[Company Name]

Construction Industry

Company Logo

THESIS

The construction industry has underinvested in technology over the last two decades resulting in many construction subsectors in need of automation improvements. The Company believes the following key observations will drive the next wave of technology adoption in the sector:

1. Below the "enterprise" part of the market, tech penetration is still low, especially at the field level.
2. Existing workflow in the field is disjointed, inefficient, and provides a poor user experience which will lead field operators to place increased emphasis on effective and streamlined collaboration tools.
3. Mobile is accelerating technology adoption by allowing all construction workers to capture real-time data at scale and enabling significant growth opportunities.
4. System of record tools will continue to see increased penetration as the opportunities to leverage data to build ancillary businesses increase.

INDUSTRY KEY TAKEAWAYS

- The construction industry is one of the largest contributors to the world economy with an annual contribution of **$10 trillion,** and is expected to reach **$14 trillion by 2025**, a CAGR of **3.8%.**
- Despite being one of the largest sectors of the economy, the construction industry faces a productivity problem due to limited investment in technology and inefficient awarding of procurement contracts driven by a desire for the lowest price possible vs. the best balance of price and service.
- Accordingly, there are several opportunities for efficiency improvement through adoption of technology in the industry, and while The Company has researched most of these areas, we have emphasized three segments – digital twin technology, construction management software, and insurance.
  - Digital twin technology creates a digital replica of a project, enabling construction companies to track the progress of projects in real time and detect errors as soon as they occur by comparing the as-built and as-designed models, which can lead to significant cost savings. **The Company has spent significant time with companies such as Company D, Company C, Company J, Company K, and Company L.**
  - Construction Management Software enables the stakeholders involved in a project to collaborate more efficiently by providing solutions that allow adjustments to construction blueprints and plans to be relayed in real time to the construction site engineers and workers, as well as tools for mobile timekeeping, real-time cost coding, geolocation of workers, and issue logging and tracking. **Companies of high interest to The Company are Company A and Company B.**

AI & AUTOMATION KEY TAKEAWAYS

- The segments of the construction workflow cycle that are most dependant on software are accounting, estimating, project management and scheduling. Currently, **these workflows are still highly dependent on spreadsheets as most existing software solutions are on-prem and lack AI functionality.**
- **The construction industry is lagging the broader economy when it comes to AI and automation spending.** Given the growing size and complexity of construction projects, spending on technological advancements will be necessary to increase productivity.
- **New surveying techniques that integrate HD photography, 3-D laser scanning, and geographic information systems, can help to bridge the gap between estimates and actual ground conditions and automate project planning and monitoring.** Integrating these techniques with pre-existing technologies, such as drones, unmanned-aerial-vehicles (UAV), and light-detection-and-ranging (LIDAR) technology, provides high-quality 3-D images that can be aligned with project-planning tools. **Companies of high interest to The Company in this vertical include Company C.**

PROGRESS AND NEXT STEPS

- **The Company's Product A is the result of many months of work meeting with entrepreneurs, executives, and analysts in the industry and seeing first-hand how leading competitors operate.** This report is a selective summary of what we have learned and includes highlights from several high impact conversations The Company has held with leading technology minds, founders with industry expertise, executives, and industry analysts.
- **The Company's Product A** into the construction technology industry has led to the **identification of potential investment opportunities such as Company A, Company D, Company C, Company E, Company F, Company G, Company H, and Company I.**
- We continue to speak with industry participants daily and learn more about the pain points across the entire sector. Our high priority focus is in the subsectors of digital twin technology, construction related insurance products, and construction management software. We are in active discussions with several entrepreneurs building new and compelling business models across these and other subsectors within the industry.

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SUMMARY

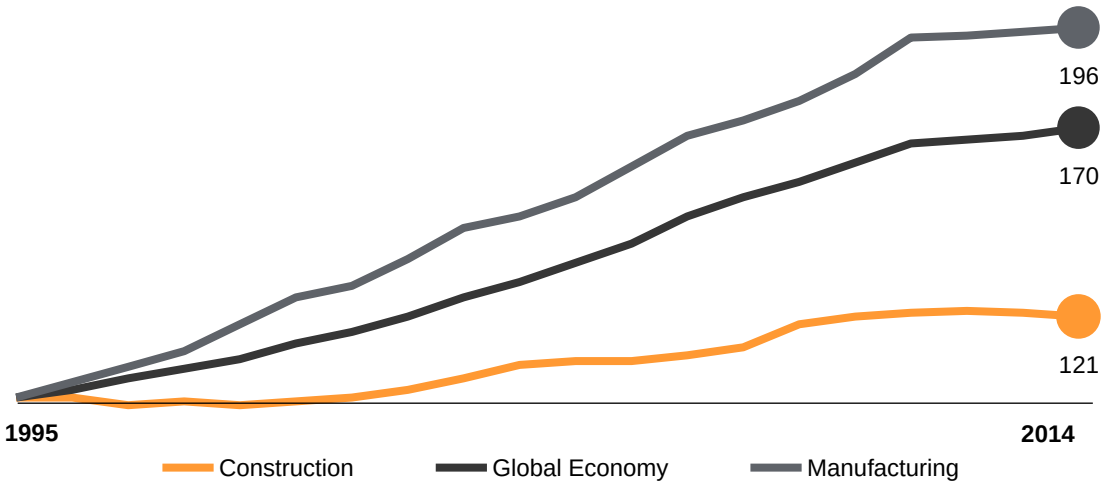
CONSTRUCTION INDUSTRY OVERVIEW

The construction industry is one of the largest contributors to the world economy, with an annual contribution of **$10 trillion that** is expected to reach **$14 trillion by 2025, growing at a CAGR of 3.8%**.[1] The growth in the industry will primarily be driven by new real estate construction and rising infrastructure spend due to increasing urbanization and a growing population. The construction industry currently employs **~7.0%**[2] of the world's working population and has bottom-quartile profit margins compared to the other sectors, which has historically constrained investment in technology and digitization.

The industry is highly fragmented, with thousands of firms broadly classified into two categories of companies – larger firms engaged in the heavy civil, industrial, and residential construction markets, and smaller firms engaged in specialized trades such as mechanical, electrical, and plumbing work that act as subcontractors to the general contractors hired by larger firms.

The lack of investment in tech and innovation has resulted in a noticeable productivity problem. Productivity growth in construction was limited to **1.0%** over the last two decades compared to **2.8%** for the overall economy.[3] According to McKinsey, if construction industry productivity increases to the level of the overall economic productivity growth, there is an opportunity to add **$1.6 trillion** to the construction economy, which will further give a boost to the global GDP by **2%.**[4]

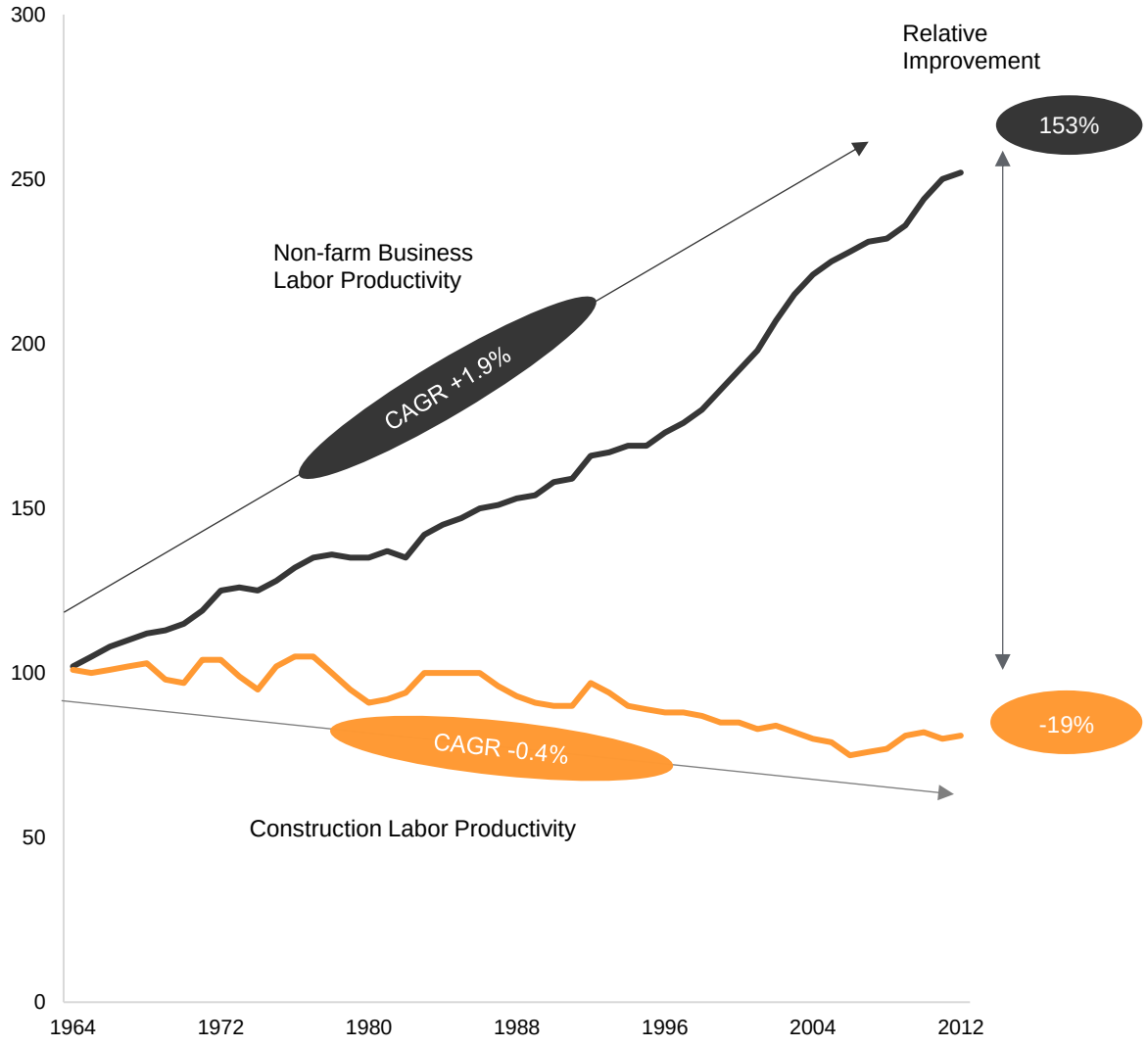
Real Gross Value Added per Hour Worked, Index of 2005 $: 100 = 1995



Source: Improving Construction Productivity, McKinsey Global Institute, February 2017

[1] Improving construction productivity, McKinsey Global Institute, July 2017
[2] Improving construction productivity, McKinsey Global Institute, July 2017
[3] Improving construction productivity, McKinsey Global Institute, July 2017
[4] Reinventing Construction: A Route to Higher Productivity, McKinsey, February 2017

US Industry Productivity and Performance, 1964-2012



Source: Shaping the Future of Construction, WEF and BCG, may 2016

In addition to limited investment in technology by construction companies, suboptimal awarding of procurement contracts is restraining productivity growth in the industry. Often, public and private owners opt for firms that submit the lowest bids when awarding contracts, even though small and specialized trade contractors offer higher productivity solutions. Per the industry estimates, the large-scale players are 20%-40% more productive than small-scale sub-contractors due to scale and their vast experience; however, there remain challenges in meeting cost and schedule commitments on megaprojects, even in the more-productive heavy construction works, as large firms routinely sub-contract specialized trades to small-scale firms.

