemingly endless.

General Background

Drone technology originated in the military in the form of unmanned aircraft used for surveillance and stealth strikes against unsuspecting enemies. By having a remote pilot in a separate location, these drones provided access into enemy territory without putting humans in any physical danger. (Benjamin, 2013) Through years of research and development, drones became an affordable commercial product, used mainly for aerial photography and videography. Whereas military drones were essentially airplanes due to their need to travel hundreds of miles, civilian drones were flat quadcopters which let the drone travel in any direction, as well as hover in a specific spot. The standard drone design allowed for nimble handling in the sky and stability due to multiple, evenly spaced propellers. As the product became more popular, people quickly discovered interesting ways to use drones in all types of applications.

The first drones made for civilian use were introduced to the public in 2010. At this time, they were meant to be fun, radio-controlled toys that could be piloted with just a smartphone or tablet. Early drones, such as the Parrot AR.Drone 2.0, included incredible features such as a fixed front facing camera, which could track objects by creating a 3D environment based on the images it captures. They were also able to track and communicate with other Parrot AR.Drones through built in Wi-Fi hotspots (Parrot, 2012). While these features were truly revolutionary at the time, the drones still had their fair share of flaws. Because the camera was fixed in a forward facing position, the ability to capture a truly aerial view directly above something was not possible. In addition, the range of connectivity, as well as flight duration, were extremely lacking. For example, the Parrot AR. Drone was considered the most state-of-the-art civilian drone at its release, yet was only capable of 12 minutes of flight within a 150 foot radius (Parrot, 2012). With such short range and little flight time, losing connection with the drones became tricky business as they would fly aimlessly until they ran out of power and crashed.



Figure 1 – Various drone designs

It was not until 2014, that drone technology had developed and matured enough to capture the attention of the construction industry. Companies such as DJI, GoPro, and Yuneec developed drones with high quality cameras which were capable of 120 degrees of angle adjustability and 360 degrees of camera rotation. In addition, they featured 3-point (roll, pitch, yaw) gimbal mounts to minimize shaky footage, as well as GPS tracking to give precise locations and homing capabilities in the case of low power or loss of connectivity to the controller (DJI, 2016). All

of these features, on top of drastically improved battery life and range of connectivity, suggested that drones were to be taken seriously as tools, rather than just toys. By the end of 2015, the drone industry was worth over 2 billion dollars, with nearly 12% of the construction industry utilizing the technology; the most of any professional market. (Patterson, 2016)

LEVEL OF PROFESSIONAL DRONE USAGE

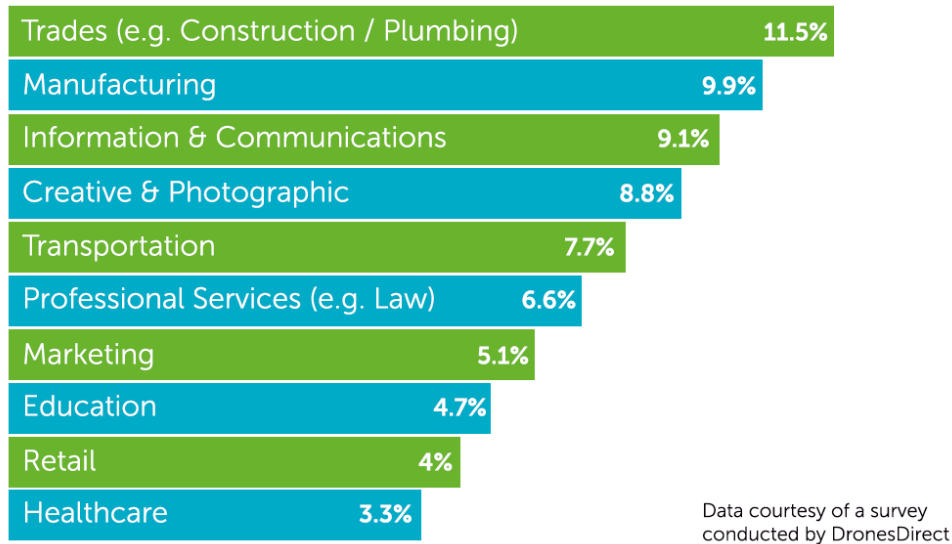


Figure 2 – Percentage of professional usage in various industries (Patterson, 2016)

