How New, Innovative Technology Can Be Implemented to Combat the Construction Industry Labor Shortage

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Abstract

This essay addresses the construction industry's need to compensate for the current and projected labor shortage through innovative technologies. In the first portion of this essay, three technologies that are most feasible for implementation – the Internet of Things (IoT), Drones, and Prefabrication – are detailed. The challenges faced are then discussed before the second major portion in which steps for implementation are outlined. These steps include forming partnerships, learning the process, communicating, training, implementing, and adapting and improving. The essay concludes with a discussion of how the AGC organization, and members within, can aid the industry in meeting this goal.

Introduction

The construction industry is in the midst of rapid innovation to compensate for the many years of falling behind the technology revolution. The force driving this is the need to maintain quality production while countering the increasing tradesmen labor shortage. After many years of resisting change, the industry has taken on the dauting challenge of fostering innovation for a prosperous future.

The largest firms are developing innovation departments, investing in new technologies, and testing products on-site. However, they are facing significant hurdles. Companies struggle to determine if the investment of time and capital is worth the efficiency improvement on-site. Additionally, companies face resistance from the tradesmen who perceive some technologies as slower, inefficient, and incapable of adapting to unpredictable site conditions.

Taking this into consideration, three technologies most feasible for implementation have been chosen for discussion. These technologies have high potential to disrupt the industry, have proven their cost effectiveness, and are least intrusive to the tradesmen. The three technologies – the Internet of Things (IoT), Drones, and Prefabrication – will work integrally together to provide a foundation for the future construction jobsite.

Technologies

Internet of Things:

The Internet of Things (IoT) describes a network of devices embedded with sensors for the purpose of connecting and exchanging data. In simpler terms, IoT is a wireless connection of smart devices. This technology is common in the manufacturing industry, however many in the construction industry are yet to understand the potential.

Innovative equipment and tool manufacturers are currently fully invested in incorporating devices linked to IoT. New equipment comes factory-equipped with sensors that can monitor various metrics, and software subscriptions that provide insight to the owner. With this data, owners can make driven decisions that increase efficiency and drive down costs. An example would be data indicating an operator's fuel consumption is significantly above average. The owner could then investigate and resolve the issue, thus saving fuel and lowering project costs. Tool manufacturers are also incorporating IoT into their products. Bosch has created software that connects their tools and gives the owner insight of tool location, battery life, and more (Bosch, 2020). These metrics can all be used by management to save time and money, without intruding on the tradesmen.

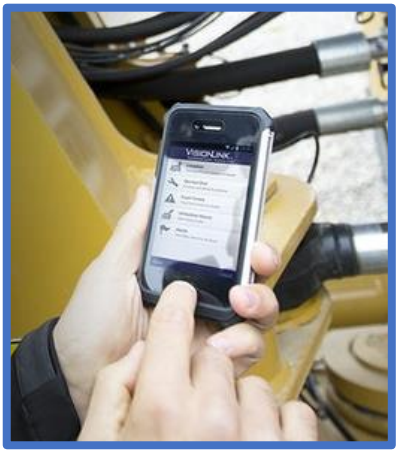

Figure 1 – Mobile software tracks fleet data to aid management decisions

Tradesmen will appreciate the advanced notice of when equipment or tools will need maintenance, the tracking abilities, and the increased information and predictive analytics IoT provides. Management will appreciate the available data to drive decisions based on the most cost-effective solution. With the tradesmen and management on board, and the financial benefits, IoT is a technology ready for implementation today.

Drones:

Drones' capabilities have been substantially improved in recent years, while their costs have decreased. This has made them more applicable to construction and ready for implementation. On-site, the opportunities for drones are seemingly endless.

Progress tracking and safety monitoring today require management to spend their valuable time walking around the construction site. Not only can drones complete this, but they can also automatically update schedules and documents with the collected data. Managers can then focus on higher-level protocol decisions. Drones are also beneficial for inspecting inaccessible areas to verify conditions as seen in Figure 2. These are just a few of the many tasks drones can complete autonomously on-site (Zucchi, 2016).


