THE 5TH ANNUAL
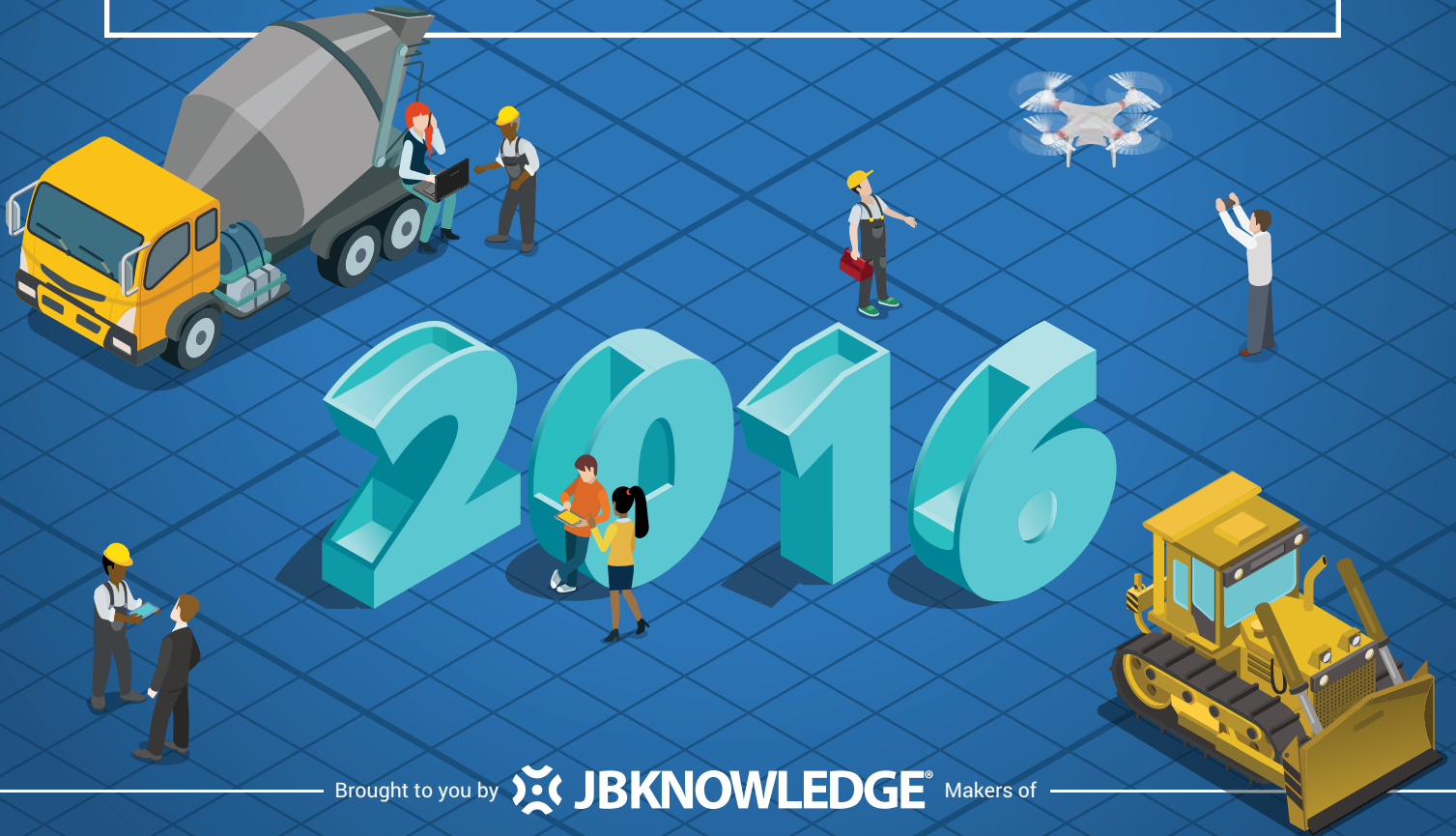# CONSTRUCTION TECHNOLOGY REPORT

2016

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CONSTRUCTION FINANCIAL MANAGEMENT ASSOCIATION
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Mechanical Contractors Association of America

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TEXAS A&M UNIVERSITY

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ABOUT THE SURVEY

452
Survey Participants
June 2012

706
Survey Participants
July 2013

1,028
Survey Participants
June 2014

2,044
Survey Participants
July 2015

2,604
Survey Participants
July 2016

In 2012, we conducted the first annual Construction Technology (CT) Survey to gain a better understanding of the trajectory of technology in the construction industry. Since then, we've been able to map that trajectory year by year and share our insight with the professionals who need it most. **In our 15 years of working with construction companies, we've found that most AEC companies lack the resources to research, analyze and benchmark their technology usage.** The goal of this survey is to fill that gap and provide valuable insights on cloud adoption, data security, software integration, mobile policies, IT budgeting, emerging technologies and ultimately the role of technology in construction companies.

This year, JBKnowledge conducted the fifth annual Construction Technology Survey in partnership with the Mechanical Contractors Association of America (MCAA), the Construction Financial Management Association (CFMA), and Texas A&M University's Department of Construction Science. **Over 2,600 industry professionals responded to the survey between June 20, 2016 and August 1, 2016.**

The survey was distributed to over 50,000 construction industry professionals via email, social media, online publications and anywhere else we could share it. It is important to note that a statistically

relevant number of respondents are users of our JBKnowledge products, therefore statistics involving mobile apps and invitation to bid software may be skewed. Every year, we make significant efforts to distribute this survey to as broad of an audience as possible to mitigate any statistical bias and get a true representation of the construction industry.

On all questions with answer choices that were not simply "Yes/No" or a ranking system, survey respondents could select multiple answers. Many companies use a combination of software and mobile apps that varies across offices and locations. **For this reason, only percentages that are displayed in a pie graph will add up to 100%.**

Lastly, it is important to note that 2,604 total responses were logged for this survey. However, to ensure statistical relevance and the highest quality data, 735 of those responses were removed or disqualified for one of the following reasons: 1) The participant was a CPA, consultant, educator, services or technology provider who could not provide relevant feedback on how the solutions and strategies mentioned are used in construction operations; 2) The participant did not provide enough answers to hold statistical significance; 3) The participant submitted unreliable or irrelevant answers, (i.e. answering every question with C, even when it wasn't multiple choice.)

This report reveals the comprehensive results from the 2016 survey with commentary and analysis from the perspective of a construction technology consulting and solutions provider. As we develop the 2017 survey, we encourage you to send us your feedback. We are also happy to provide excerpts and graphs for re-print upon request. Any re-print of the contents of this report without permission from JBKnowledge is a copyright violation. You can send any re-print, press, or other inquiries directly to me. My information is below and I look forward to your feedback. Thanks for nerding out with us!

Editor-In-Chief

Liz Welsh
Marketing Director, JBKnowledge, Inc.
liz@jbknowledge.com

FOREWORD

Howdy!

First, thank you to every construction professional who took 10-15 minutes from their day to complete this survey. **We believe that this report will be well worth your time and trust that you'll let us know if it is not.**

We started this survey with a strong desire to understand the construction industry's affinity for technology. We wanted to know how builders evaluate technology, how they pay for it, how they use it, and how it affects their projects. **To have over 2,600 builders share their experience with us in the fifth year is more than we could have hoped for**, and having partner organizations like MCAA, CFMA and Texas A&M University's (Whoop!) world-renowned Construction Science Department add reach, diversity and credibility to the distribution and publication of the report is more than we deserve.

Every month, I talk with a ton of construction professionals. I speak at their events, consult on their IT strategy, attend their organizational conferences, but mainly I pick their brain any time I can get them in a room. As a hard-core IT nerd, my days are driven by a fascination with technology and the potential it holds to make our lives and our work better. **I got into construction tech because there aren't many other industries more in need of and ready for transformation by technology.**

As one of the oldest industries, it's not hard to comprehend why construction is slow to "believe" in tech. After all, the Pyramids at Giza, the Empire State Building and many of our world's most iconic structures were built without bid software or BIM. **Who cares that you now have more computing power in a $500 device than a $100,000 device in the '80s?**

This report helps us understand that the issue isn't necessarily that builders don't see the need for tech, it's just hard to compute the return. Technology is an expense, it's yet to be viewed as a value-add. So as you read this year's report I challenge you to think about the success metrics most important to your company, whether that's profit margin, employee retention, new project sales volume, or something else. Consider the hard costs (i.e. paper, ink), soft costs (i.e. time at work and home), and mistakes (i.e. change orders) that impact those metrics. Then consider the technology in this report that can reduce those costs, and with proof, can then be bundled into pricing on projects for cost recovery. I think with that in mind you'll find a technology strategy start to formulate on its own in your head.

While this year's report showed IT spending lower than ever, staffing still abysmal, and spreadsheets still rearing their ugly heads, I see a glimmer of hope in the increase of survey respondents with a R&D budget. They are using a small speculative budget to hire staff, or interns, or enlist the IT guy with a little extra time to analyze costs and propose how tech can reduce them. **They're finding someone who gets excited about tech to do the research and present the facts on what can be improved with their technology, and it's making all the difference.**

Some other highlights you'll see in this year's report are more BIM, better mobile apps, incredible drone systems, job site scanners and sensors, and some seriously snarky comments from survey participants that are tired of tech providers "promising" integration and tired of not knowing how their company's IT budget is set.

Every year, we have many objectives for this report. 1) We aim to jumpstart the construction newbie who has no idea where to start. 2) We hope to inspire the seasoned veterans to fight complacency. 3) We want technology providers to see the opportunities and weaknesses of what we're bringing to the table. **And finally, 4) We want to encourage you, the individual construction professionals around the world, to nerd out.** Because technology doesn't have to be the scary 'expense we don't talk about' on the budget, nor the nuisance that keeps us glued to our phones. Technology can be the key differentiator in our quality of life at work and at home.

Now get past the foreword already.

Thanks & keep geeking out,

James M. Benham
CEO, JBKnowledge, Inc.
jamesbenham.com

Survey Participants

Learn about the companies and professionals who participated in the 2016 Construction Technology Survey.

COMPANY DEMOGRAPHICS

PRIMARY INDUSTRY

Industry	Percentage
Commercial	71.8%
Residential	17.1%
Industrial	16.8%
Transportation	11.4%
Waste Management	10.3%
Power	10.2%
Manufacturing	9%
Land Development	6.3%
Oil & Gas	5.7%
Telecommunications	4.5%
Construction Services Provider	4.2%
Construction Technology Provider	3.7%
Educator or Student	2.1%
Hazardous Waste	1.1%
Other	14.4%

COMPANY TYPE

Type	Percentage
Contractor/Construction Manager	58%
Subcontractor/Material Supplier	27.4%
Architectural/Engineering/Design	4.3%
Owner/Developer	2.8%
Other	6.7%

This year survey respondents came from many industries including commercial, industrial, transportation, waste management, power and manufacturing. **The majority, over 70%, build in Commercial Construction, and 58% of those identify as a Contractor/Construction Manager.** Subcontractor/Material Supplier formed the next largest company type. Highway and electrical were frequent "Other Industry" write-ins, which fall into transportation and power, showing the industry has a prominent, but not completely cohesive naming standard for sectors. The number of surveyed companies operating within the commercial and residential sectors increased in the last year, while transportation took a downward trend from 22.6% to 16.8%. Those building in the Commercial sector were most likely to also build in the Residential or Industrial sectors if building in more than one sector.