The industry also suffers from a lack of proper knowledge transfer, as lessons learnt from one project are not applied in subsequent projects. This is mainly because companies have not institutionalized proper knowledge transfer processes, resulting in lost experience and expertise after the completion of a project.

Unlike other sectors, big data generated at the construction sites is not captured by construction firms. If such real-time data from these sites were captured, processed and analyzed, it would enable managers to identify, predict and effectively tackle problems as they occur, thereby reducing the time and cost overruns. Digital twin platforms and services have the potential to fix this problem, as they can act as a system of record across projects and pillars within an organization.

The Company believes that to bridge the **productivity gap** and compensate for the **lack of skilled construction labor**, construction companies are going to invest more in new collaboration technologies, design and engineering, and technologies such as big data analytics and digital twins that have the potential to significantly increase on-site productivity.

Potential Investment Opportunities across Construction Project Work Streams

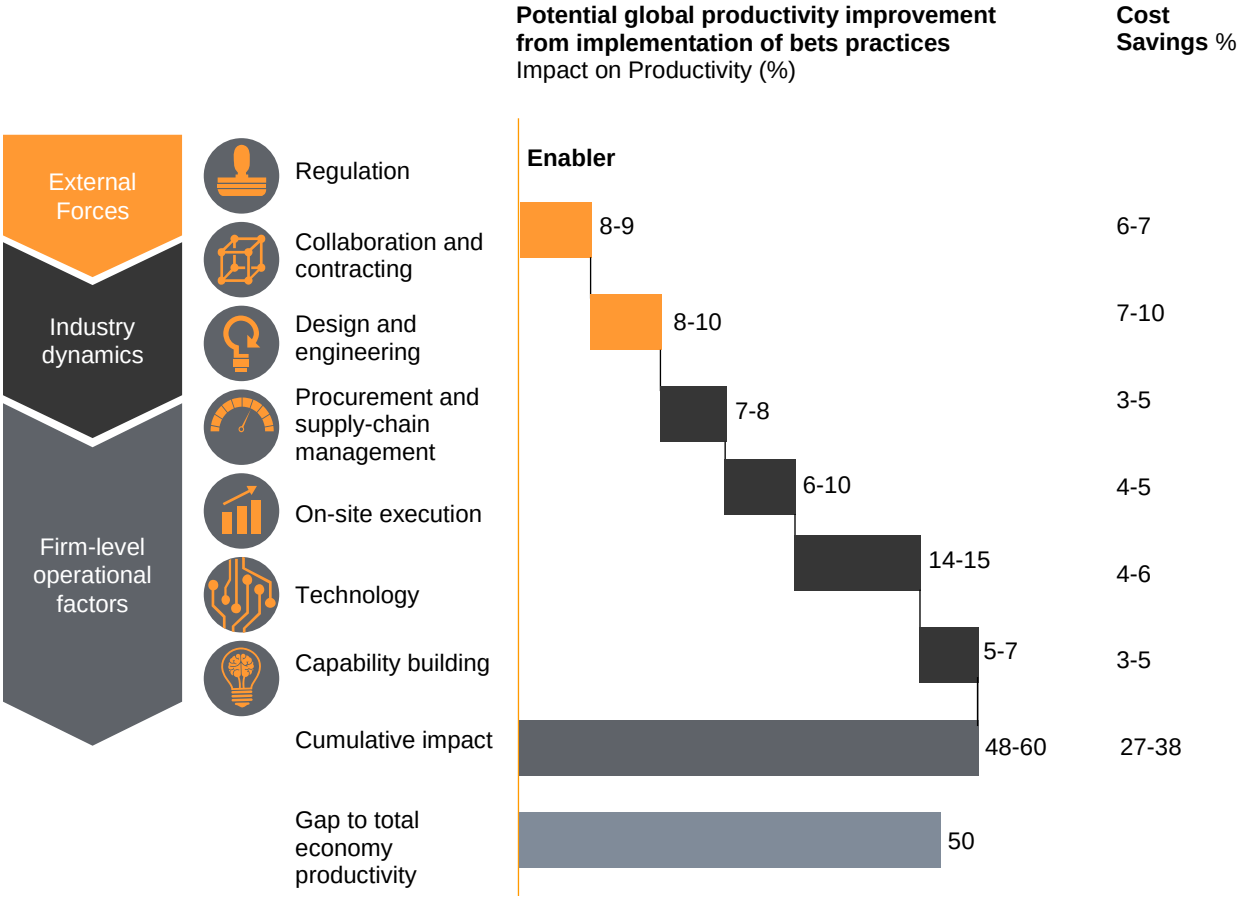
A construction project workflow cycle is highly dependent on spreadsheets and manual labor, which indicates a lack of technology solutions. However, there is an upcoming trend of using technology to efficiently manage the project work streams, resulting in rise of several new companies across segments.

Segment	Company	Description
Accounting	Company A	Provides an online platform for automating subcontract management processes, specifically invoicing, compliance and lien waivers
Estimating	Company B	Provides construction estimating software coupled with the ability to share digital blueprint plans and collaborate in real time
Project Management	Company C	Provides construction management solutions such as daily reporting, sub-contractor reporting, and contractor reporting
Scheduling	Company D	Provides an automated BIM to provide optimized construction schedule solutions
Bid Management	Company E	Provides analytics tools to contractors for bid management
CAD/BIM	Company F	Provides building information modeling software solutions such as content services, Eco Scorecard, library, and virtual showroom solutions
CRM	Company G	Provides cloud-based CRM and proposal automation tools to the construction industry
Prequalification	Company H	Provides construction bid management software that also has a prequal component to help general contractors select subcontractors

Construction Can Catch Up with Total Economic Productivity in these Seven Areas

Several innovative companies and regions are addressing current market failures and improving productivity, as well as cost and schedule reliability, within the construction industry. With action and widespread adoption of these seven areas, the sector's productivity could be 50 to 60 percent higher.

Cascading effect



Source: Reinventing Construction: A Route to Higher Productivity, McKinsey, February 2017

Despite technology at 15%, its true impact is larger as its effect is amplified on other categories as it acts as an enabler to all the categories helping improve productivity across the entire sector.

UNITED STATES CONSTRUCTION INDUSTRY OUTLOOK

The construction industry is forecasted to grow at 5.0% in 2018 (nominal dollars) in the United States vs. 4.0% in 2017, which ended on a high note for the industry with both spending and workforce witnessing positive year-on-year growth. Construction spending in the United States stood at $1.25 trillion in 2017, up by 2.6% as compared to 2016.[5]

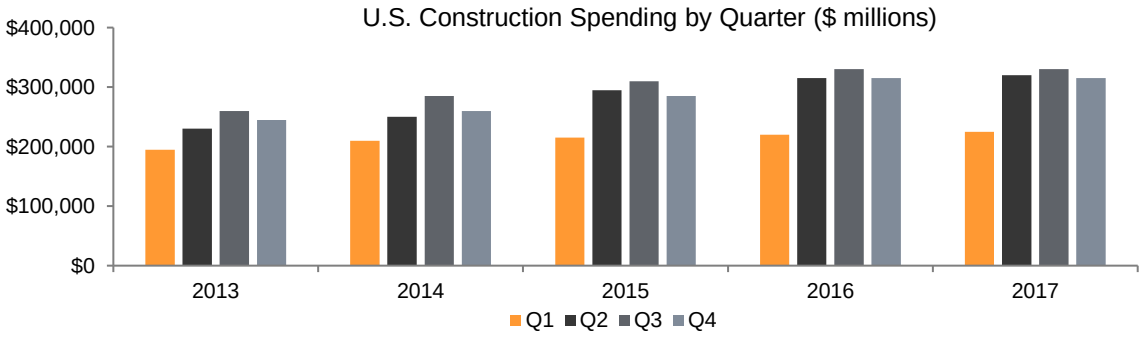
Construction Forecast by Segment in the U.S.

Year	Consensus	
	2017	2018
Total	4%	5%
Residential	6%	6%
Single Family	9%	9%
Multi Family	1%	-1%
Non-Residential	2%	4%
Commercial	1%	2%
Hotels	8%	-2%
Office	5%	6%
Retail	-8%	1%
Education	5%	6%
Healthcare	1%	5%
Public Buildings	2%	6%
Industrial	0%	4%
Other Non-Residential	2%	0%
Non-Building	4%	4%
Roads and Bridges	5%	6%
Infrastructure	3%	3%

Construction Spending in the U.S.[1]

$1.25 trillion
2017 U.S. construction spending

+2.6%
Over 2016 spending total



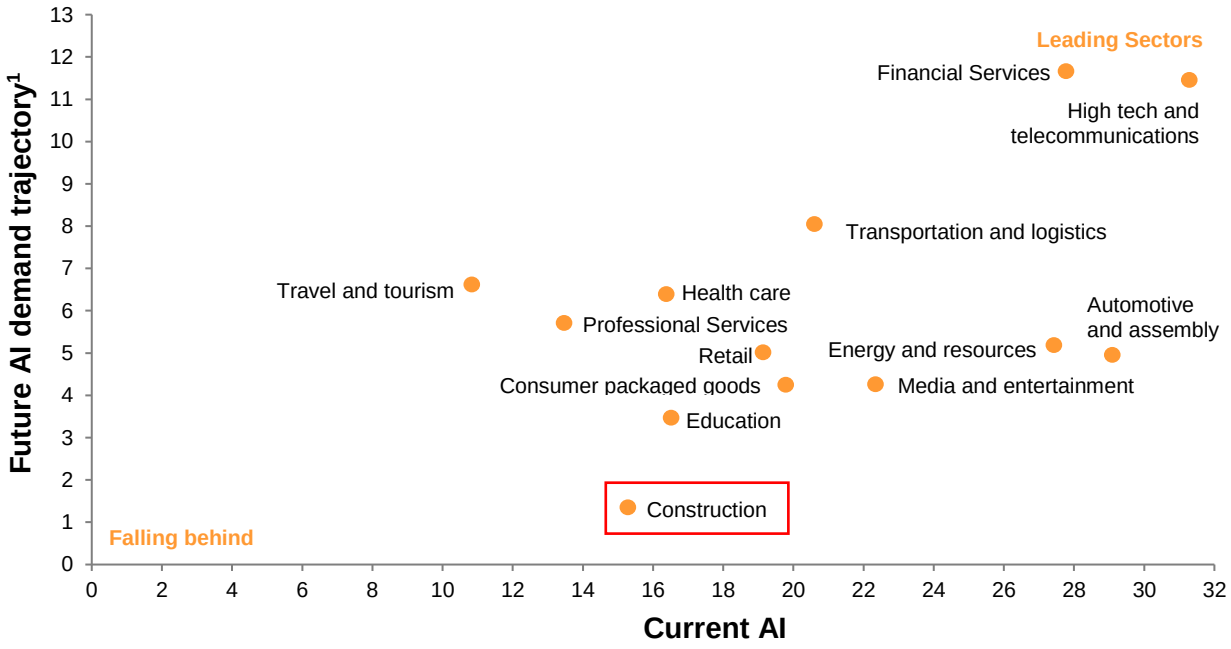
[5] US Construction Update – Year End 2017, JLL