Impact of Drone Technology on Construction Projects

Prior to the introduction of digital photography in the commercial market during the early 1990s, photographic documentation of construction projects was virtually impossible. Digital photography transformed the way that builders were able to quickly document progress on a project and convey to the owner what was being completed on a daily basis. Fast-forwarding to the present, drone technology has developed alongside digital photography, as cameras are used as the eyes of the drone. By combining the maneuverability and accessibility of the quadcopter, as well as high quality images taken by the cameras, drones opened up a vast amount of opportunity for improvement in the construction industry.

The construction industry has seen significant changes and improvements since the introduction of drones on the jobsite only a few years ago. Major steps towards bettering a number of processes on a construction project have been made, revolutionizing the way we approach project delivery. One of the most prominent applications of drones in construction has been site surveillance, which includes tasks ranging from aerial photography to inspections and tracking (Higgins, 2017). Due to its small size and maneuverability, drones are able to quickly fly to a distant location which would typically take a person much longer to do. In addition, drones take away the safety risk of sending a person into a hazardous location. Rather than having a person climb up several stories to make an inspection, a drone can be flown to that location and send back footage and photographs of the desired inspection location. This process saves precious time and also provides builders with the critical information they are looking for without putting somebody's safety at risk.

Drones have also proven themselves to be powerful tools for land surveying. Due to their ability to reduce the amount of labor and time involved in producing accurate surveys, drones are rapidly replacing traditional land-surveying methods usually done through total stations. Thanks to GPS tracking technology and state-of-the-art camera equipment, drone surveying also eliminates much of the human error involved in the process and has the ability to capture necessary data in much less time than traditional methods would take (Burger, 2018). This is

greatly beneficial for larger construction projects, where the site is simply too big for human labor to efficiently gather vast amounts of data in a short period of time. For example, at the massive new port project in Haifa, Israel, (See *Figure 3*) drones are being utilized to survey the 810-acre complex, providing critical information to the builders regarding how much fill is needed to construct an artificial breakwater. Within just 8 hours after a flight, a team is able to assemble an accurate, high-definition aerial photograph of the entire 810-acre site, using hundreds of thousands of surface points to generate data, instead of manual surveying which only uses hundreds of data points. (Reagan, 2018)



Figure 3 – New breakwater being constructed in Haifa, Israel



Figure 4 – Aerial view of construction site taken by drone

Methodology

The approach I have chosen to take for this case study is to focus on the central coast commercial builder, Robbins|Reed, specifically their experiences since implementing drone usage as part of their project delivery program. In addition, I will be focusing on the key differences and effects in efficiency and marketing that they have noticed since bringing drones onto their jobsites. I will gather this information via interviews with a Robbins|Reed field engineer who has personal experience and flight time with their DJI Phantom 4 drone. With this case study, I would like to discover both the benefits and detriments of using drones on a commercial construction project, as well as the future potential for drone technology to grow and develop within the construction industry. New and unproven technology tends to cause skepticism and keep people away. Through this case study, I will determine whether or not drone use truly increases efficiency in a construction project, and provide information to companies who are on the fence about investing in drones for their own construction program. Because drone usage is so versatile, the results of this case-study are applicable to any construction company, regardless of size and scope of their projects.