Thanks to survey partner, MCAA, this survey reached a wide audience of mechanical contractors involved in heating, air conditioning, refrigeration, plumbing, piping, and mechanical services. Due to their heavy involvement, survey results may have been influenced, which explains the majority of "Other Company Type" write-ins containing trade subcontractors. **Their members are also likely to have led the downward trend in the Contractor/Construction Manager type and the 9% upward trend in Subcontractors.**

SCALE OF OPERATIONS

YEARS IN BUSINESS

1%
4.4%
5.9%
12%
37.5%
39.2%

- Less than 1 year
- 1-5 years
- 6-10 years
- 11-20 years
- 21-50 years
- 50+ years

RANGE OF WORK

3.1%
13.1%
27.8%
23.5%
32.5%

- Local
- In-State
- Regional
- National
- International

PRIMARY AREA OF WORK
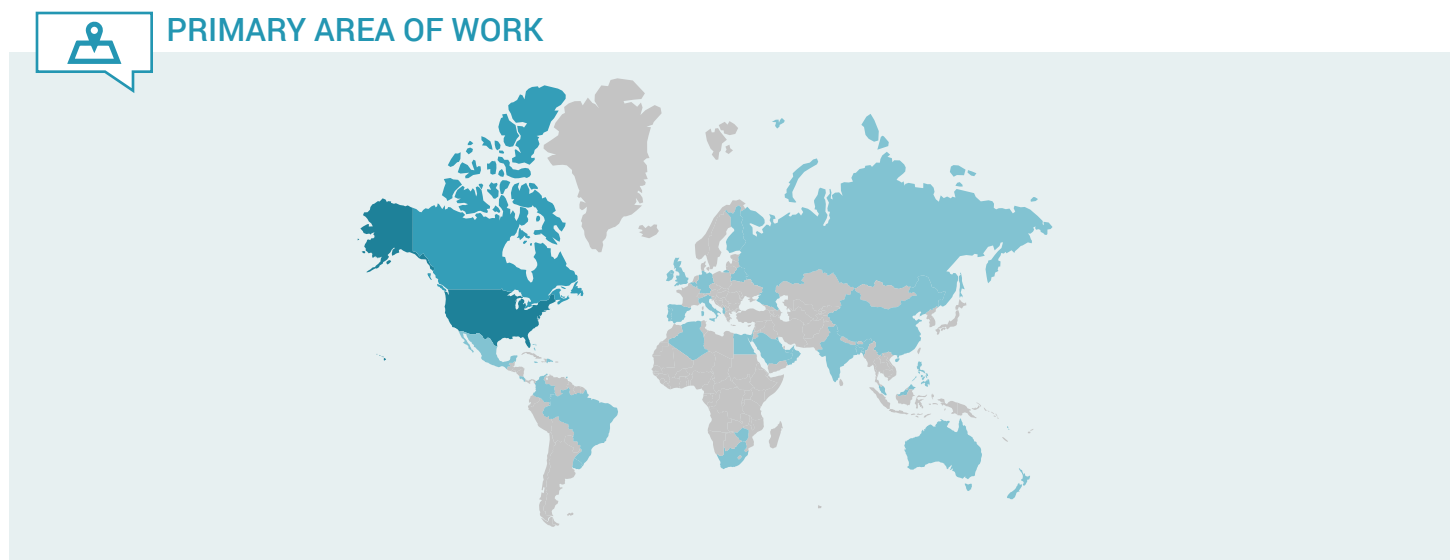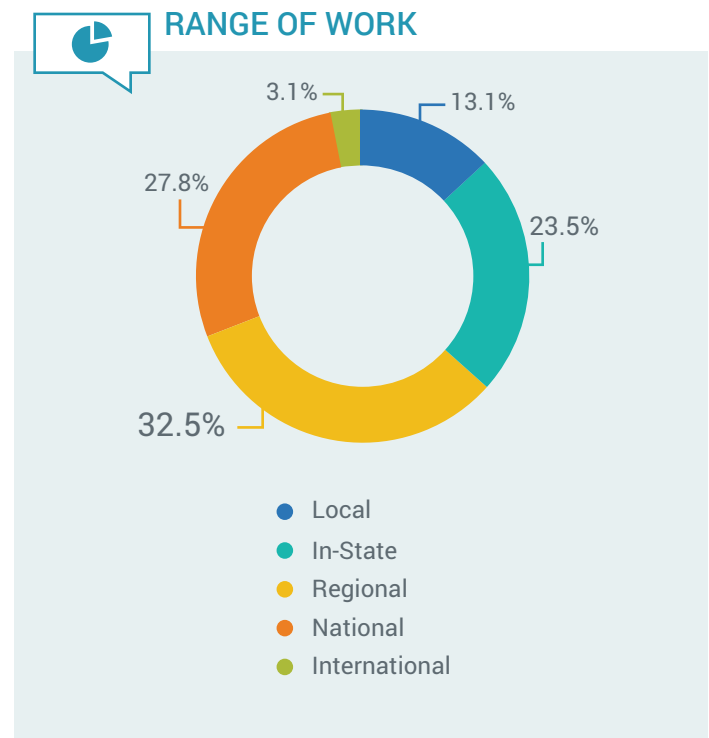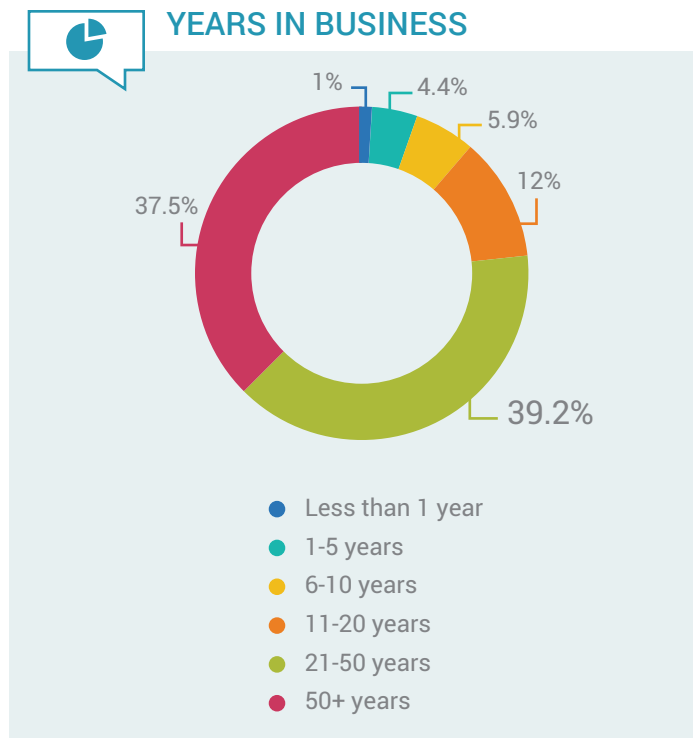
Over 75% of surveyed companies have been in business over 20 years, reinforcing the fact that construction is one of the oldest industries. Construction isn't an industry ripe for startups, even if construction technology is. As expected, a majority of surveyed companies, over 90%, build primarily in the US. 4% operate in Canada, and the rest were scattered from Brazil to Israel to Singapore. Most of the companies build regionally or nationally, few internationally, which is understandable due to high investment costs and diverse policies, procedures, and resources required to design and build abroad.

SIZE OF COMPANY

0.8% 5.4% 9.8% 13.9% 15% 8.5% 16.5% 14.3% 15.8%

- 1-5 employees
- 6-20 employees
- 21-50 employees
- 51-100 employees
- 101-200 employees
- 201-500 employees
- 501-1,000 employees
- 1,000+ employees
- I don't know

ANNUAL SALES VOLUME

1.6% 5.9% 7.3% 8.8% 9.6% 9.2% 19.5% 16.8% 21.3%

- Less than $1 Million
- $1-5 Million
- $6-20 Million
- $21-50 Million
- $51-100 Million
- $101-200 Million
- $201-500 Million
- $500+ Million
- I don't know
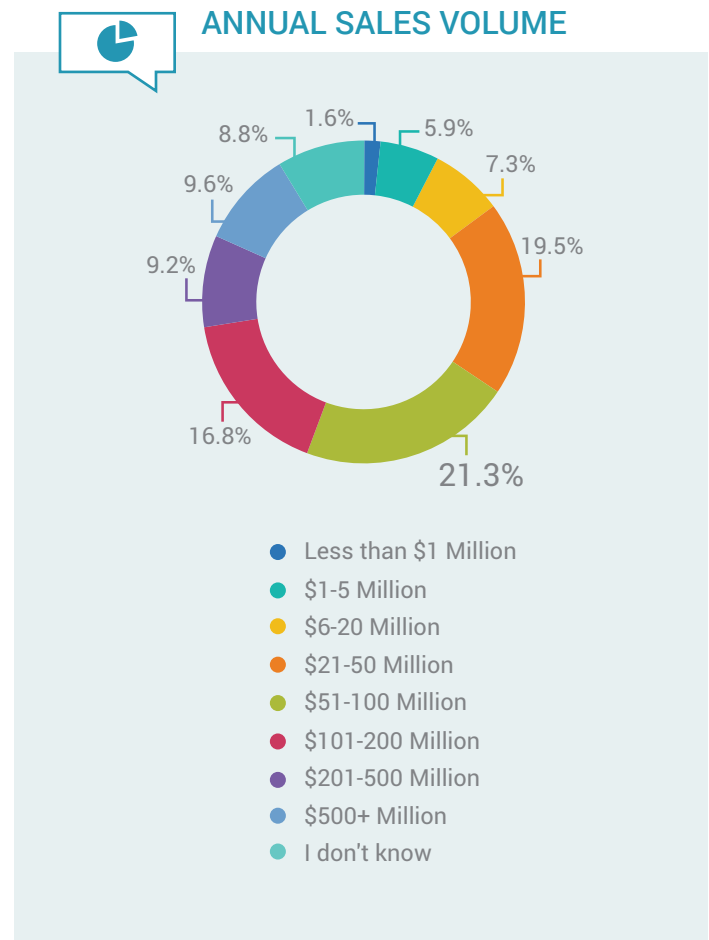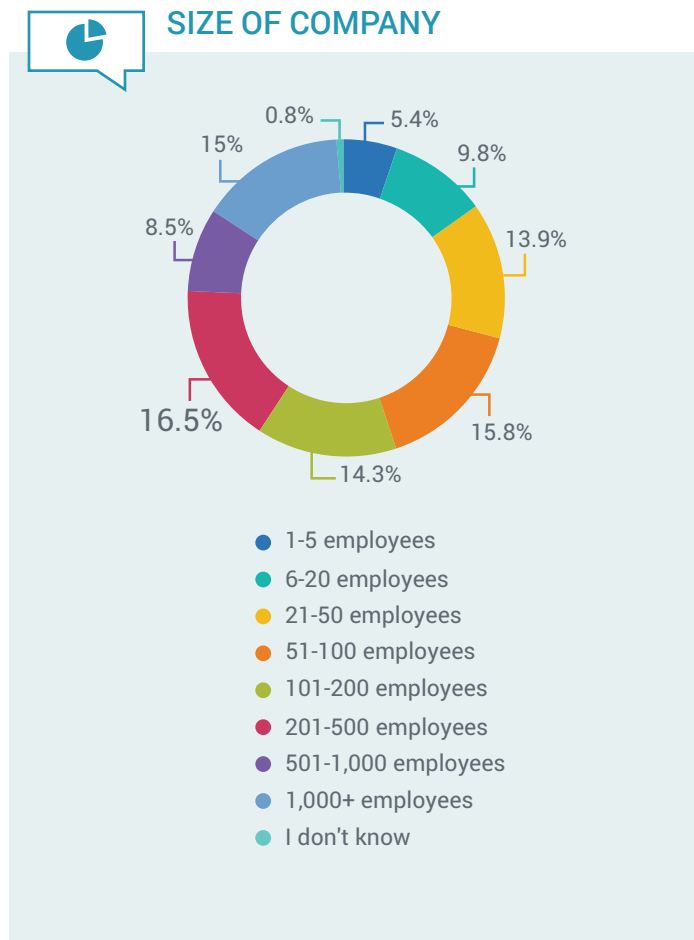
Over 40% of the construction professionals surveyed work for companies with over 200 employees, 27.6% of them with a sales volume of above $100M per year. Companies experienced a downward trend from 2015 on the size by sales volume, with a bulk of participants earning less than $100M this year. The shift to more subcontractors in the survey population likely caused the annual sales volume drop. Interestingly, company size did not change significantly in the last year.