AI & AUTOMATION OVERVIEW

Emerging and established technology provides tools and software such as 3D laser scanning, embedded sensors, drones, big data analysis, business information modelling, and mobile applications to the construction industry, enabling companies to plan, design, and construct more efficiently and accurately, and reduce construction costs. **With projects growing in size and complexity, adoption of technological advancements is necessary to improve the productivity and automation in the construction sector. The construction industry as a whole is lagging the broader economy when it comes to AI and automation adoption spending.**

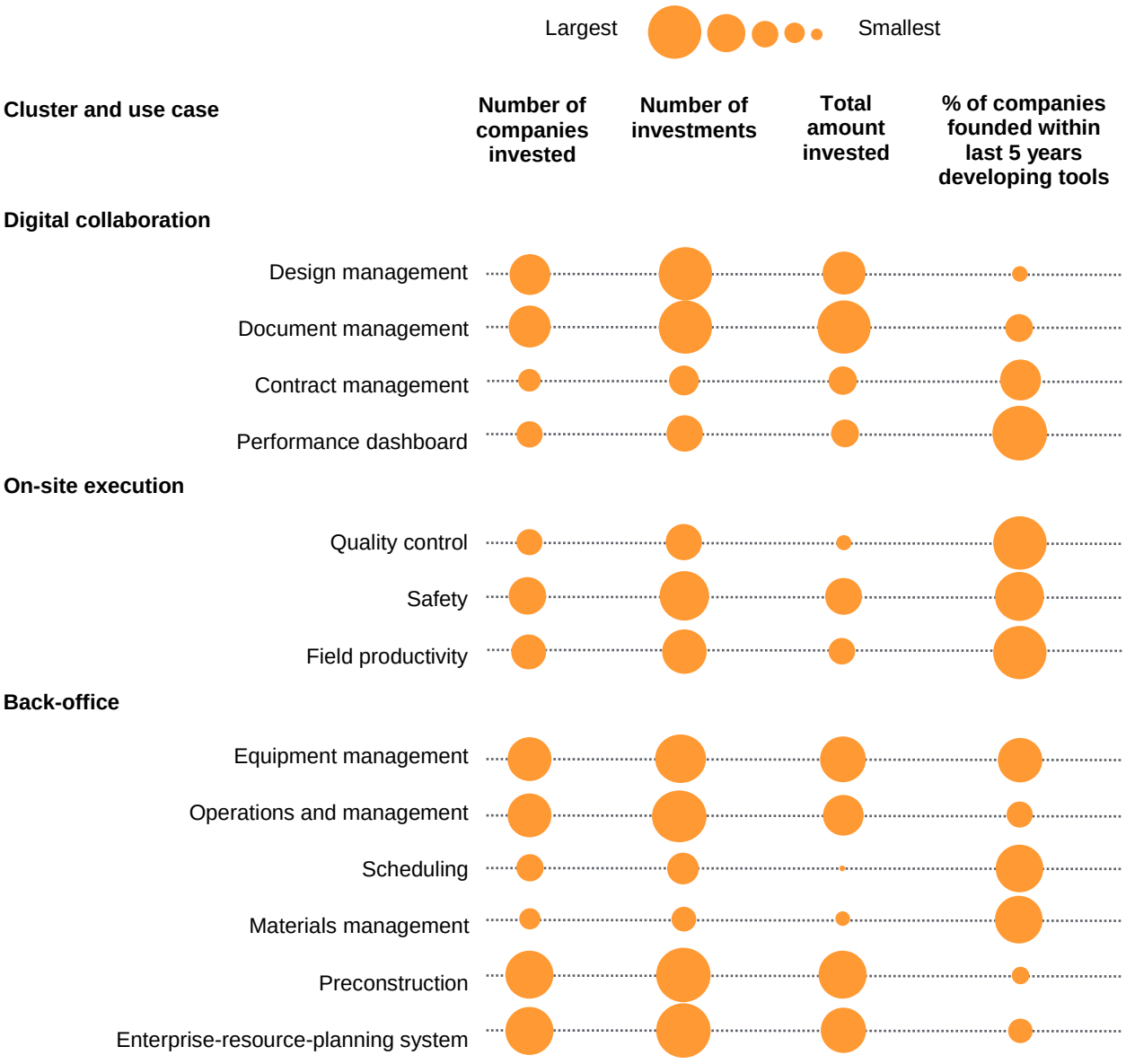
Source: Technology in the Construction Industry, eSUB

AI Adoption Across Industries



Source: McKinsey Global Institute AI Adoption and Use Survey (2016)
(1) Average estimated % change in AI spending, next 3 years, weighted by firm size
(2) % of firms adopting one or more AI technology at scale or in a core part of their business, weighted by firm size

The lifecycle of construction tech investing trends can clearly be seen in the chart below. Document management is a category that has been heavily funded over the last two decades and there are entrenched, large competitors who are winning the market and have led on innovation. From an early stage perspective, there are less opportunities and the data support this conclusion. Performance dashboard, on the other hand, is a very interesting category from an early stage perspective. As can be seen from the data most the companies solving this problem have raised capital in the last five years, and it is an area we are seeing a lot of early stage opportunities



Source: The new age of engineering and construction technology, McKinsey (July 2017)

Construction Technologies across Construction Lifecycle

The technologies within the construction ecosystem, as described below are constantly changing. Each new adoption or data innovation enhances other parts of the ecosystem and the technology, as a result, is evolving on an everyday basis.

Digital Design: Assist with document control and integration as design progresses from sketches to construction documents

Preconstruction

Estimating: Automate and improve the accuracy of bid estimates

Construction relationship management: Provide dashboard for business-development pipeline

Market Intelligence: Gather and analyze Information gathering from past projects and competitor performance

Marketplace: Create a platform for stakeholders to prequalify, evaluate, and select partners

Construction

Design management

- Visualize drawings and 3-D models on site, on mobile platforms
- Update blueprints in the field with mark-ups, annotations, and hyperlinks

Scheduling

- Create, assign, and prioritize tasks in real time
- Track progress online
- Immediately deliver work plan and schedule to all schedule to all workers

Materials management

- Identify, track, and locate materials across the supply chain

Field productivity

- Track crew deployment in real time
- Manage project staffing across skilled trades
- Track on-site productivity at a trade and worker level

Equipment management

- Track and manage construction equipment fleet

Quality control

- Inspect remote sites through pictures and tags shared through app
- Update and track live punch lists across projects to expedite project closure

Contract management

- Update and track contract compliance checklist
- Update records for all client and contractor communication regarding contract terms
- Track vendor prequalification and liens and manage payments

Performance dashboard

- Monitor projects progress and performance
- Provide automated dashboards created from field data
- Generate manpower updates and view past reports on handheld devices

Document management

- Upload and distribute documents
- Search all projects across sites
- Share information across sites

Safety

- Track and report safety incidents across the job site
- Alert workers on safety procedures and provide tips live

Enterprise-resource-planning systems

Operations and Management

Work-order Management

Remote monitoring of building systems

Predictive analytics for system management

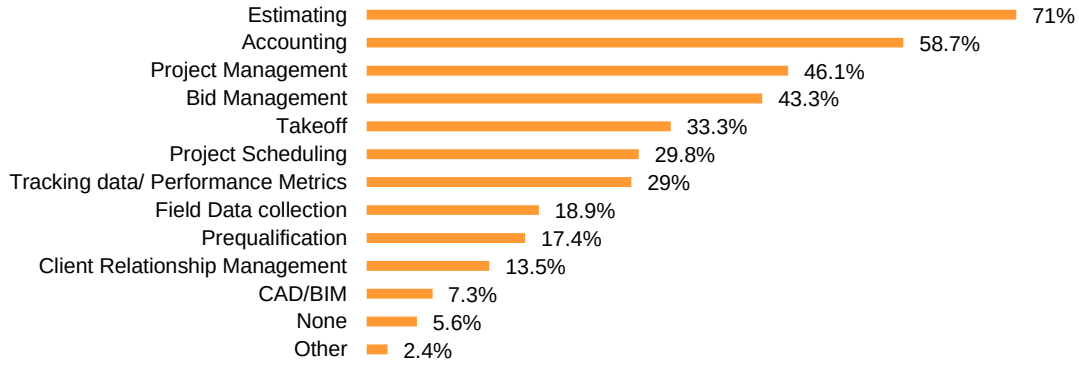
Mid to small project management

Asset management with an ongoing record of facility performance

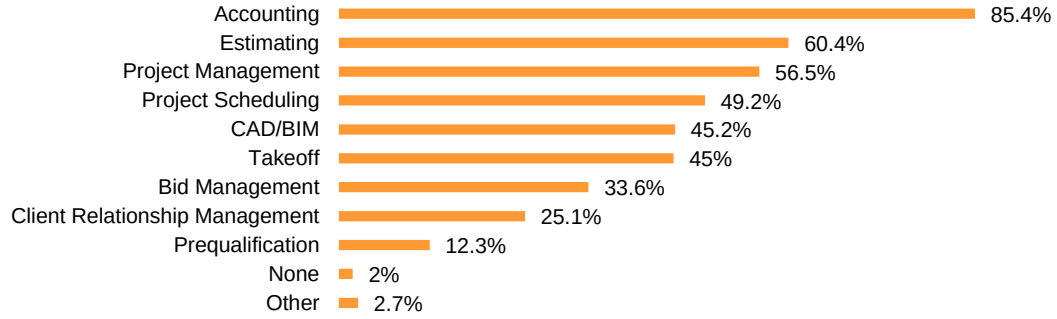
Source: The New Age of Construction Technology, McKinsey, July 2017

According to a survey done by JBKnowledge, the respondents – which included professionals from firms such as architectural/engineering/design firms, construction service providers, construction technology providers, as well as design build general contractors, sub-contractors, general contractors/construction managers – indicated the workflows that are most dependent on software are **accounting (85%), estimating (60%), project management (50%) and scheduling (50%).**[6] Interestingly, the respondents also noted that the same workflows are still highly dependent on spreadsheets, indicating a lack of capable AI built into these software solutions.