Through my methodology, my goals for this case study include:

- Present an overall understanding of drone technology and its uses within the construction industry
- Convey specific uses of drones currently implemented in specific commercial construction companies
- Analyze benefits and detriments experienced by current users of drones
- Explore room for improvement of drone technology and how it can be altered specifically to serve construction processes and needs
- Assess feasibility of setting industry standard of drone usage in commercial construction projects in the future

Case Study

Robbins|Reed is a commercial construction company based out of San Luis Obispo, California. They are one of most reputable general contractors on the central coast and have been serving its communities since 2007. Though their work only resides along the central coast, Robbins|Reed is involved in massive amounts of construction in the area. The company is split into 3 sub-companies: Robbins|Reed Communities, Robbins|Reed Builders, and Robbins|Reed Custom Homes. They are involved in construction projects ranging from custom homes and housing development communities, to retail buildings and RV resorts.

Because the company is so young, they are extremely passionate about new technology and staying relevant in new project delivery methods and trends. They acquired a drone from DJI around 2016 and have been using it on their larger projects such as the Cava Robles RV Resort in Paso Robles, California. Although the amount of time they have used drones on their construction projects has been brief, Robbins|Reed has already discovered many benefits of this impressive little tool. Field Engineer and Cal Poly Construction Management alumni, Jeffrey Hadley, was kind enough to participate in a phone interview with me, providing me with excellent information regarding his experience with drones at Robbins|Reed and personal opinions on the future of drone use in construction.

Specifics of Given Project

The information below is based on the Cava Robles RV Resort being built by Robbins|Reed, in Paso Robles, California. The resort was recently completed in early 2018 and had an active drone on its site throughout the entire duration of the project. Although no hard numbers were recorded to track the impact of a drone on site, Robbins|Reed engineer Jeffrey Hadley stated in the interview that there was a noticeable difference of jobsite efficiency through drone use.

On the next page, I have provided the exact interview questions I used to conduct my interview, as well as responses given by Jeff Hadley of Robbins|Reed regarding our discussion about drones in construction.

How are drones utilized on your jobsite?

Our drone is mainly used for tracking daily progress and site surveillance. Because the size of our RV resort is so large, the drone allows me to quickly inspect a distant area of the site, making sure everything is still okay. The drone also helps me check the work that is being done on a daily basis to give me a better idea of how our schedule is going. From the sky, I can get the most useful view of the site and plan my daily activities around the information I gather.

What other uses, if any, are drones used for with your company?

Drones have been extremely helpful for us for marketing. We use our drones to take photos of our site prior to construction, during construction, and after construction to give to the owners. They love being able to see what is happening on site every day without having to come out to Paso. The incredible camera on the drone has also allowed us to take photos of the completed project for our website and helping the owners to lure potential customers to their new RV resort. The drone is an extremely cost efficient way for us to capture these photographs, whereas traditionally, we would have needed to get a professional photographer in a helicopter.

Why did your company decide to utilize drones in their jobs?

It's a new technology and seems to be a growing trend in the industry. We figured such a small investment was worth giving it a shot. We're a very young company so a lot of us are super interested in seeing what all of this is about.

What kind of investment was involved in incorporating drones in your project?

From a company budget's standpoint, there was really no big investment involved in getting this drone on site. We have the DJI Phantom 4, which anybody can buy online or from a Best Buy. The drone itself was about a grand (\$1000) for a full kill, with the drone, controller, charger, and extra propellers all included. Once it was out of the box, we just connected our smartphones or iPads to the controller, and it was ready to go.

What kind of changes have you seen on the jobsite after incorporating drones?

Unfortunately, the drone was already on the jobsite by the time I started working for Robbins|Reed, so I can't say that I've noticed any differences since I've been here. But personally, the drone helps me cut down on wasted time driving or walking around the jobsite, looking for things or people throughout the 10 -acre lot. That saves me a lot of time to tend to more important tasks throughout my day. Flying the drone also beats being out in the scorching heat here during the summer months.

What are the biggest benefits you have noticed from using drones on the jobsite?

Definitely the cost savings that we had from taking photographs and documenting for both our client and internally within Robbins|Reed. The drone gave us the safest and most affordable way to capture photos of our project from up in the sky.

What are the biggest drawbacks you have experience with drone usage?