INDIVIDUAL DEMOGRAPHICS

PRIMARY ROLE

Role	Percent
Executive	30%
Accounting	26.1%
Estimator	23%
Project Manager	20%
IT Staff	17.3%
Owner/Principal	15.5%
Preconstruction Manager	10.8%
Risk Manager	8.9%
Safety Manager/Coordinator	7.4%
Quality Assurance/Quality Control	7%
Project Engineer	6.5%
BIM/VDC Manager	5.6%
Project Supervisor/Foreman	5%
BIM/VDC Specialist	3.7%
Equipment Manager	3.6%
Design Engineer	3.4%
Draft Person (CAD/BIM)	3.3%
Architect	2.3%
Fabrication Shop Manager	1.3%
Other	12.7%

Other includes:
• IT Director
• Business Development

The demographics section of the 2016 survey changed significantly compared to previous surveys. This year's survey respondents were presented with new answer choices, and asked entirely new questions to gain further insight into answer choices. The largest number of survey respondents identified their primary role as an Executive. **In 2016, less chose Estimator and Project Manager, while more classified as Executive, Accounting, IT Staff and Owner/Principal.** Thanks to survey partner CFMA, this survey reached a wide audience of decision makers in a financial role.

AGE RANGE

23.4%
22%
54.6%

● Born in the '40s - '50s
● Born in the '60s - '70s
● Born in the '80s - '90s

GENDER

20.6%
79.4%

● Male
● Female

DO YOU PERFORM AN IT ROLE?

17.6%

48.4%

34%

- No
- Unofficially, yes.
- Officially, yes.
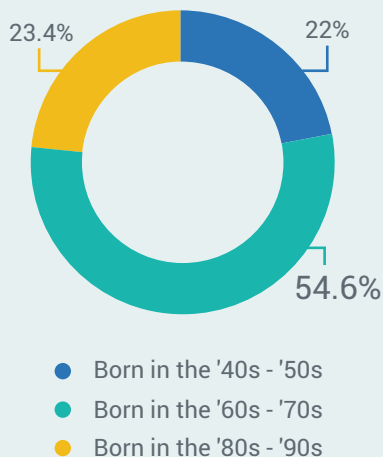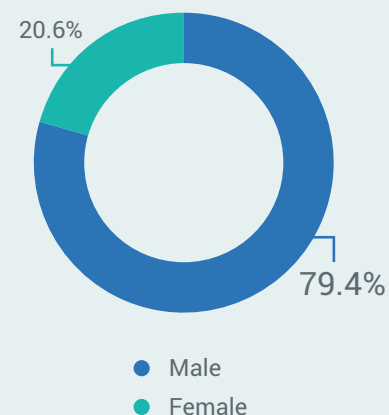
Survey Participants Commented:

"As a millennial, I'm everyone's first stop for IT problems before submitting a help ticket."

"Most technologically capable employee, thus I perform a lot of immediate IT needs when our consultant is not involved (for small-scale issues)."

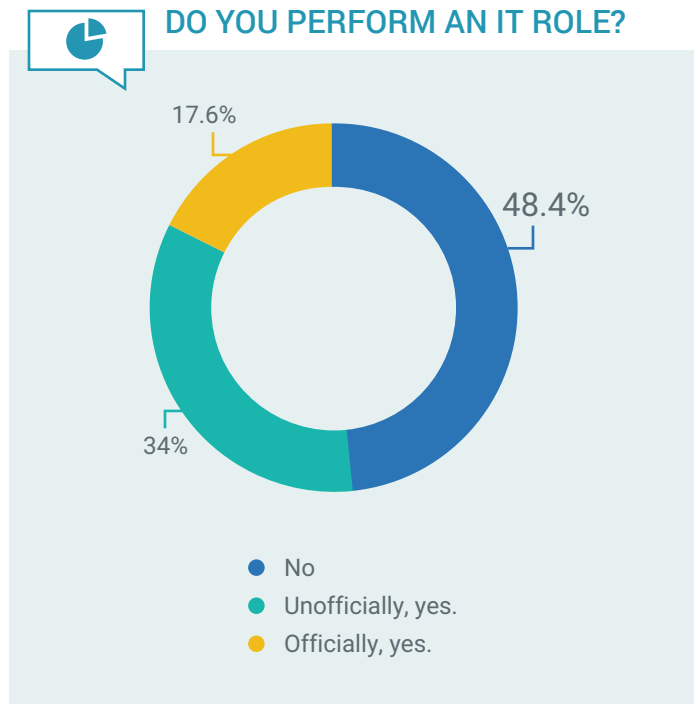**Age range was added to the 2016 survey and more than 50% of those surveyed were born in the 60s-70s, which is consistent with the seniority required of the most prominent staff roles.** In order to more deeply analyze industry demographics, a question on gender was added to this year's survey. Females made up 20% of the survey population, which interestingly differs from the 2015 federal labor force statistics figure of 9.3%. Nearly 50% of the participants do not perform an IT role and another 34% fill an IT related role, although unofficially. Only 17.6% of the over 2,600 construction professionals who took the survey perform an official IT role. **Since a majority of the survey participants do not fill an official IT role, their participation signals a positive shift in the focus/curiosity of professionals on technology.** However, it unfortunately doesn't show any more formalization of IT roles or departments from previous years.

IT Budget

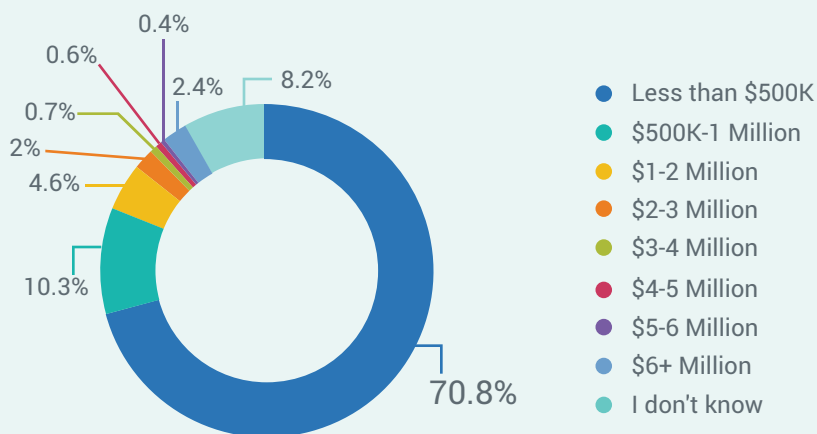Learn how construction companies are budgeting for IT resources.

ANNUAL IT SPEND

Donut chart showing Annual IT Spend:
- Less than $500K — 70.8%
- $500K-1 Million — 10.3%
- $1-2 Million — 4.6%
- $2-3 Million — 2%
- $3-4 Million — 0.7%
- $4-5 Million — 0.6%
- $5-6 Million — 0.4%
- $6+ Million — 2.4%
- I don't know — 8.2%

First and foremost, it's important to note the quantity of "I don't know" responses throughout this section. It is notable because only survey participants who identified as staff involved with executive budgeting decisions, financial management or accounting received these questions.

The largest amount of those surveyed spend less than $500,000 per year on IT. **Digging deeper into the responses revealed that IT spend only increased to over $500,000 when the company's annual sales volume was higher than $200 million.**

PERCENTAGE OF ANNUAL SALES VOLUME SPENT ON IT

Donut chart showing Percentage of Annual Sales Volume Spent on IT:
- Less than 1% — 55.9%
- 1% — 14.1%
- 2% — 7%
- 3% — 2.8%
- 4% — 1.1%
- 5% — 2.2%
- 6% — 0.2%
- More than 7% — 1.9%
- I don't know — 14.8%
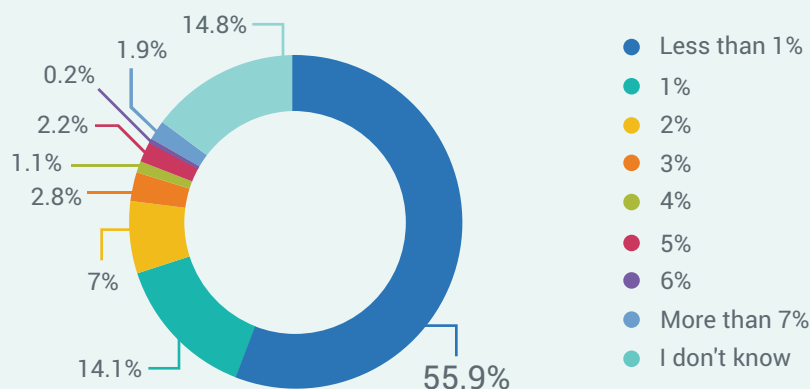
The percentage of companies spending 1% or Less than 1% of annual sales volume on IT continues to grow, from 45% in 2015 to 70% in 2016. These statistics correlate with the data gathered from JBKnowledge consulting clients, in that despite the proliferation and improvement of technology, companies are still not allocating budget to employ it. This also supports the fact that the construction

industry underspends cross-industry averages in regards to technology by upwards of 60% to 70%. Survey results show that despite the majority of participants being Con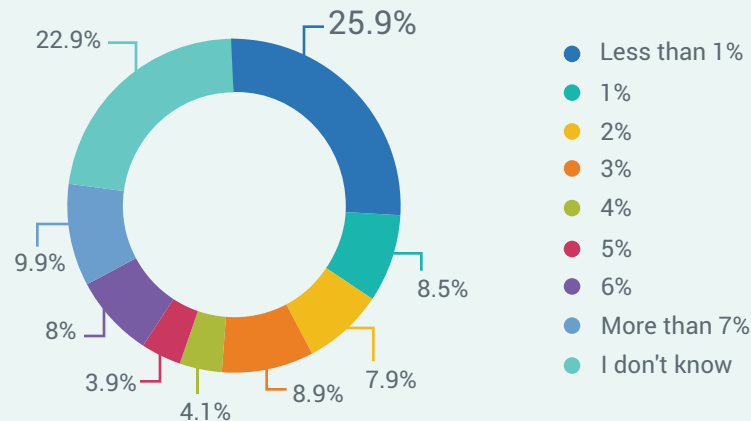tractor/Construction Managers, the companies that spend more than 1% of annual sales volume on IT are primarily subcontractors.

PERCENTAGE OF CORPORATE G&A EXPENSE SPENT ON IT

- Less than 1%
- 1%
- 2%
- 3%
- 4%
- 5%
- 6%
- More than 7%
- I don't know

A majority of construction companies report they spend more than 1% of their General and Administrative Expenses on technology. This is important because it highlights an opportunity to identify and shift construction technology expenditures from overhead to job costs. With nearly a quarter of respondents answering "I don't know," these expenditures clearly do not receive the same scrutiny as project budgets.

BILLING IT EXPENDITURES TO PROJECTS

- Yes
- No
- It depends on the expense
- I don't know
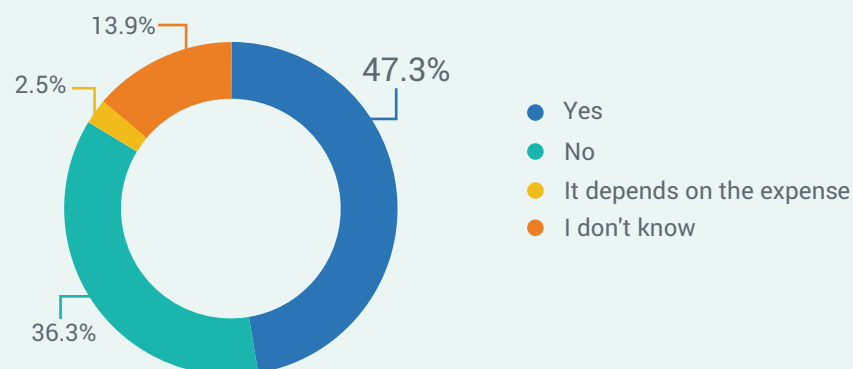
Survey Participants Commented:

"IT budgets for all equipment. Specialty equipment/ software is billed to projects directly. Consumable expenses are billed directly (telco, print, etc.). We are working on a fee for service, otherwise it's an overhead allocation to the Business Unit who then expenses each job."

"It really depends on the size of the job."

"BIM and prefabrication expenses are charged to jobs directly if utilized."