Figure 2 - Drone inspects bridge condition

Drones will not replace management, rather they will aid staff in focusing less on mundane tasks. With the decreasing costs of drones and increasing costs of management, the financial benefits are clear.

Prefabrication:

Prefabrication provides a more attractive and efficient environment as it transitions tasks previously completed in the field to a controlled location. These controlled manufacturing environments consistently produce worker efficiency of 80-90%, as compared to present levels of on-site construction producing between 30-40%.

With the crippling labor shortage that the industry is experiencing and expecting in the future, focus needs to be set on mass adoption of prefabrication. "In an ideal

construction process with a high degree of prefabrication, the work on site… is carried out… so simply that it can be performed by very little specialist labor" (Knaack, 2012). On-site work will then move towards assembly.

Assembly jobsites will require less workers, freeing up space and further increasing efficiency. Implementing prefabrication, in addition to the previously mentioned innovations, will prove to drastically improve the construction industry.

Working Together:

Depicted below is a visual to represent how these three technologies will work integrally on-site. IoT will collect information and deliver data to the office, where decisions will be made. Drones will fly around collecting and analyzing various metrics. Fewer tradesmen will be on-site to complete the assembly of prefabricated modules. The interconnectivity of these technologies will lead to a more efficient site, competing with the production levels of the manufacturing industry.

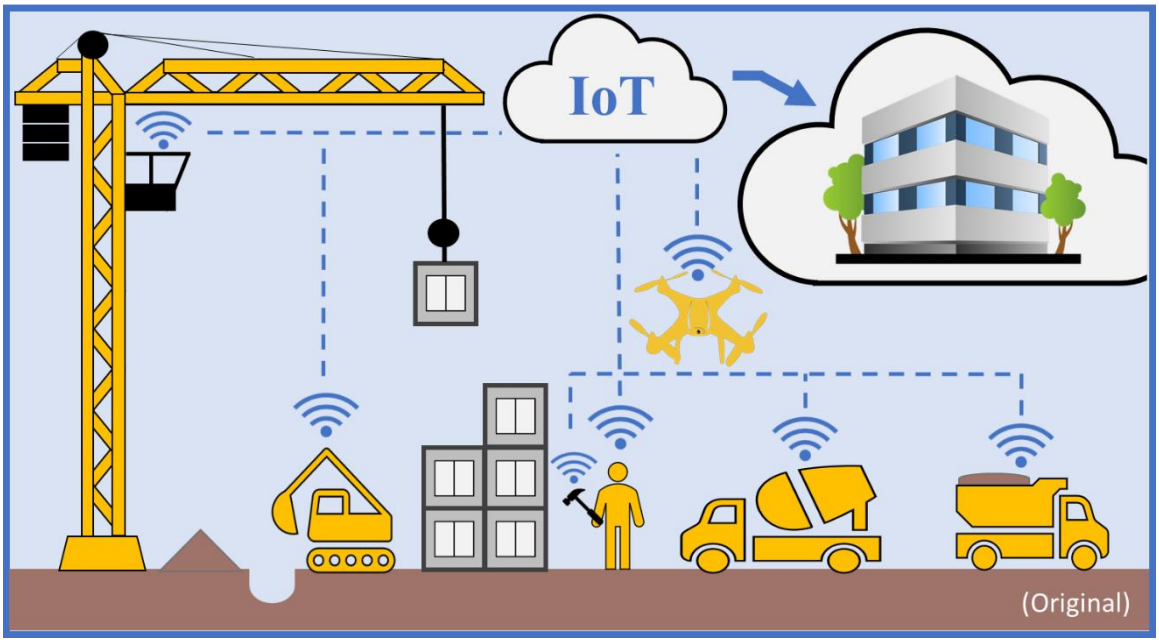

Figure 3 – IoT, Drones, and Prefabrication work integrally together to create an efficient jobsite

Challenges

As great as these technologies are, and as great as futuristic construction sites seem, they will not be possible without methodical implementation. Many new technologies are being implemented too quickly and without enough analysis – they are too expensive or not fully capable. An example of a this is with robots.