Workflow Dependent on Spread Sheets



Workflow Dependent on Software

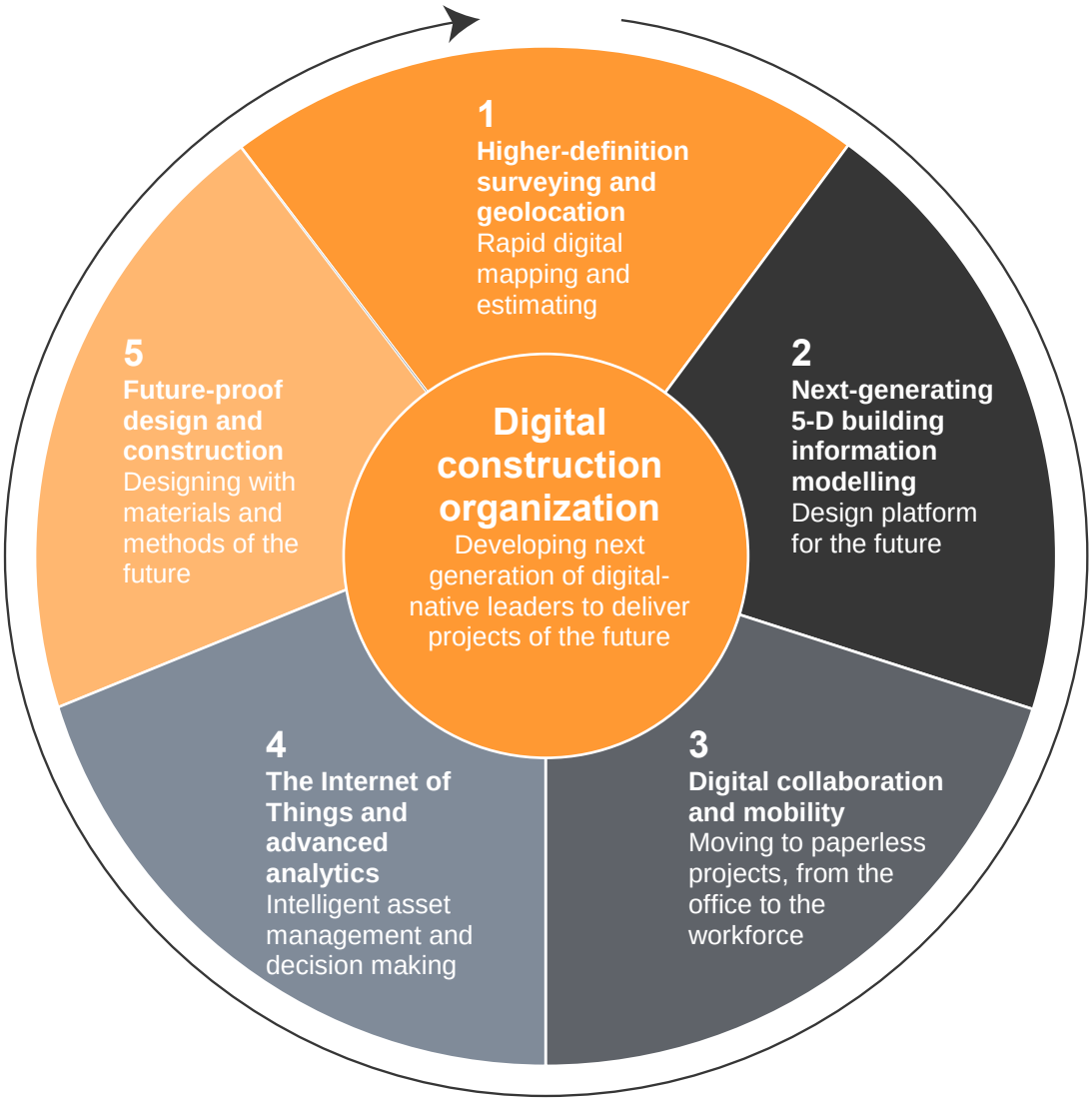


Source: Annual Construction Technology Report, 2017, JBKnowledge

[6] Annual Construction Technology Report, 2017, JBKnowledge

The Company believes there are five key technological trends that can further help the construction industry unlock its growth potential – higher-definition surveying and geolocation, 5D building information modelling, digital collaboration and mobility, internet of things, and future-proof design and construction.

Five Trends Will Shape the Automation of Construction and Capital Projects



Source: Imagining Constructions Digital Future, McKinsey, June 2016

HD SURVEYING AND GEOLOCATION

Inconsistencies between actual ground conditions and estimates often result in last minute changes to the project space and design, which leads to increased project costs and construction delays. New techniques that integrate HD photography, 3-D laser scanning, and geographic information systems can significantly improve accuracy and speed. These advances are enabled by pre-existing technologies, including drone and unmanned-aerial-vehicles (UAV), and light-detection-and-ranging (LIDAR) technology, which provide high-quality 3-D images that can be integrated with project-planning tools, such as BIM.

LIDAR represents an evolution is surveying; added mobility from drones and handheld technology is a breakthrough

Overview of Technology Commonly Used in Site Surveys

Electronic distance measurement	GPS	Photogrammetry	Light detection and ranging (lidar)
• Most commonly deployed • Requires on-site personnel • Best used for on-site rechecks prior to work	• Use GPS coordinates • Ineffective when blocked (e.g., by tall buildings or clouds) • Best used when there's a need for high accuracy in small open sites	• Uses high-resolution images • Requires postprocessing time to convert to usable data • Best used when there's a need for high accuracy in large sites	• Uses optical lasers to detect thousands of points per second, with native 3-D output • May have issues with some terrain, such as steep slopes

While LIDAR has existed for some time, there has been a breakthrough in its use via drones/unmanned aerial vehicles (UAVs) and handheld platforms:

- Handheld 3-D laser scanners
- Mounted on mobile platforms
- Some lidar systems are now under 10kg and can be deployed with drones/UAVs

Source: Imagining Constructions Digital Future, McKinsey, June 2016

LIDAR, when used in conjunction with ground-penetrating radar, magnetometers, and other equipment, provides both under and above ground 3D images of project sites with more efficiency and reduces discrepancies in the surveys. For example, during a survey of river sites for mini-hydropower plants in Southeast Asia, surveyors used LIDAR maps to provide general terrain information and drone-mounted high-definition cameras to focus on specific areas. Given the growing interest of companies in this space, The Company is considering a potential investment opportunity in **Company C**, a digital twin technology

solution. **Company C helps companies collect data using drones and aerial imagery and provides AI powered insights by creating a digital replica of the project, thereby eliminating the need for a survey crew and automating the monitoring of industrial construction sites.** It also uses laser scanners to map a project site down to the millimeter, allowing project managers to accurately build offsite and construct onsite, saving time and money while reducing the chance of project delays.

5-D BUILDING INFORMATION MODELING

Similar to the way computer-aided **3D modeling** transformed the building of aircraft and **helped improve sector productivity by up to ten times, The Company believes 5D BIM could have similar effects and help automate many processes in the construction industry.** While the **construction industry** currently relies on on-prem software tools, owners and contractors often use different platforms that do not sync with one another. This means there is no single source that provides a dynamic view of project design, cost, and schedule, allowing for delays and errors to go unchecked.

- 5D BIM is a five-dimensional representation of the physical and functional characteristics of any project that takes into account the cost and schedule of the project, along with the standard spatial design parameters in 3D.
- It includes details such as geometry, specifications, aesthetics, thermal, and acoustic properties, enabling owners and contractors to identify, analyze, and record the impact of changes on project costs and scheduling.
- This helps the parties involved to identify risks and complexities earlier and make better decisions by avoiding any last-minute surprises that could increase the project scope.
- Various studies have shown that construction companies that use BIM report higher efficiencies and increased cost savings.
- Many governments in countries such as Britain, Finland and Singapore have made it mandatory for construction companies to use BIM for public infrastructure projects, given the significant benefits to the speed of execution of projects and keeping project costs under check.

DIGITAL COLLABORATION AND MOBILITY

The construction industry still primarily relies on paper for blueprints, design drawings, procurement and supply-chain orders, equipment logs, daily progress reports, and punch lists. Due to the lack of digitization, there is a gap in data sharing between the stakeholder which creates inefficiencies. The use of paper also makes it difficult to capture and analyze data, leaving a major chunk of important data uncaptured. **The capturing of historical data plays an important role in performance analytics that can lead to better outcomes, risk management, and automation possibilities.** Owners and contractors are beginning to digitize their project-management work-flows offering digital-collaboration and field-mobility solutions.

- Digitizing workflows has already shown significant benefits in the retail and manufacturing industries.
- Even in the construction industry, digitizing workflows has shown significant improvements in terms of efficiency and cost savings. For instance, in an American tunnel project with almost 600 vendors, the contractor developed a single platform solution for bidding, tendering, and contract management. This saved more than 20 hours of staff time per week, cut down the time to generate reports by 75%, and expedited document submission by 90%.

- Crew mobility solutions have also proved to have a positive effect on productivity by enabling central planning teams and on-site construction teams to connect and share information about progress in real time. The availability of low-cost mobile connectivity via tablets and handheld devices, has resulted in a new generation of “mobile first” cloud-based crew-mobility apps that can be deployed even at remote construction sites and provide real-time updates. These are commercially viable for contractors and project owners of all sizes.

Given the aforementioned benefits, the digital collaboration and mobility solutions segment has emerged as one of the key sub-sectors for construction technology startups and has attracted approximately **60% of all venture funding in the construction technology sector.** Accordingly, The Company is looking at several companies in this segment such as **Company A, Company M, and Company N. Company M** provides a construction management software that provides real-time access to construction scheduling, change orders, documents, and blueprints to the stakeholders involved in the project. **Company N** provides a mobile application for contractors on the field and provides solutions such as task management scheduling, punch list inspection, and plan viewing.

INTERNET OF THINGS AND ADVANCED ANALYTICS

As production sites get denser in terms of number of people, available construction equipment, and the amount of work going on at the same time, they generate vast amount of data, a majority of which is not captured.

The Internet of Things (IoT), which has already seen deployment across sectors, uses sensors and wireless-enabled equipment, and connects various assets. The technology solution would allow construction machinery, equipment, materials, structures, and even formwork to transmit data to a central data platform at a construction site, capturing performance data based on specified parameters. Sensors, near-field-communication (NFC) devices, and other technologies can help monitor the productivity and reliability of both staff and assets. There are several potential uses:

- **Equipment monitoring and repair:** Advanced sensors would enable the machines at the construction site to detect and communicate maintenance requirements, send automated alerts for preventive maintenance, and compile usage and maintenance data.
- **Inventory management and ordering:** Connected systems can keep stock of the inventory and use the historical trends to forecast and alert site managers when stock is running short and when orders need to be made. NFC tagging and tracking of materials can also pinpoint their location and movement and help reconcile physical and electronic inventory**. Company C is currently tackling this problem with continuous aerial drone flights.**
- **Quality assessment:** Using vibration sensors at construction sites enables the workers to test the strength and reliability of a structure during the construction stage. Workers can detect deficiencies in the structure using data from the sensors and make the requisite changes.
- **Energy efficiency:** Sensors that monitor the conditions around a construction site and fuel consumption for assets and equipment can foster on-site energy efficiency, enabling companies to adhere to strict environmental regulations.
- **Safety:** Wearable bands can send alerts if workers on the site are in restricted areas or if a vehicle or asset is stationary or non-operational for a given window of time during shift hours.