Nearly half of respondents do not bill any IT expenditures to projects, only 36.3% bill to projects depending on the line item (i.e. if it's possible to provide enough direct correlation between project operations/success and the value of the IT.) This will continue to be a problem until key stakeholders in the construction process achieve consensus on how to quantify the added value of technology in hours saved, efficiency created, etc.

A frequent comment of "It depends on the size of the job" is also interesting - essentially the larger the job, the easier it is to justify tech in the expenses. **Unfortunately, the cost of technology does not scale according to job size, but is typically priced per user, year or month.** Another frequent comment on this question noted that BIM is an exception. Since BIM tools are often employed per project, builders find that it's easier to carve out the marginal cost and apply to the project.

IT Staff

Learn how construction companies are allocating resources for IT staff.

DEDICATED IT DEPARTMENT

No
41.1%

2014

Yes
58.9%

No
42.6%

2016

Yes
57.4%
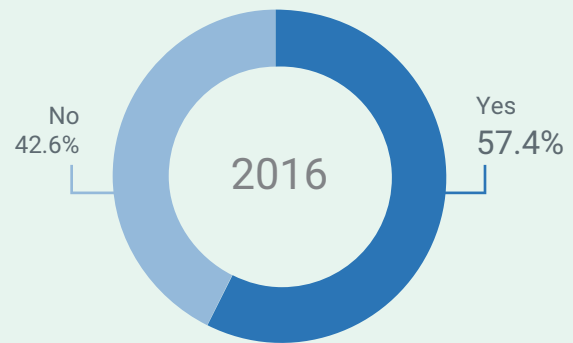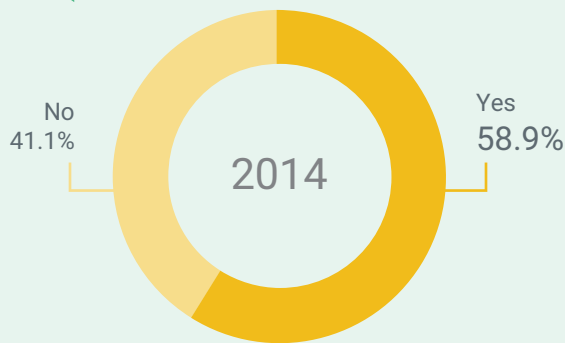
No, because:

- We outsource IT.
- We're too small to have dedicated IT.
- It's too costly to have dedicated IT.
- We have no need for dedicated IT.
- Does a one person department count?

Survey Participants Commented:

"Yes, but it is limited to hardware support. We still utilize a 3rd party for server and network support."

"Technically yes, but it is one person with other responsibilities as well."

"We only have 22 in our office and do not have enough IT issues to justify a full time in-house IT employee."

The number of surveyed companies with dedicated IT departments did not change in the last year. **Only companies with more than 100 employees and over $50 million in annual sales volume are companies likely to have a dedicated IT department.** According to the survey, construction companies with 1-5 employees dedicated to IT increased from 2015, while the number with 6-15 employees decreased. It is important to note that comments in the survey indicated that companies are still having a hard time differentiating and structuring IT departments to address all aspects of technology including: hardware, software, issues, technical support, network maintenance, etc.

NUMBER OF EMPLOYEES DEDICATED TO IT

- 66.3%
- 16.6%
- 6.8%
- 3.9%
- 6.4%
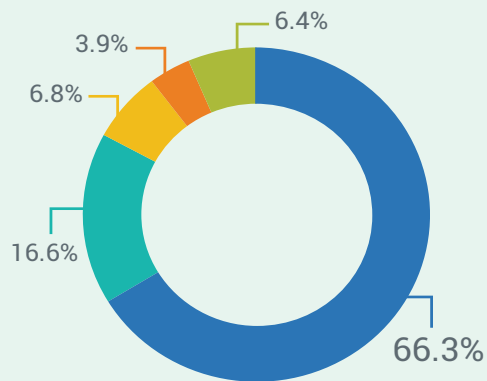
- ● 1-5 employees
- ● 6-15 employees
- ● 16-30 employees
- ● 31-50 employees
- ● 50+ employees

Survey Participants Commented:

"Technically, the only full-time IT employee is our CFO - who obviously has other duties. For some reason we divide "IT" and "Technology" into two categories. There is collaboration, however it allows employees to approach two different entities until they receive the answer they want (not need)."

SIZE OF IT STAFF

Increased — 35.9%

Decreased — 5.5%

Maintained — 47.5%

- ● 2016
- ● 2015
- ● 2014
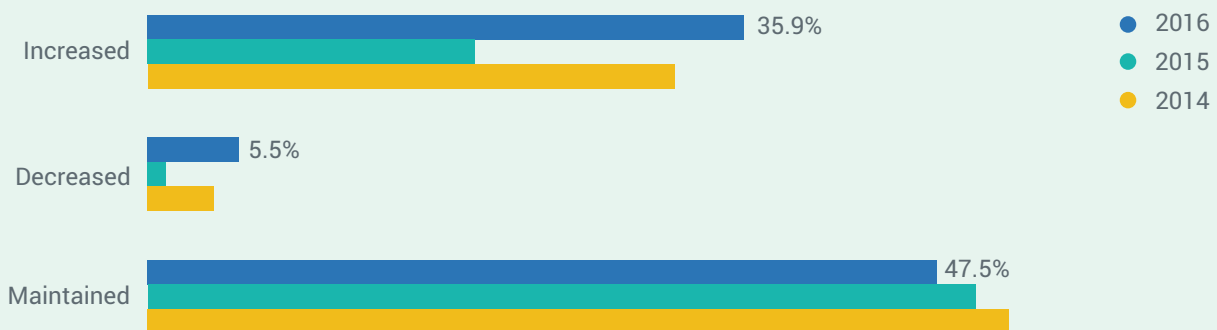
Survey Participants Commented:

"We added a full-time Support Technician, but we had someone retire at the end of 2013 and as far as I'm concerned, we finally got a replacement. It felt like breaking even."

"Hired third-party to solve many of our day-to-day networking issues."

In 2016, roughly 36% of companies say they increased their IT staff size, even if not in a formalized department, which is the highest level reported in the past 4 years. However, the number of companies who decreased their IT staff also rose to levels not seen since the 2013 survey. **This explains why the total number of IT staff members remains unchanged from 2015.** Significantly fewer survey respondents answered "I don't know" to how their IT staff has changed over the last year. This is due to more senior executives and accounting types participating in the survey, ultimately producing more accurate responses on many questions relating to staffing and budget.

SIZE OF IT STAFF DEPENDS ON

Number of Employees — 38.1%

Number of Technology Solutions — 23.5%

Size of Current & Upcoming Projects — 21.4%

Revenue — 3.2%

Other — 7.9%

- 2016
- 2015
- 2014
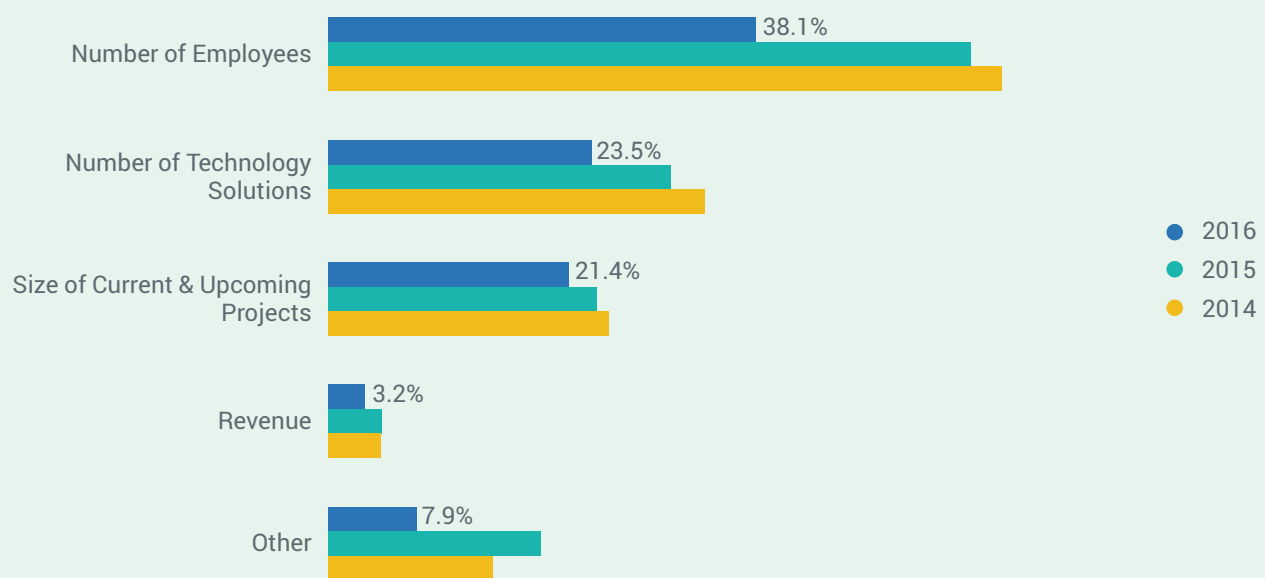
Survey Participants Commented:

"Despite the fact that our company is growing rapidly we continue with the same number of IT employees 'because that's what we've always had.' We're 'money out' not 'money in'."

The factors that influence the Size of IT Employees Needed remain in the same order as years past, with Number of Employees as the most influential factor. However, this does not align with the size of IT staff by size of company comparisons earlier in this report. **Very few statistics elsewhere in the survey saw a correlation between total staff size and IT staff.** "Other" write-ins included a mixed bag of responses that seemed more in line with what the size of IT staff numbers indicate. **Respondents said "IT staff numbers are 'set in stone' by the business plan,"** determined by "gut feeling" or signaled **that numbers are simply based on "that's how it's always been."** For the fifth year in a row, the survey

indicates that IT staffing is not based on a scalable business formula - or if it is, that formula is not communicated or shared by those making the decisions.

IT JOB TITLE

IT Support Specialist
Director Senior Project Manager
Chief Estimator
Principal IT Manager Operations Manager
CTO
Secretary-Treasurer Senior Estimator BIM Manager
President IT Director
Vice President CFO Office Manager
Chief Financial Officer Owner
Accounting Manager CIO COO Project Manager
Controller Preconstruction Manager
CEO
Estimator Project Engineer
VP Finance and Administration VDC Manager
Assistant Project Manager

JOB TITLE OF HIGHEST RANKING IT STAFF MEMBER

Office Manager
General Manager VP of Finance
Secretary/Treasurer
IT Administrator COO Chief Accounting
Officer President
Accounting CAD Draftsman
Director of Virtual CIO Manager Director Of Systems
Construction and Controls
Owner Information CTO IT Consultant
Systems Manager Administrative
Project Manager CFO Assistant Controller
Systems Network
Administrator Administrator
IT Director Director of Operational
IT Manager Excellence Vice President
VP of Internal Operations

WHO MANAGES THE IT STAFF

8.4%

30.8%

30.5%

1.5%

3.1%

25.7%

- CFO
- CEO
- CIO
- CTO
- Other
- I don't know
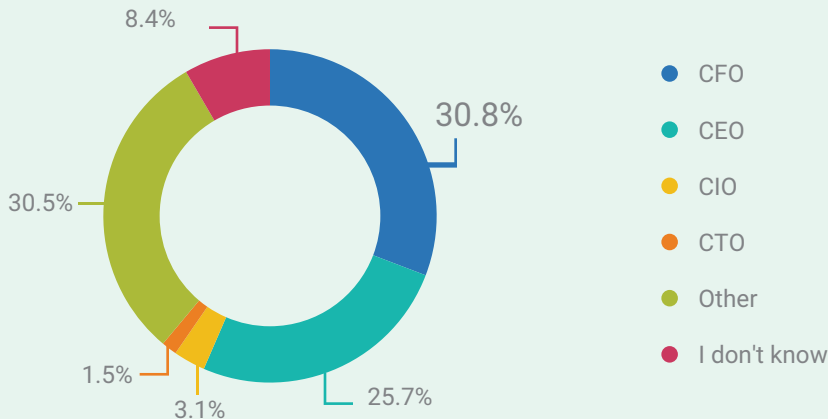
Other includes:
- Controller
- COO
- President
- Vice President

Survey Participants Commented:

"While the CFO is the highest-ranking "IT Member", our President/CEO will occasionally make decisions without discussing with either our IT or Technology Departments."