Robots are not yet advanced enough to fully take the place of a tradesman. While they have proven their capability to complete repetitive tasks, they struggle to adapt to issues and cannot handle change. They need to be monitored, are expensive, and create logistical issues that occupy a lot of high-salaried management time. The collective cost to implement robots, beyond for repetitive tasks, is presently challenging to defend. Robots may one day run construction sites, but not until they are affordable and fully capable. Therefore, focusing on technologies that can be rapidly implemented today will prove most advantageous.

The tradesmen themselves also need to be seriously considered when evaluating the implementation of a new technology. Many have been successful with their techniques incorporated over their careers and may be resistant to change. Forcing robots or other intrusive technologies into their environment will cause issues with the labor force – issues our industry cannot afford. Proper implementation will take time. To ease the transition, it will be prudent to first introduce technologies that are least intrusive.

IoT, Drones, and Prefabrication were meticulously chosen to detail because of their feasibility and readiness to implement. The final section will outline how general contractors can implement these technologies and foster an excited tradesmen cohort for the future.

Implementation

There are two key factors for the successful implementation of new technologies in the construction industry: acceptance from the tradesmen and cost effectiveness. Forcing technologies into the industry, without tradesmen acceptance, will increase the labor shortage crisis that is already crippling the industry. Therefore, technologies must be phased in the least intrusive manners. More importantly, to promote why every contractor is in business, the technologies must be cost effective. New technologies must directly contribute to lowering costs or increasing efficiency. Of all the innovative technologies, IoT, Drones, and Prefabrication are most aligned today with these critical factors for implementation.

Identifying the technologies to start implementing, however, is only the first step. The hard next steps are conducting the implementation. Below is a graphic to represent how a general contractor can best implement these three innovative technologies:

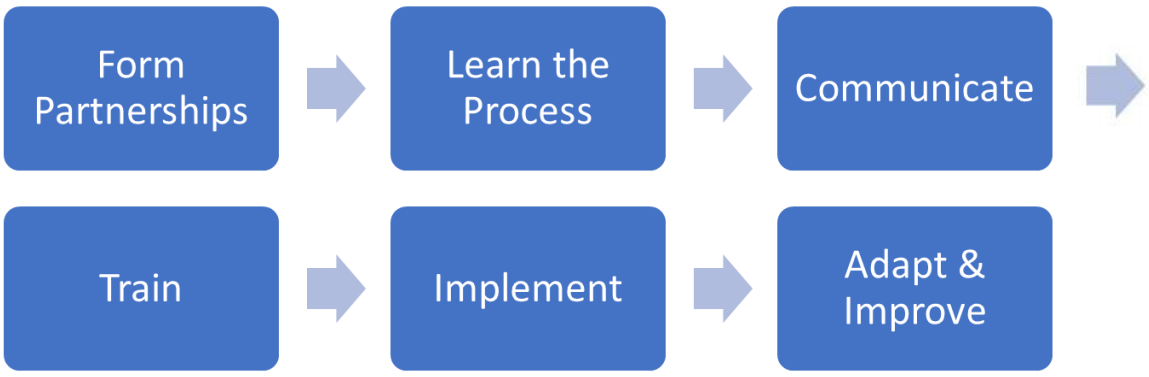

Figure 4 - Steps to successfully implement innovative technologies

1. Form Partnerships:

The first step to implement innovative technologies is to form strategic partnerships. This is a matter of recognizing our expertise in construction, and lack of expertise in areas of technology, manufacturing, and psychology. Efforts in forming partnerships shall be focused on complementing our knowledge with industries that are experts in what they do.

Technology partners will be beneficial in giving insight to current and future products, helping to bridge the gap between an older, tenured generation of executives currently in place in our industry. Manufacturing partners are crucial as they have experience implementing innovative technologies. The construction industry can take lessons learned from manufacturers to increase rates of implementation. Psychology partners will help with planning least intrusive implementation – especially for the tradesmen. As an industry, we can't afford to lose tradesmen due to a lack of consideration for how they feel or what they think about change. Psychology partners will explain how different decisions regarding implementation will affect each stakeholder.