In addition to the above opportunities, the Internet of Things will also enable companies to capture data that would have otherwise remained uncaptured. The insights gained through the adoption of advanced analytics in construction projects can help to improve efficiency, timelines, and risk management.

For example, advanced analytics solutions have helped a major infrastructure project in London save time and capital when project managers worked with a data-analytics company to produce a web-based adaptive-instrumentation-and-monitoring system. The system absorbed field-sensor data, construction-progress data, and workforce and vehicle movements. Statistical analysis based on this information helped project teams detect anomalies and identify potential risks—critical information for a dense and historically sensitive city like London.

There are a number of startups that have ventured into this space including; **Company H**, a mobile platform for construction field supervision to ensure crews have the materials, tools, equipment, and approved drawings to complete the day's work; **Company O**, a platform to analyze data from construction projects; **Company P**, a startup providing big data analytics solutions across industries such as industrial, and oil and gas; **Company Q**, a cloud-based suite of pre-built applications that offer big data, artificial intelligence, and IoT applications; and **Company R**, a data acquisition and digital twin solutions provider. Another startup, **Company I,** has taken the sensors from autonomous vehicles and retrofit them into construction equipment, and developed of suite of autonomous software to manage the equipment. **All these startups are helping to automate various processes in the industry.**

FUTURE-PROOF DESIGN AND CONSTRUCTION

New building materials, such as self-healing concrete, aerogels, and nanomaterials, as well as new and innovative construction approaches like 3-D printing and preassembled modules, can lower costs and speed up construction while improving quality and safety. Building materials is a $1 trillion global industry, and often materials account for more than half of the total cost of projects. Traditional materials such as concrete, cement, and asphalt make up most of this demand. But new and better construction materials are also required due to several trends:

- **Green construction:** There is an immense push to adopt materials and technologies with lower carbon footprints.
- **Cost efficiency:** Given substantial cost pressures, there is a need for structural change in the choice of materials, in addition to incremental lean efforts.
- **Supply-chain agility:** Transporting heavy materials and equipment has massive implications on supply chain costs and time, especially because many new projects are located in remote or dense areas.
- **Improved durability and strength:** With capital costs rising and scarcity of land in many markets, owners are insisting that projects have longer commercial lives.
- **Off-site construction:** Assembling lighter, easier-to-handle materials off-site can improve project efficiency, address on-site space constraints, and create the conditions for crews to improve their skills.

A number of advancements have already been made in the past few decades in developing advanced construction materials. Some of the new materials used in construction include:

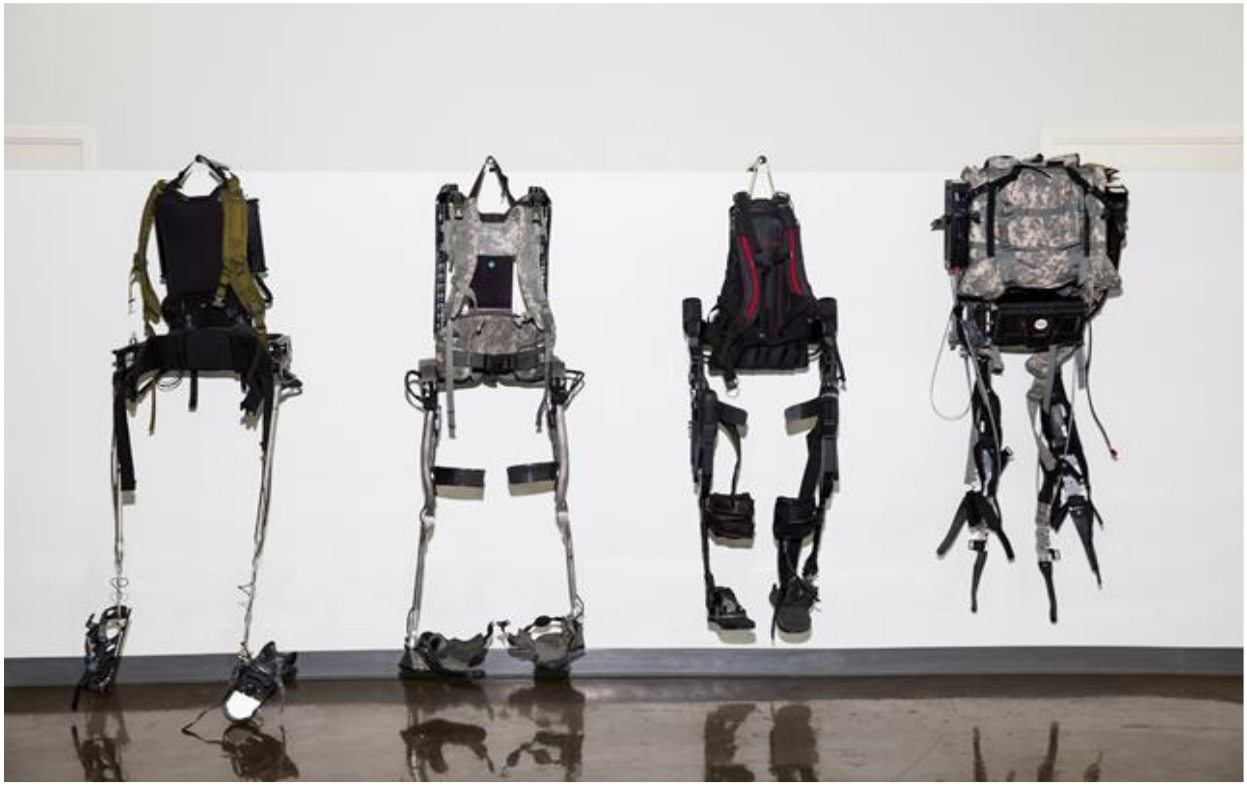
- **Self-healing concrete:** Self-healing concrete uses bacteria as a healing agent to close cracks on concrete and is currently at the proof-of-concept stage.

- **Concrete canvas:** Concrete canvas is formed by adding water to a layer of concrete cloth and then allowing it to set. It is typically used for drains, channels, and passages, and is now available commercially.
- **Topmix permeable:** Topmix permeable is a cement alternative that can absorb 4,000 liters of water a minute and is currently in the early-adoption stage.
- **Aerogel:** Aerogel is a super-transparent, super-insulating material that is 99.9% air.
- **Nanomaterials:** Nanomaterials are super-strong, ultra-lightweight materials that may eventually be a substitute for steel reinforcement in structures and foundations, though they are still in the research stage.

Some of these materials could redefine how projects are conceptualized, designed, and executed. Using these advanced materials along with new construction techniques such as 3D printing, pre-assembled and pre-fabricated structures, and robot-assembled construction, would lead to tremendous cost-savings and increased efficiency. However, adoption has been slow due to a lack of awareness and familiarity within the design and engineering community, a limited supply chain and lack of availability at scale, and risk aversion among project owners and contractors.

For example, despite being available for more than 30 years, ethylene tetrafluoroethylene (ETFE) only gained widespread adoption after it was used to build part of the aquatic building for the Beijing Olympics in 2008. ETFE weighs less than 1% of an equivalent glass panel and costs 24% to 70% less to install.

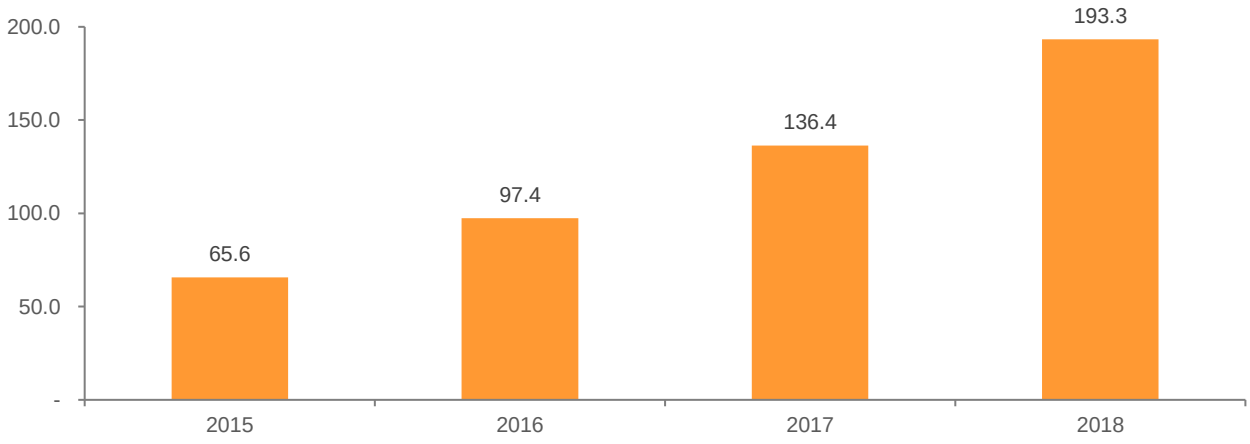
In addition to the technologies related to BIM, AR/VR, and data analytics, start-ups are also building new technologies such as Exoskeletons that enable workers to perform difficult tasks using heavy equipment for longer periods of time with less physical exertion. These wearable suits use motors, braces, and levers to increase the user's strength. **Despite the fact that this technology is still in its nascent stages, a number of start-ups such as Company T and Company U are operating in this space.** These companies offer light-weight designs of exterior scaffolding that can be used by workers in the construction and logistics industry.



Exoskeletons offered by Ekso Bionics; Source: Wired

As per ABI Research analysis, the exoskeleton market is expected to cross $1 billion over the next 10 years, with more than half of the revenue coming from labor intensive sectors such as construction, manufacturing, and logistics.