"The person who manages our highest ranking IT staff member also manages our highest-ranking staff members in HR, Accounting, and Safety."

Respondents were asked to write-in their IT job title and responses ranged from the standard CIO to the less conventional Office Manager. **As seen in previous years, survey responses are still showing IT roles spread throughout the company, since concentrated IT departments and roles are scarce within construction companies.** A majority of respondents identified Presidents and CFOs as the highest-ranking staff member. Interestingly, many chose Manager or Administrative roles as well, which explains a tendency towards low IT spend, as these particular positions rarely have strong purchasing power or influential budget authority. The significant CFO involvement and supervision in IT may also be a cause for underspending within this department, since they are (rightfully so) ultimately held responsible for the company's profit/loss numbers.

In general, these statistics indicate that companies do not have a defined and communicated IT strategy when managing and allocating staff. Employees at construction companies lack IT decision making that doesn't start and end with the budget. **IT is an expense of the HR, Accounting and Finance departments instead of a value-adding department of its own.**

Cloud Security

Learn how cloud security solutions, devices and policies are impacting data security.
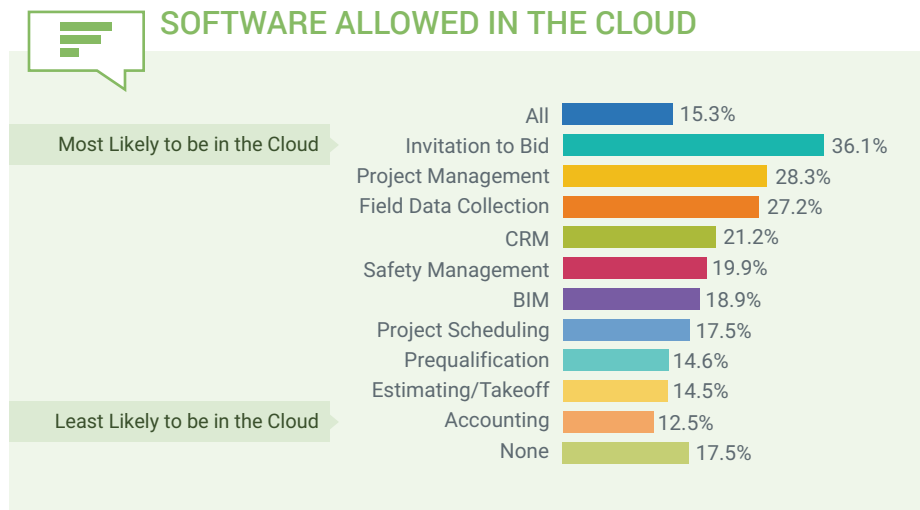
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CONSTRUCTION SCIENCE
TEXAS A&M UNIVERSITY

SOFTWARE ALLOWED IN THE CLOUD

Most Likely to be in the Cloud ▶

All	15.3%
Invitation to Bid	36.1%
Project Management	28.3%
Field Data Collection	27.2%
CRM	21.2%
Safety Management	19.9%
BIM	18.9%
Project Scheduling	17.5%
Prequalification	14.6%
Estimating/Takeoff	14.5%
Accounting	12.5%
None	17.5%

Least Likely to be in the Cloud ▶

Survey Participants Commented:

"Our company has feared "the cloud" as insecure for far too long. Some officers are beginning to see the merits and others are even beginning to understand that it's MORE secure than on-site servers (which back-up to 2 additional locations)."

Every year we start this report's cloud security section with a definition of "cloud computing" as defined by The National Institute of Standards and Technology (NIST):

"Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction."

To simplify this statement, 'the cloud' is computing, storage and data transmission that is available anywhere, anytime, on any device, in any capacity or location desired.

Since the Construction Technology Survey was first conducted in 2012 the type of software allowed in the cloud has stayed consistent. Year after year, Accounting remains the least likely department to use cloud solutions, due to its highly sensitive financial data and the illogical perception that data on premise is safer than data in the cloud. **Each year Accounting is often accompanied by Prequal and Estimating as solutions most likely not in the cloud - whether this is due to fear of the cloud as a repository for financial information or lack of prominent cloud solutions for these functions (and dependence on spreadsheets) it's hard to tell.**

This year, Project Management advanced above Field Data Collection, showing signs of a downward trend because participants are seeing data collection less as a specific workflow and more of a universal task across all workflows. Safety was not included in previous surveys, however has a prominent position near the top of the cloud ranks in 2016. This could be attributed to the increase in subcontractors participating in this year's survey. **Sharing safety information across the job site is an increased focus for subcontractors and general contractors when it comes to risk management - the cloud makes this sharing space possible and highly efficient.**

METHODS OF SECURING CLOUD DATA

Employee Training — 54.9%
Corporate IT Policy — 30.1%
Installing Security on Mobile Devices — 29.5%
Cyber Liability Insurance — 22.5%
Two-Factor Authentication — 14.5%
Cross-Platform Authentication — 8.4%
Cloud Liability Insurance — 5.1%
None — 18.2%
I don't know — 16.4%
Other — 1.3%

● 2016
● 2015
● 2014
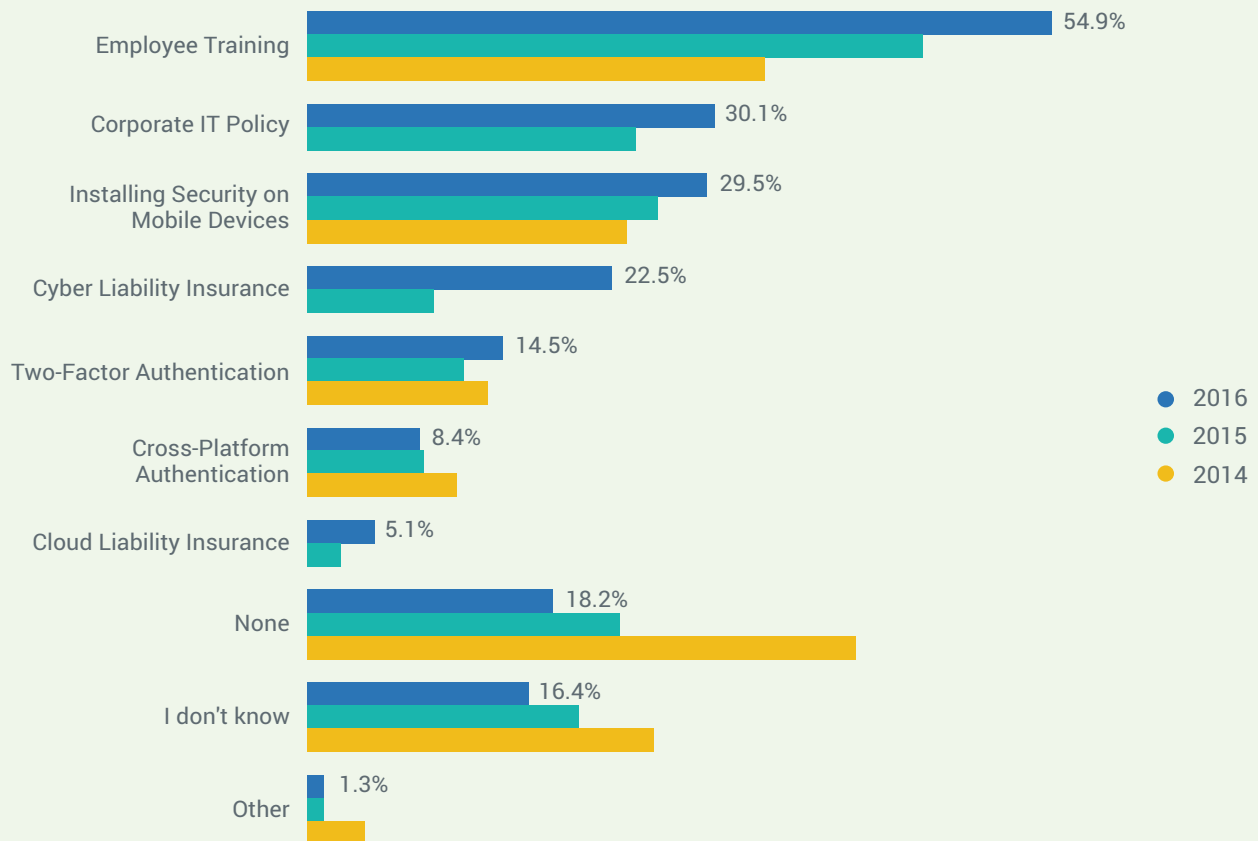
Survey Participants Commented:

"Our network has a security software program that allows the IT consultant to monitor our network 24/7."

"IT policy is weak, has not been distributed to staff, is therefore non-enforceable and not monitored."

Construction professionals employing cloud solutions were asked how their companies are securing those solutions. While the overall trend lines are nearly identical to previous years, there is a dramatic increase in almost every category represented. **Cyber liability coverage more than doubled since 2015 and those that are not using cloud security methods dropped by half since 2014.** Employee training continues to be the most frequent data security method used, most likely because it is the least expensive, and is often the 'easiest' to implement. These results show that more construction firms are understanding the need to implement cyber security defenses to protect sensitive data available in the cloud.

DO COMPANIES SECURE PERSONAL DEVICES?

2014

No 32.7%

Yes 39.8%

27.5% I don't use personal devices at work

2015

No 26.7%

Yes 34.5%

38.8% I don't use personal devices at work

2016

No 35.3%

Yes 28.3%

36.4% I don't use personal devices at work
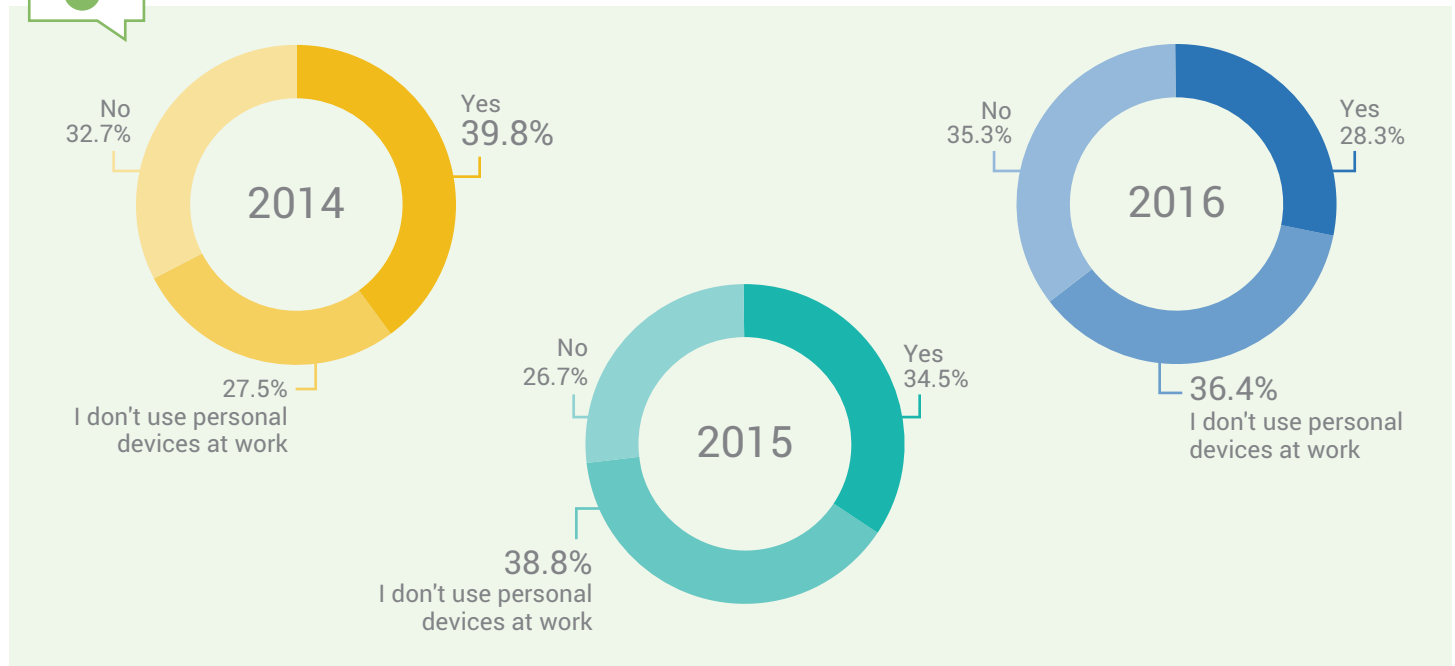
Survey Participants Commented:

"We don't allow personal devices for work related purposes. We do let people use personal smartphones to check company email, but that would be the extent of it."