2. Learn the Process:

Learning the process is a matter of general contractors leveraging their newly formed partnerships to understand how these expert perspectives will help.

From the technology partners, general contractors should focus on learning the details of innovative products. They should dive into the depths of how IoT and Drones work, and what their capabilities are. Technology partners will also be able to give realistic estimates of cost of implementation, potential savings, and overall impact.

From the manufacturing partners, prefabrication methods can be observed, as well as how they integrated technology. Many manufacturing industries are incorporating IoT, and general contractors can learn how to include this in prefabrication processes. From the psychology partners, management can learn how best to communicate, train, and implement technologies – while minimizing intrusiveness and motivating the workforce.

3. Communicate:

After learning all aspects from each of the partners, general contractors will need to strategically communicate the plan to their team. This should be conducted early so that the information has time to spread down the management ladder to the tradesmen. Each manager should be given specific guidelines for how to best communicate with his or her team. The goal of the communication step is to inform all stakeholders that change is coming, how that change will work, and why it will be beneficial. The right communication will instill passion in the workforce and create excitement for the future.

4. Train:

Training is necessary for management and tradesmen to learn how to use, and behave around, technology. However, these three technologies chosen will not require the expensive and time-consuming training that many other technologies do. For IoT, management will simply need to be trained on how to utilize software and access data. Tradesmen training will consist of showing how to wear sensors and perform tasks of this nature. Drones will likely be operated by third-party companies or hired operators. Therefore, the training is simple as well. Management will be shown how to access drone data and tradesmen will be taught how to behave around them. Prefabrication will require training in the manufacturing facility, where rooms can be dedicated for this. These three

technologies were strategically selected with ease of training in mind. Easier training translates to lower costs and increased tradesmen acceptance – the two crucial factors for technology implementation.

5. Implement:

Timely and effective implementation of these technologies should begin during the training stage. This step requires getting connected devices on site for IoT, software packages to collect and analyze data, hiring or outsourcing a drone operator, and expanding prefabrication. This step would be near impossible without the strategic partnerships developed early on. By this step, the general contractor's relationship with its partners is anticipated to be well-developed and substantially helpful.

6. Adapt & Improve:

The final step, after the job site is up and running with all of the new technology, is to receive feedback and continue to improve. Technology will continue to advance with or without the construction industry. The general contractor must focus on continual improvement – never to become stagnant. Feedback from the tradesmen and management should be collected often. Efficiency, production, and cost reports should be regularly analyzed as well. Most importantly, general contractors should stay connected with their partners and look to the future.

Conclusion

The implementation of IoT, Drones, and Prefabrication will serve as the foundation for rapid innovation in the construction industry. Construction sites will accomplish more with less through strategic implementation of technologies.

The future construction site will have devices collaboratively working together through a network connection. Data points will be collected to track historical data, project progress, and safety metrics. Drones will conduct routine management tasks and automatically update schedules and reports. Buildings will be prefabricated off-site and assembled in the field. The technology of the future is here today; the challenge is implementation. The three technologies detailed throughout this report are most feasible with that in mind.

As an association, AGC can enhance its mission, "to ensure the continued success of the commercial construction industry", by focusing on the technology that can be implemented today. AGC can leverage its network to provide partners for general contractors in the three necessary categories – technology, manufacturing, and psychology. Furthermore, AGC can develop detailed steps for properly implementing innovative technology on-site – focused on minimal intrusiveness and maximum cost effectiveness. AGC's support will provide general contractors the resources they need to start the construction technology revolution.

Each and every industry member has a responsibility to help foster this critical innovation. The two keys for success will be to maintain cost effectiveness and ensure all stakeholders are educated for maximum cooperation. Starting with the foundation of IoT, Drones, and Prefabrication will enable this. The construction industry of tomorrow is here today; it is time to get to work.

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