Global Revenue from Exoskeleton Sales (Reported and Projected)



Source: ABI Research

THE COMPANY'S HIGH PRIORITY SUB-SECTORS

DIGITAL TWIN TECHNOLOGY

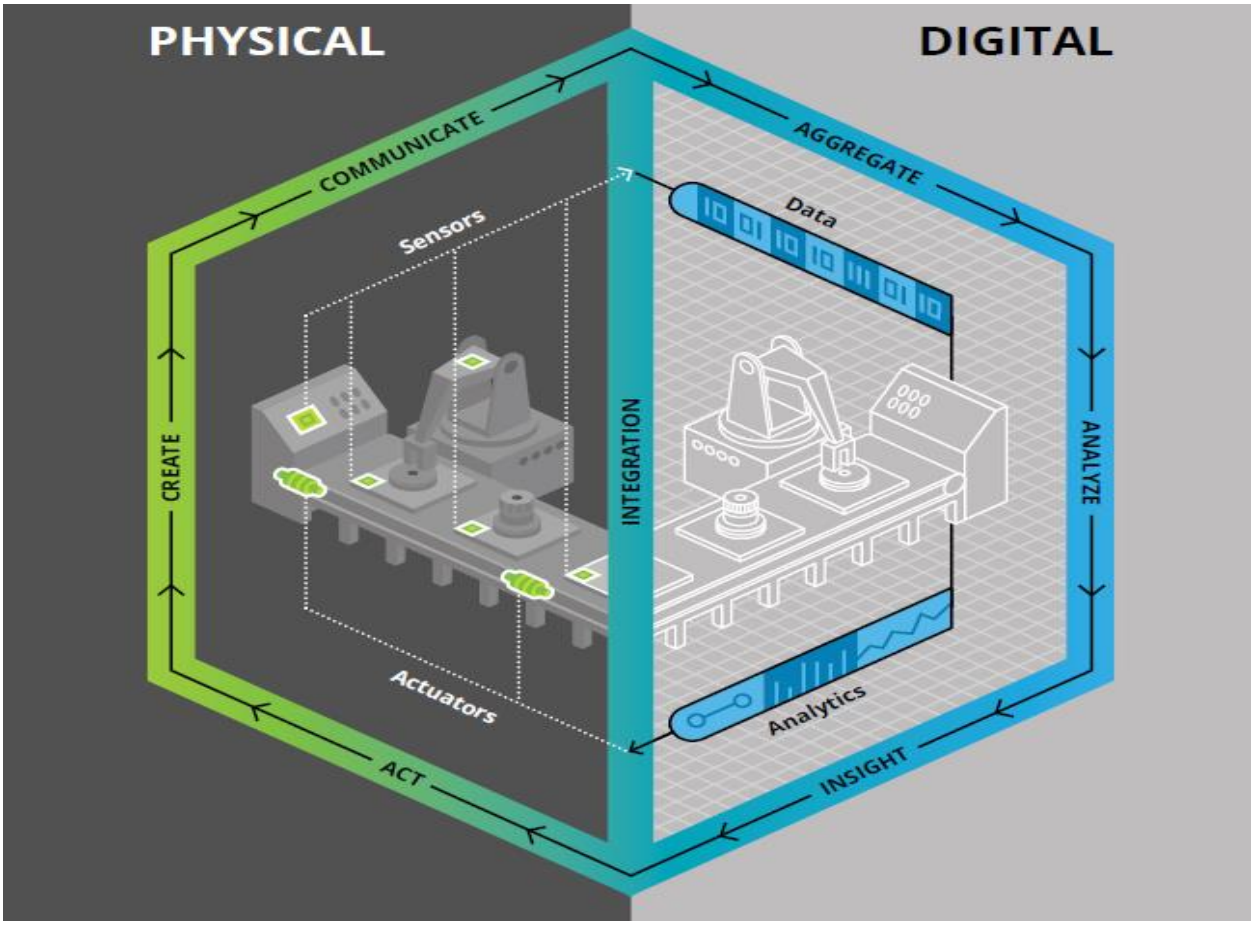
The total size of the digital twin technology market stood at **$1.8 billion in 2016** and is expected to reach **$15.7 billion by 2023**, growing at a robust **CAGR of 37.9%**.[7] The growth in the market will primarily be driven by **increasing adoption of IoT by industrial and manufacturing industries.** According to the global research firm International Data Corporation (IDC), digital twin technology is one of the major technological advancements in which the companies would invest $2.1 trillion by 2019.[8] The use of this technology in the construction sector can lead to savings of up to **$21.3 billion per year in North America.**[9] As per The Company's research, the potential market size for the digital twin technology in North America alone would be **$6.3 billion.**[10]

A digital twin of the job site is an exact digital replica of a physical asset or a process in the digital world. It is built using cumulative, real-time data which creates a digital model of an object or a process, providing intriguing insights on system performance and sometimes leading to adjustments in the design of a system or a process. **Accordingly, the technology enables companies to tackle physical issues by detecting them in the digital model upfront and with a higher degree of accuracy, thereby enabling them to remove inefficiencies.**

The Company is currently evaluating companies in the space. One such company we are looking at is Company C, an industrial IoT company that provides digital twins of projects to its customers to effectively manage industrial and capital projects.

[7] Digital Twin Market by End User and Geography, Coherent Market Insights
[8] Leveraging Digital Twins To Breathe New Life Into Your Products And Services, Digitalist Magazine
[9] Wall Street Research
[10] Base10 Research; (Based on the assumption that construction companies are willing to invest 0.5% of the project size in the digital twin technology)

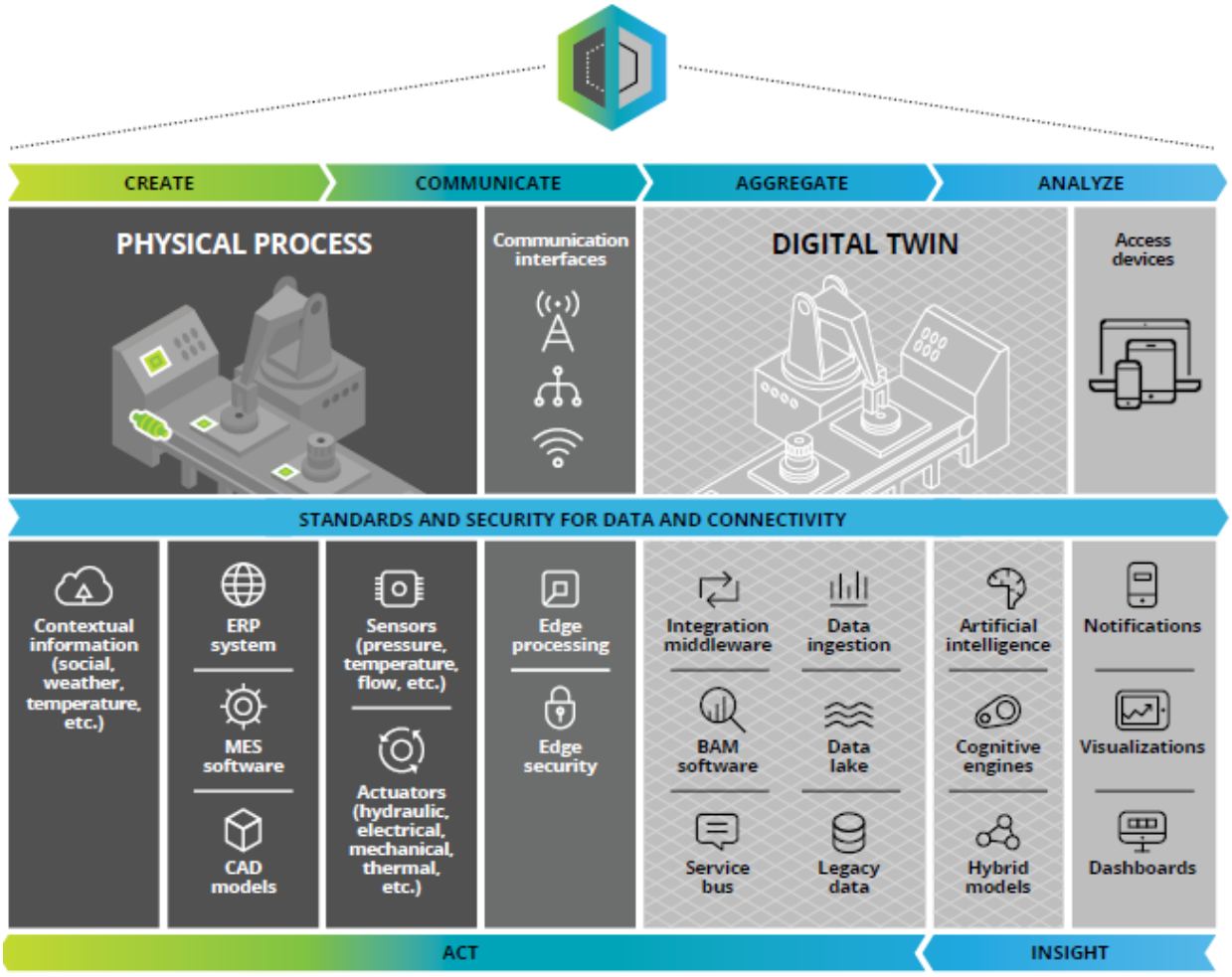
Manufacturing Process Virtualization Model



Source: Industry 4.0 and the digital twin, Deloitte

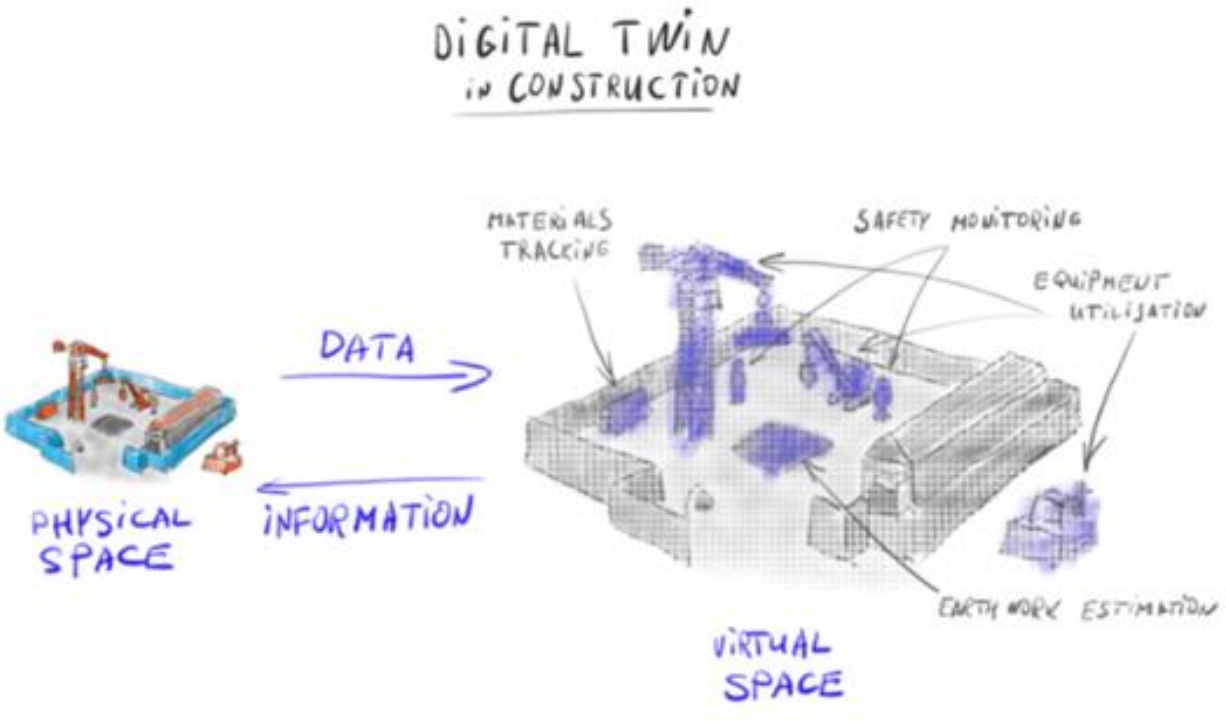
To understand the applications of the digital twin technology in the construction industry, it is best to first understand how a digital twin is created. The creation of a digital twin encompasses two main phases – designing the digital twin and integrating the enabling technology that facilitates exchange of real-time data between the physical asset and the digital model. The data collected by the sensors is used in collaboration with the data collected from the ERP systems and CAD models that enable real-time updating of the data used for analysis.