"I would estimate, generously, that maybe 20% of our employees who access our server use the VPN or realize that security measures are needed - let alone know what those measures are."

Construction companies are supplying more devices to their employees than ever before. The downside, is that companies are not managing or securing these mobile devices. Every app, email and message is a window to cyber threat - even if employees are "only checking email" they are opening up company networks to severe vulnerabilities. It only takes one employee, downloading one app to play a game on a flight, to give outside parties access to everything on their phone and everything it connects to within your corporate network.

According to McAfee's 2016 Mobile Threat Report mobile malware has tripled since Q1 of 2014. Data security is like health insurance, it's hard to comprehend it's value until you really need it - mom's old adage of "better to be safe than sorry" is extremely applicable in the data security space. A massive distributed denial-of-service attack was recently reported on Oct. 21, 2016 that caused outages for websites like Amazon, Spotify, Reddit and Twitter - proving the importance of employing or contracting full-time IT professionals with data and network security experience. **One or two staff members who provide technical support for software, as needed, is not enough.**

Mobile Strategy

See how builders are prioritizing mobile software and hardware in project workflows.

IS MOBILE A PRIORITY?

HOW IMPORTANT ARE MOBILE CAPABILITIES?

Very Important 28.8%

41.1% Not very important

2012

30.1% Important

Very Important 36.8%

20.7% Not very important

2016

42.5% Important
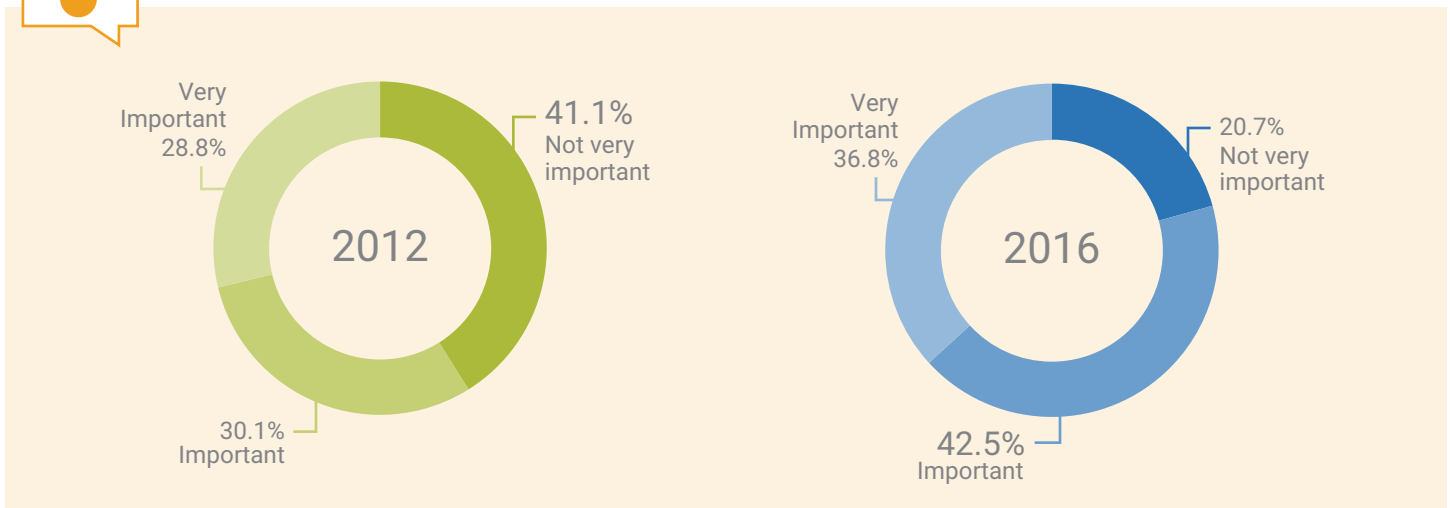
The construction industry is entering the "Mobile Revolution," in which apps are becoming an accepted means for workflows. A majority of workers have a mobile device, yet many companies still do not comprehend how to build a corporate strategy around leveraging mobile technology. **There has been a drastic change in the importance of mobile capabilities shown in the survey since 2012.** The 20% increase in participants who now see mobile as Very Important or Important appears to signal a recognition that participants are seeing real benefit from early investments in mobile tech and are embracing mobile as a force multiplier.

Out of all the company types (General Contractors, Subcontractors, Architects), only the Owner/Developer type had a majority of survey respondents say mobile is Very Important, the other company types were more likely to say just Important. Owners/Developers have a portfolio of properties to manage and need access to property information and statuses at any given time, wherever they are - thus requiring more mobile capabilities. General Contractors and Subcontractors are likely to only use the technology to help in specific workflows throughout the project. **Survey participants who were born in the 80s-90s were only slightly (4%) more likely to say mobile is Very Important than someone born in the 60s-70s.** This statistic was unexpected, however 'Millennials' (80s-90s) were by far the least likely of all the survey age groups to say mobile is Not Very Important, which was expected.

Survey Participants Commented:

"Our President/CEO has mandated that all mobile devices be Apple devices. All "office" machines (desktops) are PC. We are so far from efficiently leveraging our mobile capabilities that it's hard to believe it will ever happen."

"It depends on who is using the software. For our field personnel, it's a must. For project managers who work in field and office, it's basically a must. For software used exclusively by our office staff, it's not important."

SOFTWARE PROVIDERS THAT OFFER MOBILE APPS

Category	Percentage
Field Data Collection	33.9%
Project Management	32.6%
Time Entry	30.3%
Accounting	26.5%
Plan Distribution	19.9%
Invitation to Bid	19.6%
BIM	19.6%
Safety Management	19.4%
CRM	15.6%
Project Scheduling	14.7%
Estimating	14.6%
Equipment Tracking	14.2%
Prequalification	5.1%
None	12.5%
All	7.4%
Other	4.3%
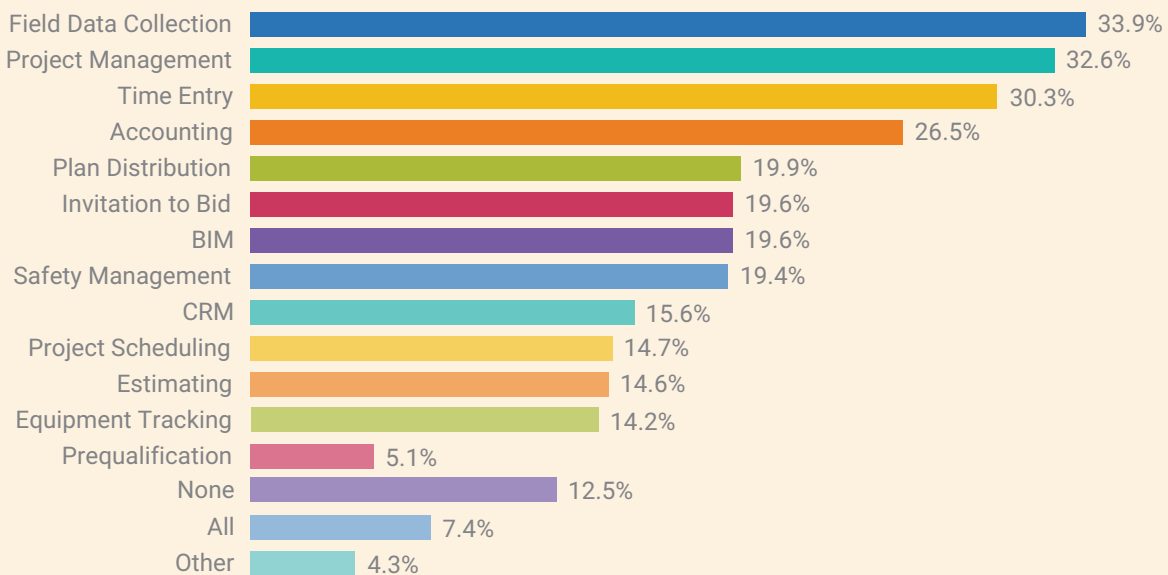
Survey Participants Commented:

"As our current Estimating, Project Management/ Operations, and Accounting software do not integrate, we are exploring custom "workarounds" and software alternatives - Time Entry is the most requested mobile feature from Operations."

"Just about everybody "offers" a mobile application - only a few are good enough or serious enough about it to be practical, affordable, well-supported, and truly useful to us."

At this point, it's safe to say that mobile apps are no longer viewed as a fad in construction, but rather a necessity. Since 2014, the categories of software in which construction professionals have seen the most growth in mobile offerings are solutions for Field Data Collection, Project Management and Accounting. There were two notable changes, Time Entry and Safety were not included in last year's survey, however both were in the top 10 for 2016 responses.

It's surprising to see that only 30% of Time Entry software providers offer mobile apps. Contractors report that manual or spreadsheet-based time collection methods burden field supervisors with too much administrative work, instead of field supervision. Manual entry also creates extra effort for the office staff who have to enter all employee hours into their payroll system. Accuracy problems caused by this manual method create a third layer of effort to correct and maintain, and the effects of the errors ripple through to the employees, especially those living paycheck to paycheck. **It's important to note that in comments, survey participants voiced frustration with companies who claim to offer "mobile capabilities" but in actuality it's merely mobile browser compliant, instead of a native mobile app.**

MOBILE DEVICES & OPERATING SYSTEMS

DAILY DEVICE USAGE

	Laptop	Tablet	Smartphone	Wearable
2016				
Personal	24.1%	35.1%	41.2%	79.9%
Company	90.9%	77.3%	77.6%	24.4%
Total	83.6%	67.1%	97.3%	10.7%
2015				
Personal	23.3%	38.9%	35.9%	71.4%
Company	91%	74.5%	81.1%	33.3%
Total	85.6%	69.4%	97.6%	9.2%
2014				
Personal	27.4%	48.8%	41.6%	
Company	86.3%	60.1%	72.3%	
Total	63.9%	50.1%	72%	
2013				
Personal	40.6%	62.7%	48.6%	
Company	79.2%	52.2%	52.2%	
Total	83.3%	53.1%	91.4%	
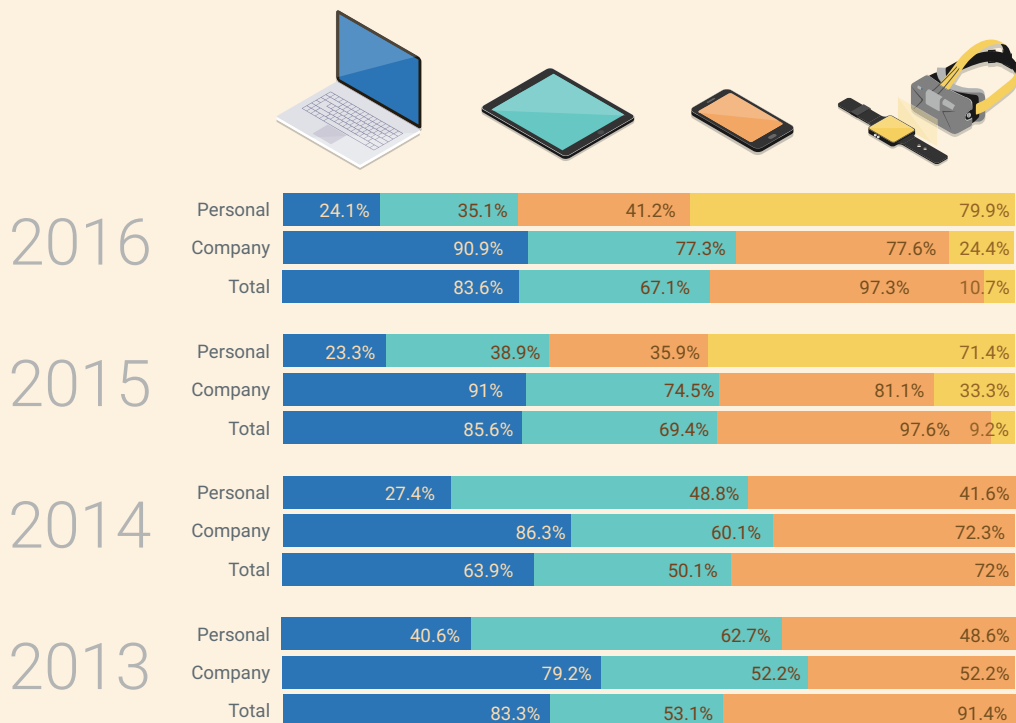
Survey Participants Commented:

"Our company is exploring exchanging desktop PCs & iPads for Project Managers (field supervisors will still have iPads), and providing laptops with docking stations. No research, testing, cost-benefit analysis, or other development has taken place to verify that this is the ideal solution. The majority (over 75%) of those who would be getting laptops are unaware of the security measures required at all times and we have no corporate policy or monitoring of such."