Honestly, I didn't feel that there were any drawbacks from having this drone on site.

What type of liabilities are involved with using drones on the jobsite?

We definitely exercise caution whenever we have the drone up in the air. Our site is out of the way of the city so we don't have many obstructions in the way. We just try our best not to fly above the workers and make sure everybody knows when the drone is out and about.

What kind of training was involved to fly the drone?

The drones are pretty much idiot proof and super easy to fly. I didn't get any professional training but one of our guys knew how to fly it and taught me within a couple minutes. It was really easy to pick up and learn. They almost fly themselves because of the GPS technology in it. I can fly it to a specific location and just leave it there to hover on its own. If it starts to run out of power, it will fly itself back to home base back at the site trailer.

Were there any permitting requirements necessary for drone usage on the jobsite?

I haven't experienced any complains or problems with flying the drone here. Our jobsite is located in what is called a "Class D Warning Zone" because of the small airport a couple miles away. This doesn't deem it a "no-fly zone" nor did we need any special permits, but we still do our best not to fly too high or far out of our site. (Hadley, 2018)

Analysis of Data

From the interview with Robbins|Reed, a lot was learned about drones and how they can be used to facilitate on the jobsite. Even on a less complex and technical project such as the Cava Robles RV Resort, the drone was able to help cut down on costs and wasted time while increasing productivity. For a small investment, the drone was able to provide the project team with updated photographs of progress on site, assisting with schedule management and risk management. It also helped Robbins|Reed to maintain fruitful conversation with the client, providing high quality photographs of the site from time to time and ensuring the client that their money is being spent well.

Positive Aspects of Drones in Construction

Without a doubt, the greatest benefit of having a drone on a construction site is the cost and time savings achieved. Drones are able to perform tasks that laborers would usually do, but in a fraction of the time and with increased accuracy. In addition, with the current state of exponential growth in the drone industry, drones are now extremely affordable and attainable by most companies. A small investment in a drone can present a company with increased business opportunity, quick return on investment, and savings on all future projects.

Negative Aspects of Drones in Construction

While Jeffrey Hadley experienced nothing negative from his experience with drones, there are a few down sides that I feel, may hinder a company from looking into this technology as a viable tool, as well as stop drone usage from becoming a norm in the world of construction. A major detriment is the liability involved with an active drone on site. While pilots will do everything in their power to prevent a mishap, accidents are unavoidable and bound to happen. Another negative aspect of drone technology is its potential to replace significant amounts of human labor on site. Due to their ability to survey in an instant and perform inspections quickly and safely, we must consider the possibility that drones will replace the need for human surveyors and inspectors. With so many undiscovered capabilities, the capacity at which drones mechanize the construction process is unpredictable and potentially damaging to the labor market.

Improvements for Drones in Construction

Drone have undoubtedly changed the construction industry already and revolutionized the way we look at project delivery and the means and methods we use to complete a job. Like most other forms of technology, the room for growth and improvement for drones is unending and unknown. However, the most significant improvement that can be made for drone technology is increasing human capability and knowledge to utilize this technology to its greatest potential, bridging the gap between advanced technology and human ability. We can start to improve on this by incorporating drone classes in construction education programs, preparing up-and-coming builders for drone use in the real world.

Conclusion

As human society continues to evolve and develop, our technology advances along with us. In this day and age, what we consider to be “state-of-the-art” can quickly become obsolete within a few years. However, with dedicated development and constant improvement, a truly revolutionary product such as a drone, can continue to serve our society. Just 10 years ago, nobody knew what a drone even was outside of the military. Now, drones are used throughout the world in an enormous amount of different applications. In the construction industry, drones are making massive strides in the modernization of project delivery methods and approaches to creating more efficient and safer construction sites. As drones continue to perform tasks such as surveying and inspection to keep humans out of harm's way, the future and potential of this technology knows no bounds. So long as professionals in the industry are willing to break free of tradition and invest time into it, drones will play a vital role in the future success and growth of the industry for years to come.

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