Digital Twin Conceptual Architecture



Source: Industry 4.0 and the digital twin, Deloitte

Digital twin technology is currently in the early stages of adoption in the manufacturing industry and has already generated a tangible return for its early adopters. It has enabled companies to keep track of events at a granular level. For example, a digital model of a jet engine enables engineers to examine the wear and tear of the engine during the course of operations, helping them with design modifications to increase the efficiency of the engine and providing data for predictive maintenance. **Company V**, a Series B digital twin technology startup that helps manufacturing companies in creating a digital twin of the manufacturing plant by sourcing information through industrial cameras, sensors, automation systems, and other factory systems, has already raised $53.9 million in funding. Another company, **Company J**, uses digital twin technology to provide inventory management solutions to companies in sectors such as manufacturing, oil and gas, and utilities. It has raised $2 million in venture funding to date. **Company K**, a Seed stage startup provides a cloud-based analysis and digital twin creation solutions to the manufacturing and supply chain industries. Another company that The Company is looking at in this space is **Company L**, a Seed stage startup that enables companies to track the project visually and schedule work by using a digital replica of the project.



Source: Advanced Imaging Algorithms in Digital Twin Reconstruction of Construction Sites, intellectsoft

Applications of Digital Twin Technology in Construction:

The possible applications of the technology in the construction space include:

- **Automated Progress Monitoring:** By creating the as-built structure of the building, companies can track the progress of projects and can also compare it to the BIM design model to check for any deviations in the building and rectify the errors in construction. **It also enables companies to automate the tracking of a project by checking the actual percentage of work completed, as the measurements provided by digital twins are more accurate than human estimation.**
- **As-built vs As-designed models:** Digital twin technology enables companies to check for errors in construction by comparing the planned design and the as-built projects. This allows the engineers to detect errors/deviations in the construction of the project, make the required changes to rectify the error, and ensure similar errors do not reoccur.

Source: Advanced Imaging Algorithms in Digital Twin Reconstruction of Construction Sites, intellectsoft

- **Resource Planning and Logistics:** Using a digital twin, construction companies can avoid over-allocation of resources and predict the requirements well in advance.
- **Safety Monitoring and Tracking of Workers:** According to the Bureau of Labor Statistics, c.4,500 construction workers died due to on-site fatalities between 2013 and 2017 in the U.S., making construction one of the most dangerous activities in the world. A digital twin allows companies to track workers' movement and conditions in hazardous areas in real time. Tracking of employees also allows companies to adhere to compliance regulations in countries where it is mandatory to track construction workers at the site.

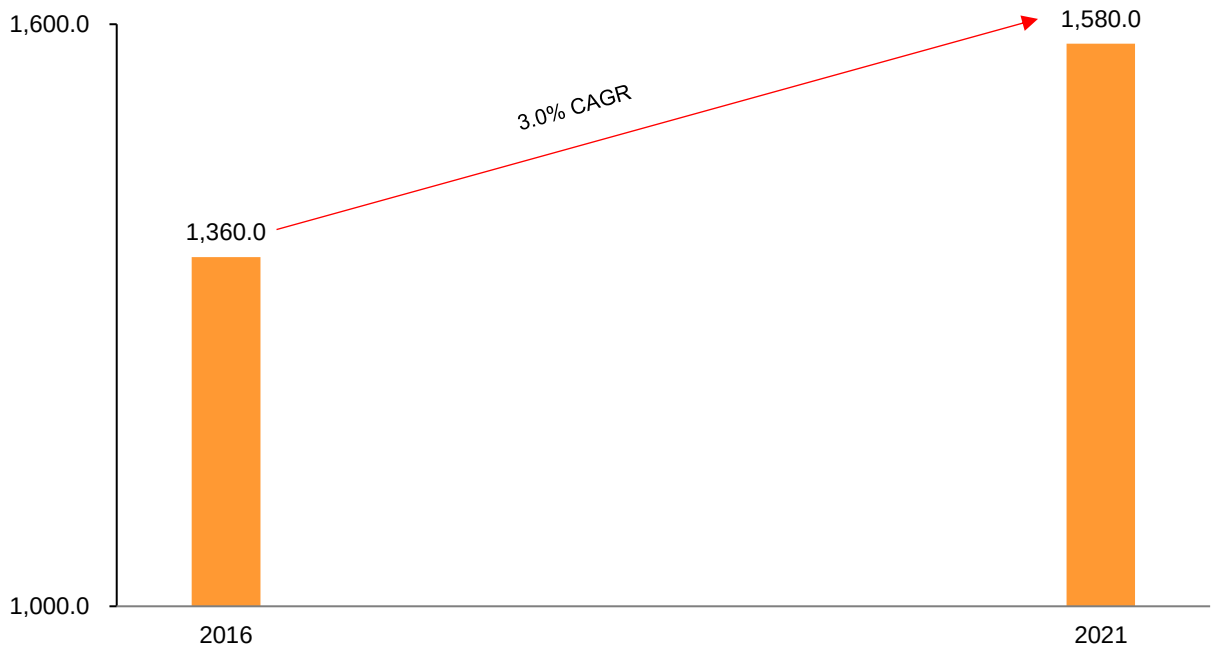
Digital twin technology, when integrated with the payment software system, enables companies to pay contractors on a day-to-day basis and facilitates real-time tracking of construction inventory. It has also reduced the costs of surveying crews on site, as surveying is now done using 3D-scanning, LIDARs, and UAVs/drones. By using digital twins, construction companies can eliminate costs related to survey crews and realize significant cost savings, while easily tracking of the status of the projects and inventory optimization.

Several start-ups have started offering digital twin solutions to the construction industry, including Company C, Company W, and Company R.

CONSTRUCTION MANAGEMENT SOFTWARE

Over the past few years, start-ups and tech companies have been creating software for the construction industry that is changing the management of projects. The software includes collaboration, monitoring and analytics tools amongst others that enable streamlining and optimization of construction operations. The construction project management software market is expected to grow at a CAGR of 3.0% from $1.4 billion in 2016 to $1.6 billion in 2021, while the global project management software market is expected to grow at a CAGR of 9.3% to $6.1 billion between 2017 and 2025.

Global Construction Management Software Market Size Estimate (in $ mn)



Source: Transparency Market Research

According to Aconex's 2016 survey of more than 70 US-based firms that handle projects ranging from under $10.0 million to over $100.0 million:

- More than 40% report difficulty finding information, tracking issues, and holding subcontractors and partners accountable.
- Nearly 60% are challenged by poor communication and collaboration between project owners, contractors, and consultants.
- For over 33%, a lack of correct information leads to mistakes, delays, and rework that end up costing them money.

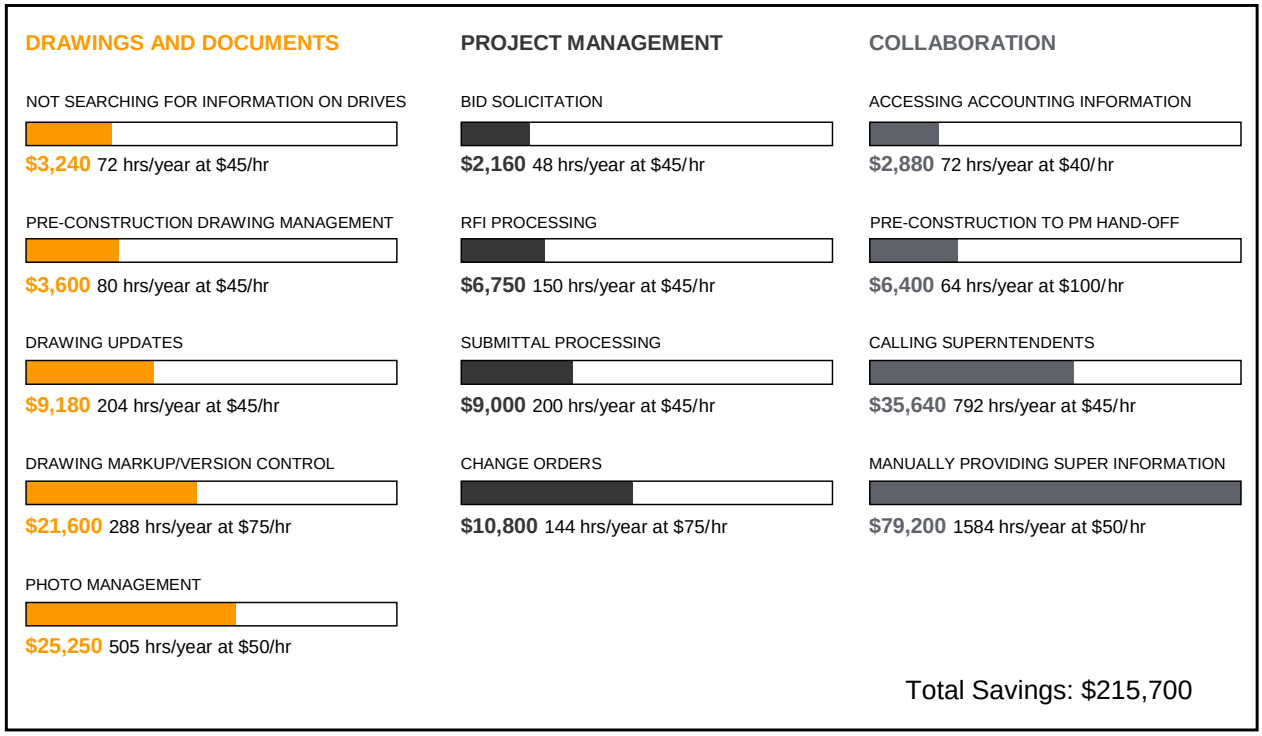
Construction companies have been generating and handling large amounts of paperwork, which is time-consuming and subject to misplacement and errors. Digitization streamlines the entire documentation process, enabling teams to generate submittals, RFIs, transmittals and other relevant documents by using their own standardized templates and uploading them to a centralized Cloud-based platform, resulting in better management and ease of access through a virtual directory.