Between 2014 and 2015 this report saw a substantial increase in the total use of mobile devices that did not occur again between 2015 and 2016. The number of construction professionals using smartphones provided by their company decreased since 2015, while personal smartphones increased. **It seems companies caught on to the mobile trend and provided devices to workers in 2014/2015, until savvy employees started preferring their personal smartphones (as opposed to managing two) and were provided the tools to work from their personal devices if necessary.**

Unlike laptops and smartphones, the number of companies providing tablets increased since 2015, probably because these devices are easier to secure, issue and collect at the end of the day. Laptops are used for heavier construction workflows and smartphones are needed for more extensive communication availability, making personal devices more convenient options. Wearables also saw an increase in usage in 2016, but are still nearly 80% personal devices.

MOBILE OPERATING SYSTEMS IN USE

- iOS — 65.6% (2016)
- Windows — 40.7% (2016)
- Android — 34.1% (2016)
- Blackberry — 1.8% (2016)
- Other — 1% (2016)

Legend:
- 2016
- 2015
- 2014
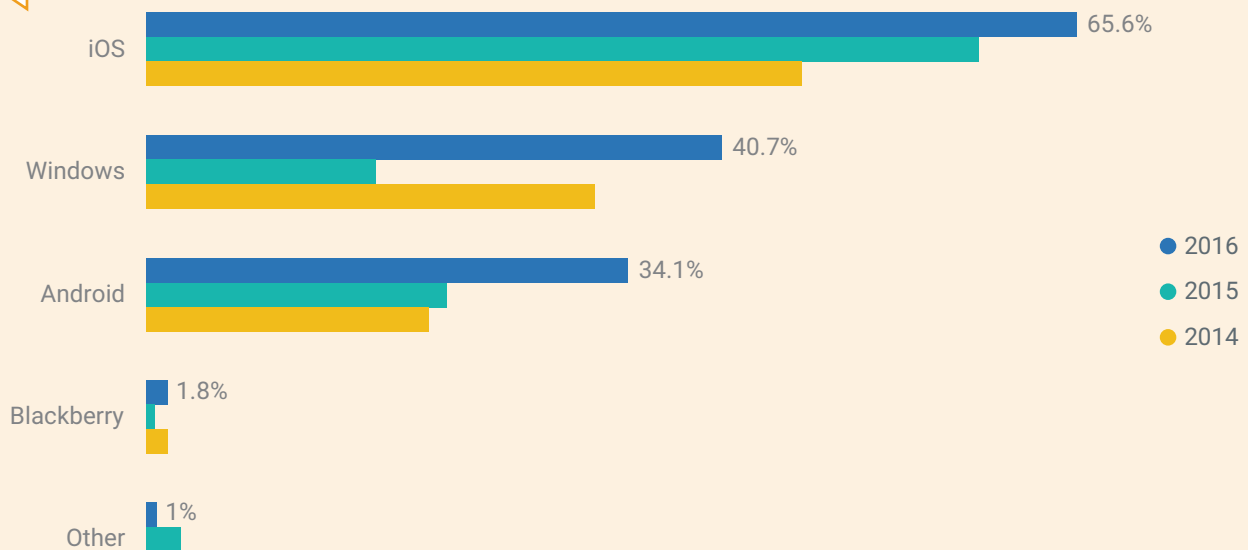
Survey Participants Commented:

"Just about everyone in my company uses iOS except myself, which is unfortunate. They really only use iOS because it's what the industry was creating mobile apps for in the beginning. Funny that the person in charge of the technology doesn't use the same technology as everyone else..."

"Starting to tinker with Android because of the virtual reality capabilities."

"Management is iOS for phones. Field Staff is Android for phones. PE's use Windows tablets, we have 1 iOS tablet."

When it comes to mobile operating systems in use for construction, iOS continues to be the dominant choice among professionals, used on over 60% of mobile devices. However, Windows is catching up, with the usage doubling since 2015. The increase in Windows mobile operating system usage is likely attributable to the Surface Pro 4 Tablet release in October 2015.

The proliferation of virtual reality could provide Android another boost in the next year, as they are making heavy investments in virtual reality compatible devices and wearables. Apple has hinted they are preparing for the augmented and virtual reality boom, however have yet to release anything big. **At the rate Windows and Android market share are growing, Apple may need to focus on a construction offering soon.** It will be worth finding out in future surveys the operating system by device. Comments from survey participants on this question suggest that most of their Windows usage is via tablets, while the heavy iOS usage is due to iPhones, not laptops or tablets.

Technology Integrations

Learn how builders are integrating data to usher information through the construction process.

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CONSTRUCTION SCIENCE
TEXAS A&M UNIVERSITY

NUMBER OF SOFTWARE APPLICATIONS IN USE

- 8.6%
- 14.6%
- 19.1%
- 18.9%
- 13.8%
- 7.2%
- 17.8%

- ● None
- ● 1
- ● 2
- ● 3
- ● 4
- ● 5
- ● 6 or More
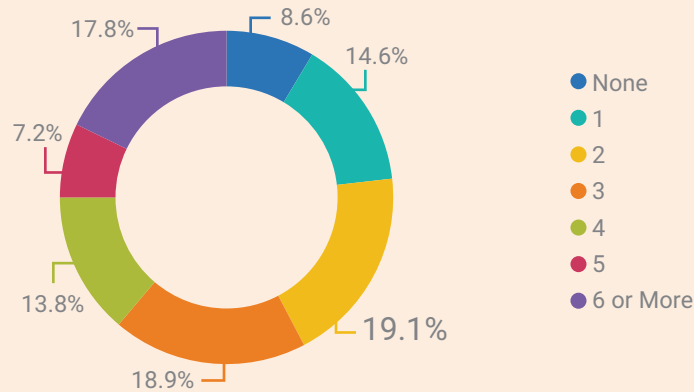
Survey Participants Commented:

"You should see our systems landscape!!! Business units and project managers have autonomy to procure their own. Way too much freedom in this space. Who's going to support all the wacky decisions?"

"We are in the middle of going from eight software tools on our job site to two."

NUMBER OF SOFTWARE APPLICATIONS THAT INTEGRATE

- 4.2%
- 2.2%
- 5.9%
- 27%
- 7.7%
- 9.6%
- 16.9%
- 26.5%

- ● None
- ● 1
- ● 2
- ● 3
- ● 4
- ● 5
- ● 6 or More
- ● All
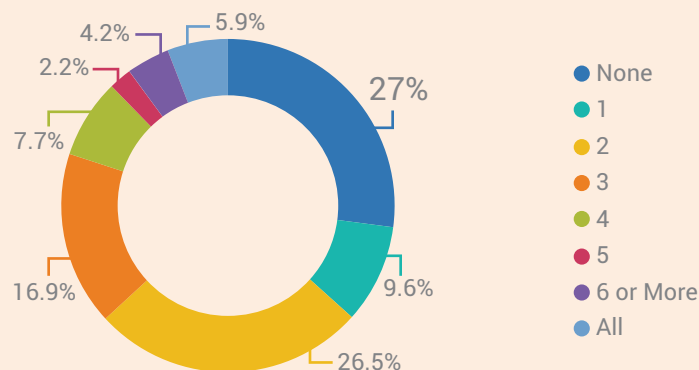
Survey Participants Commented:

"Only the applications from the same company seem to truly integrate, otherwise the "integration" is through CSV files."

"One of the biggest problems in our industry!"

The number of software applications in use by construction professionals has continuously dropped throughout the five years of conducting this survey. In 2012 and 2013, this report revealed that most builders were using over six software applications in their construction roles. In 2016, two software applications was the most common answer and fewer builders are using 4 or more software solutions. However, participants using one software application saw an increase of nearly 5%.

In 2015, more builders had at least 2 applications that integrate than none. **However in 2016, most often builders have no software applications that integrate.** And there is a fair amount of skepticism, as indicated by the comments, in the effectiveness and extent of integrations that still require a CSV or manual process to transfer data.

HOW DO YOU TRANSFER DATA IF APPLICATIONS DON'T INTEGRATE?

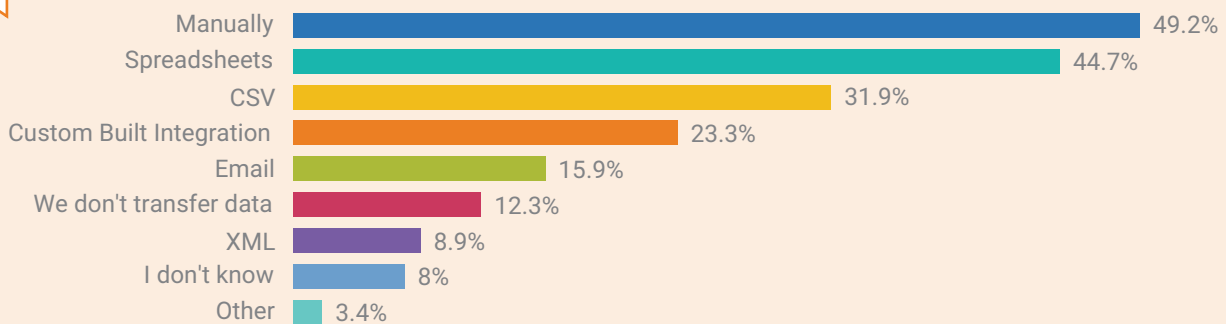|	
Manually	49.2%
Spreadsheets	44.7%
CSV	31.9%
Custom Built Integration	23.3%
Email	15.9%
We don't transfer data	12.3%
XML	8.9%
I don't know	8%
Other	3.4%

Survey Participants Commented:

"Interoperability and system integration is a huge challenge in our industry. As a Consultant PM/CM organization, 99% of the time we have to interface with an owner's legacy system (generally an Access or similar). Integrating an in-house solution with an off-the-shelf system is always a painful process."

"This is one of the most frustrating parts of construction IT. Most large software providers use non-integration as their business strategy."

Since 2014, the number of builders relying on manual entry for data transfer continues to rise, along with the use of spreadsheets and CSV files. Survey participant comments reinforce the lack of integration efforts on the part of technology providers and the difficulties with integrating not only internal solutions, but data transferred to and from clients and project partners.

Since 2015, no significant increase in software integration availability occurred. With low IT budgets and staffing, custom integrations are not an option for most construction companies, and even APIs

can be hard to navigate for the non-tech savvy. A vocal minority believe vendors are paying lip service to integration through APIs, but in reality don't have any integration relationships with other providers, so there is no way of knowing if the APIs will really work together. It's up to builders to require true integration development and partner with organizations like the Construction Open Standards Alliance (http://cosa.build) who develop open integration standards that are available to all software providers to adopt for the benefit of their end-users.