On the execution front, changes on-ground can be recorded in real-time on the platforms, enabling project managers and all the other stakeholders to monitor the progress and adapt to new scenarios that come up during construction. Through software, changes in plans can be communicated to all teams efficiently, which saves time and keeps all stakeholders well-informed.

Analytics tools using AI and machine learning provide managers with optimization solutions to organize budgets and timelines, increasing the overall efficiency of construction work. The tools also facilitate risk management through the use of predictive analytics.

Construction management software provides benefits across multiple points in the project lifecycle, which is estimated to save $215,700 annually in expenses for a customer.

Cost Savings achieved using Construction Management Software



Source: Procore Technologies Case Study

Among the industry players, **Company S**, a provider of a cloud-based construction management solutions, has emerged as a market leader. Their solutions include a bidding platform with analytics to evaluate vendors, a platform where drawings can be uploaded with overlays for comparison, collated emails and meeting minutes, scheduling tools, and document management tools for RFIs, submittals, and transmittals. **Company M** and **Company X** are close competitors of Procore in terms of industry leadership. Companies such as **Company Y** also provide a platform that uses images taken on-site to create a timeline to track progress, which can be viewed by all teams. The tools also enable generation of customized reports for tasks within the project. **Company G** provides bid management software that enables general contractors to send project invites, compare bids, and select qualified subcontractors on the same platform. Another company, **Company Z**, provides algorithms that automatically index stored data and establish patterns and relationships that can be used to put information into context when viewed by different teams. **Company F** provides reporting solutions using voice-to-text technology that enables field workers to capture on-site data in near real-time. **The Company has spent a lot of time with Company A, which is a provider of a cloud-based reporting platform for the construction industry. The company provides an application for daily reporting, document managing, and analytics for construction-related tasks.**

CONSTRUCTION TECHNOLOGY LANDSCAPE

In the first half of 2017, there were at least 25 deals in the construction technology space with a combined value of approximately $169 million. Start-ups are coming up across segments, including field equipment management, construction products marketplaces, mobile and cloud technologies, artificial intelligence and robotics, augmented reality and virtual reality, and CAD software.

In terms of closed deals, the construction technology market is still at a nascent stage and has attracted good investor interest over the years. 2015 was a record year for smart money VC investment in the construction technology industry, with 15 deals worth approximately $414 million, in line with total VC funding of $425 million across 59 deals.[11] The funding increase was driven in part by an increase in average deal size to mid- and late-stage deals, as a result of multiple investment rounds for CAD software provider Onshape ($80M Series D) and drone company 3D Robotics ($50M Series C), among others

THE COMPANY'S PRIORITY RANKING OF STARTUP LANDSCAPE

When determining the construction technology start-up landscape from The Company's point of view, we initially reviewed several hundred start-ups that could be categorized as construction technology start-ups. The list below contains early stage, seed stage, and Series A start-ups of high interest to The Company, as well later stage start-ups that are well positioned in the industry and have good investors and/or significant momentum. We also concentrated on companies based in the US; however, we still have high interest in and have listed several companies based outside the US. Our priority ranking methodology is below:

The Company's priority 1 start-ups	The Company's priority 2 start-ups	The Company's priority 3 start-ups	The Company's low / no priority
Pre-Series A stage start-ups in US or Canada and in an industry subsector of high interest to The Company	Series A stage start-ups in US or Canada in an industry subsector of high interest to The Company, or;	Seed or Series A stage companies in industry subsector of medium interest to The Company , or;	Series B and later start-ups, or;
	Pre-Series A stage start-ups outside of the US or Canada in an industry subsector of high interest	Series A stage start-ups outside of US or Canada in an industry subsector of high interest to The Company , or;	Series A start-ups with >$xxxM raised, or;
		Pre-Series A stage start-ups that are Company C / Company A competitors	Series A start-ups that are competitors to Company C / Company A, or;
			Seed companies in subsectors of little interest.

The list follows below.

[11] Where Smart Money VCs Place Bets in Construction Technology, CBInsights

Company	Industry Sub Sector	B 10 Priority	Location	Stage	Funding	Notable Investors	Short Description
Company 1	Construction Management Software	1	Location A	Angel	xx.x	NA	Provides construction management software that enables file sharing, document management, contact management, messaging, reporting, and collaboration.
Company 2	Construction Management Software	1	Location B	Series A	xx.x	Investor A	Develops software to help with labor and equipment time tracking for construction companies.
Company 3	Construction Management Software	1	Location C	Accelerator/Incubator	xx.x	Investor B	Provides mobile work tracking for construction teams.
Company 4	Construction Management Software	1	Location D	NA	xx.x	NA	Provides a cloud platform that helps to easily synchronize internal departments, systems, products as well as project participants.
Company 5	Construction Management Software	1	Location E	Later Stage	xx.x	Investor C	Provides a cloud-based tool for contractors in commercial construction with the ability to share digital blueprint plans and collaborate in real time.
Company 6	Construction Management Software	1	Location F	Series A	xx.x	Investor D, Investor E	Provides a cloud-based mobile and web construction software enabling real-time collaboration.
Company 7	Construction Management Software	1	Location G	Angel	xx.x	NA	Provides a web-based home builder software to optimize communication between the residential builders, their customers, vendors, and subcontractors.
Company 8	Construction Management Software	1	Location H	Angel	xx.x	NA	Provides a platform for online payments designed to ease payments in the construction sector.
Company 9	Construction Management Software	1	Location I	NA	xx.x	Investor F	Provides integrated home builder application for supply chain management, collaboration and scheduling solutions.

Company	Industry Sub Sector	B 10 Priority	Location	Stage	Funding	Notable Investors	Short Description
Company 1	Construction Management Software	1	Location A	Series A	xx.x	Investor A	Provides construction management solutions such as daily reporting, sub-contractor reporting, and contractor reporting.
Company 2	Construction Management Software	1	Location B	Accelerator/Incubator	xx.x	Investor B	Provides building Internet-of-things technology for construction and mining industries.
Company 3	Construction Management Software	1	Location C	Seed	xx.x	Investor C	Develops safety sensors for construction that notify the workers of breaches.
Company 4	Internet of Things	1	Location D	Accelerator/Incubator	xx.x	Investor D	Provides digital twin solutions and real-time access to frac data.
Company 5	Internet of Things	1	Location E	Seed	xx.x	Investor E	Provides cloud-based SaaS construction analytics.
Company 6	Data Analytics	1	Location F	Seed	xx.x	Investor F	Provides predictive computer vision data analytics for construction sites.
Company 7	Internet of Things	1	Location G	Seed	xx.x	Investor G	Provides digital twin solutions to construction and capital projects.
Company 8	Construction Management Software	2	Location H	Accelerator/Incubator	xx.x	Investor H	Provides a construction management web and mobile app enabling communication between engineers and project managers.
Company 9	Internet of Things	2	Location I	Series A	xx.x	Investor I	Provides autonomous software using sensor technology to manage construction equipment.

Company Logo

Company	Industry Sub Sector	B 10 Priority	Location	Stage	Funding	Notable Investors	Short Description

Company Logo

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Company	Industry Sub Sector	B 10 Priority	Location	Stage	Funding	Notable Investors	Short Description

Company Logo

Company	Industry Sub Sector	B 10 Priority	Location	Stage	Funding	Notable Investors	Short Description

Company Logo

COMPARABLES

COMPARABLE COMPANIES

As of

Company Name	Ticker	Share Price $	Market Cap $M	EV $M	Revenue $M (LTM)	Rev Growth	Gross Profit $M (LTM)	GPM	EBITDA $M (LTM)	EV / Rev	EV / GP	EV/EBITDA
Construction Companies												
Company 1										0.93x	6.2x	18.8x
Company 2										1.34x	7.1x	14.9x
Company 3										0.35x	11.1x	12.6x
Company 4										1.19x	1.6x	16.1x
Company 5										0.65x	5.1x	10.4x
Company 6										0.46x	12.8x	11.0x
Company 7										0.58x	3.9x	10.9x
Company 8										0.79x	6.3x	9.7x
Company 9										1.2x	5.6x	8.8x
Company 10										1.32x	2.5x	12.2x
Company 11										1.62x	6.9x	16.5x
Company 12										0.68x	8.1x	6.4x

Company Name	Ticker	Share Price $	Market Cap $M	EV $M	Revenue $M (LTM)	Rev Growth	Gross Profit $M (LTM)	GPM	EBITDA $M (LTM)	EV / Rev	EV / GP	EV/EBITDA
Company 13										6.62x	20.0x	27.9x
Company 14										0.75x	7.3x	12.1x
Company 15										1.92x	7.0x	17.1x
	Min									0.35x	1.6x	6.4x
	Median									0.86x	6.9x	12.4x
	Average									1.37x	7.4x	14.1x
	Max									6.62x	20.0x	27.9x

Company Name	Ticker	Share Price $	Market Cap $M	EV $M	Revenue $M (LTM)	Rev Growth	Gross Profit $M (LTM)	GPM	EBITDA $M (LTM)	EV / Rev	EV / GP	EV/EBITDA
Construction Technology Companies												
Company 1										9.2x	11.4x	NM
Company 2										NM	17.2x	NM
Company 3										NM	14.7x	29.7x
Company 4										3.4x	6.8x	21.4x
Company 5										5.8x	8.2x	23.9x
Company 6										7.7x	81.4x	NM
Company 7										7.1x	12.9x	23.5x

Company Name	Ticker	Share Price $	Market Cap $M	EV $M	Revenue $M (LTM)	Rev Growth	Gross Profit $M (LTM)	GPM	EBITDA $M (LTM)	EV / Rev	EV / GP	EV/EBITDA
Company 8										NM	20.4x	NM
Company 1										NM	NA	NM
Company 2										3.3x	3.8x	17.9x
Company 3										1.7x	2.6x	NM
	Min									1.7x	2.6x	17.9x
	Median									5.8x	12.2x	23.5x
	Average									5.5x	17.9x	23.3x
	Max									9.2x	81.4x	29.7x

Company Logo

CONSTRUCTION TECHNOLOGY INDUSTRY

TOP 10 CONSTRUCTION DEALS IN 2018 YTD

Announced	Target Name	Acquirer Name	Status	Deal Value $B

TOP 10 CONSTRUCTION DEALS IN 2017

Announced	Target Name	Acquirer Name	Status	Deal Value $B

Company Logo

TOP 10 CONSTRUCTION DEALS IN 2016

Announced	Target Name	Acquirer Name	Status	Deal Value $B

TOP CONSTRUCTION TECHNOLOGY DEALS IN 2018 YTD

Announced	Target Name	Acquirer Name	Status	Deal Value $M

TOP CONSTRUCTION TECHNOLOGY DEALS IN 2017

Announced	Target Name	Acquirer Name	Status	Deal Value $M

TOP CONSTRUCTION TECHNOLOGY DEALS IN 2016

Announced	Target Name	Acquirer Name	Status	Deal Value $M