Two way integration offerings will continue to remain stagnant until builders demand more of their technology providers. As mobile capabilities and offering a mobile app become the "norm," end users should demand the same of open APIs and integrations between complementary software applications when making purchasing decisions.

Software & Mobile Apps In Use

Learn about the solutions companies are using to manage data in each stage of the construction process.

ACCOUNTING

ACCOUNTING SOFTWARE

Software	Percentage
Sage	16.5%
Viewpoint®	15.6%
Timberline	11.9%
Quickbooks™	11.3%
Dexter + Chaney	7.7%
CMiC	6.4%
Custom In-House Solution	4.9%
JD Edwards	4.5%
Spreadsheets	4.4%
GradeBeam® (Oracle® Textura)	3.6%
ComputerEase	3.4%
Foundation®	2.7%
Manual Process	2.5%
Deltek Vision™	2.4%
SAP®	2.3%
COINS	1.9%
CGC - Computer Guidance - eCMS	1.7%
Jonas™	1.1%
Other	13.8%
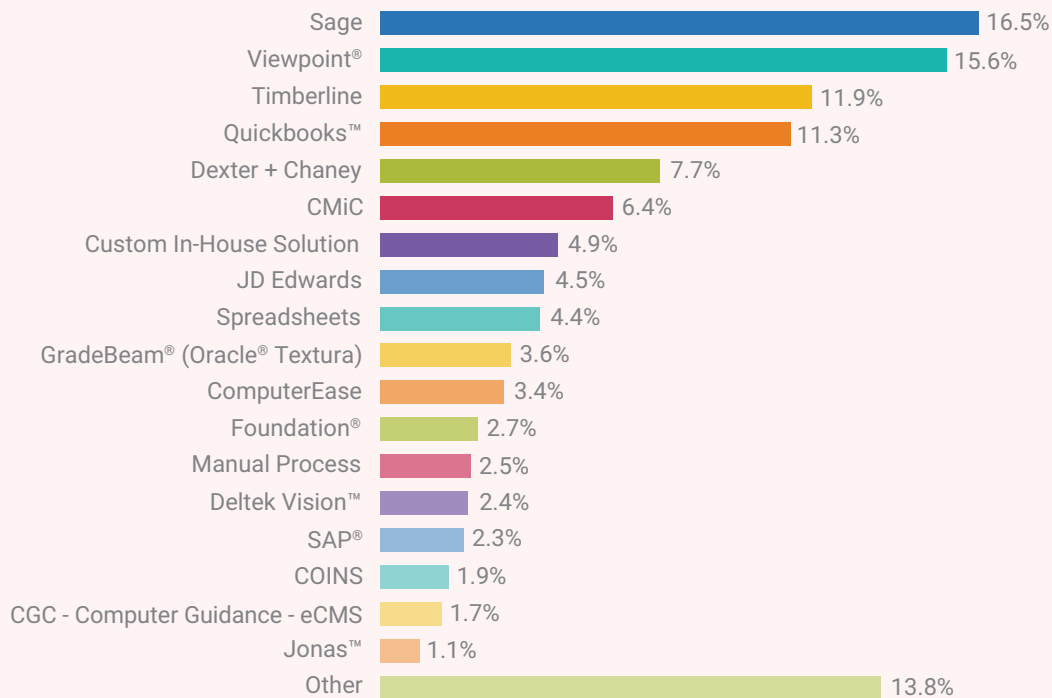
Survey Participants Commented:

"Actively seeking to transition from QuickBooks to a true construction accounting software to eliminate manual and spreadsheet work."

"Heavily customized in-house concoction."

The accounting software that survey participants are using did not experience any big changes in rankings from 2015, just slight variations, most likely due to more subcontractors taking this year's survey. For the fifth year in a row, Sage's accounting solution is the most widely used among construction professionals participating in the survey, followed by Viewpoint. Many survey participants chose to make a comment on this question and nearly half of those comments were looking for alternatives or actively transitioning accounting systems.

Unfortunately, the percentage of builders using spreadsheets and manual processes for accounting climbed. This is most likely due to the fear of storing accounting data in the cloud (showed earlier in this report) and the tendency to stick to spreadsheets that are seemingly secure, saved internally, on a desktop. **These spreadsheets of sensitive financial data stored without change logs, notifications,**

error tracking, or other measures are therefore even more vulnerable to costly data errors and omission than information in the cloud.

PREQUALIFICATION

PREQUAL SOFTWARE

Software	Percentage
Manual Process	47.1%
SmartBid™	14.3%
Spreadsheets	13.4%
We don't prequalify subs/suppliers	9.6%
Custom In-House Solution	8.2%
iSqFt®	8%
Textura PQM™ (Oracle®)	4.2%
CMiC	3.7%
SmartInsight™	1.5%
Other	5.6%

Survey Participants Commented:

"As a sub, we mostly complete each respective GC's specific prequal forms via their website."

"We have used the same subs/suppliers for many years so instead of prequal its mostly on a relationship build basis."

The largest percentage of survey respondents prequalify subcontractors manually, through a process of paper, email and PDF attachments. The number of builders using manual processes dropped by 2% in 2016, however spreadsheet usage increased. While manual and spreadsheets are not identical, they often go hand in hand.

The number of companies that do not prequalify subcontractors for build projects decreased by 5%. While the ranking of prequalification software in use remains basically the same, the quantity of participants specifying their software solution increased dramatically. The decrease in the number of builders that do not prequalify and the increase in participants using purpose built software for prequal signals a shift to greater due diligence in the marketplace. **As more construction companies expand where they build and what they build, firms are increasing the requirements for prequalification to avoid costly project delays later on due to financial instability, subcontractor defaults, non-compliance, etc. Respondents indicate that they continue to increase their usage on operational software systems however there seems to be a gap in the adoption of integrated prequalification and risk management solutions.** Tech providers are working hard to build their offerings in this space. Many invitation to bid software companies like Gradebeam, iSqFt and SmartBid offer a prequalification component for general contractors. However, this seems to be one of the most disparate areas in
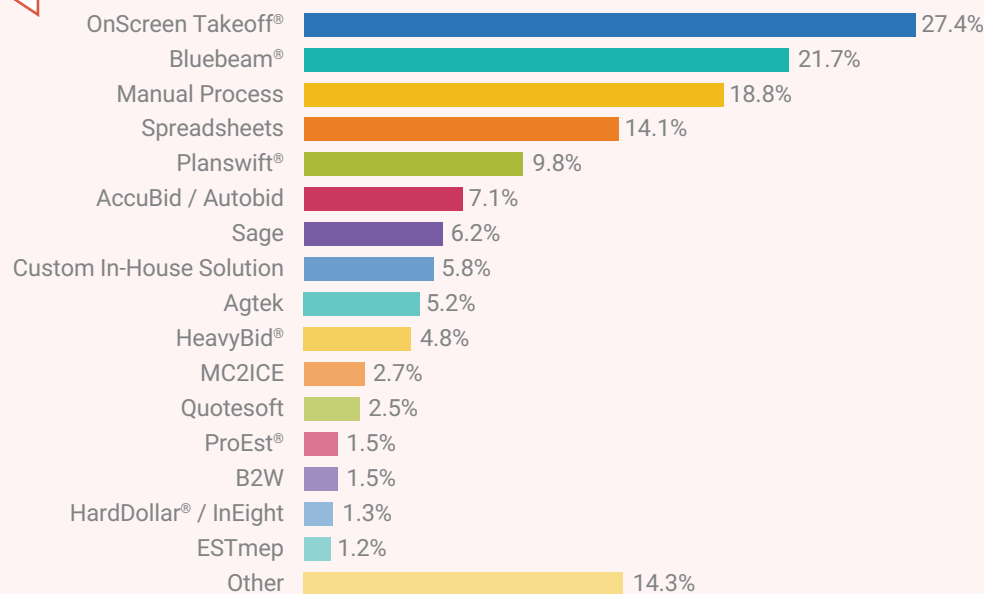
construction technology. There are no widespread standards of prequalification and firms are often conducting risk assessments with a combination of in-house resources and dedicated solutions that don't allow for key areas of assessment such as comparative analysis (trending or benchmarking) or integration into other risk and estimating programs. This trend in prequalification results in firms assuming elevated levels of risk which can negatively impact profitability.

Companies looking for dedicated prequalification options are exploring online construction networks like SmartInsight, which help subcontractors consolidate their prequal requests and respond with centralized, current data more easily. Firms are also exploring integrated risk reporting solutions from their insurance brokers like Marsh (Subsecure Reports) or BM&B (COVReports) to aggregate and verify company documents and data, evaluate risk prior to awarding contracts and conduct ongoing analysis of risk.

TAKEOFF & ESTIMATING

TAKEOFF SOFTWARE

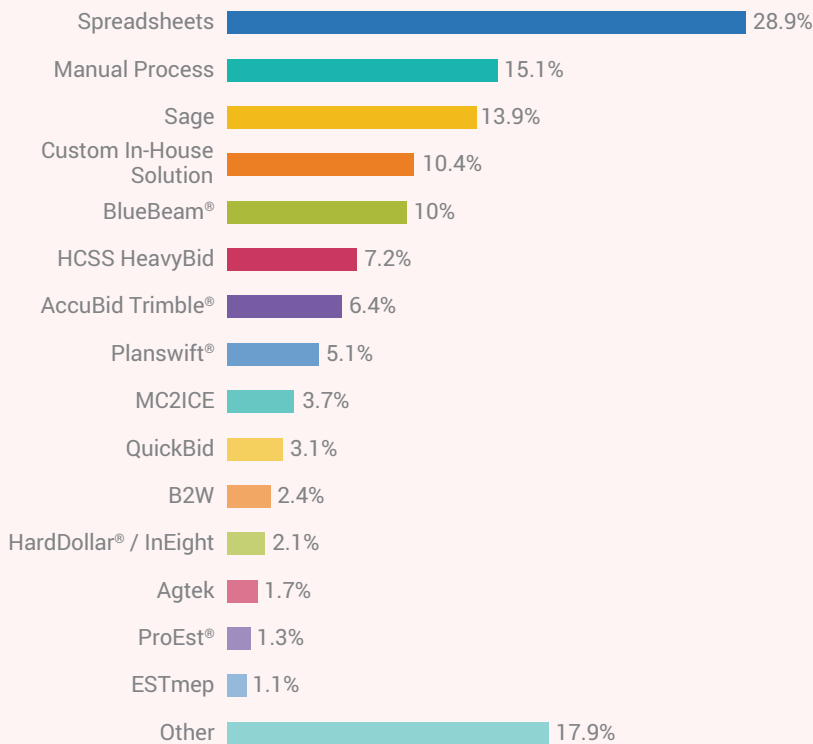| Software	Percentage
OnScreen Takeoff®	27.4%
Bluebeam®	21.7%
Manual Process	18.8%
Spreadsheets	14.1%
Planswift®	9.8%
AccuBid / Autobid	7.1%
Sage	6.2%
Custom In-House Solution	5.8%
Agtek	5.2%
HeavyBid®	4.8%
MC2ICE	2.7%
Quotesoft	2.5%
ProEst®	1.5%
B2W	1.5%
HardDollar® / InEight	1.3%
ESTmep	1.2%
Other	14.3%

Other includes:
- QuickPen
- STACK

Survey Participants Commented:

"We have one old-timer who still takes off everything manually."

ESTIMATING SOFTWARE

Software	Percentage
Spreadsheets	28.9%
Manual Process	15.1%
Sage	13.9%
Custom In-House Solution	10.4%
BlueBeam®	10%
HCSS HeavyBid	7.2%
AccuBid Trimble®	6.4%
Planswift®	5.1%
MC2ICE	3.7%
QuickBid	3.1%
B2W	2.4%
HardDollar® / InEight	2.1%
Agtek	1.7%
ProEst®	1.3%
ESTmep	1.1%
Other	17.9%

Other includes: • WinEst   • QuickPen   • STACK

Survey Participants Commented:

"We currently use takeoff software then export the takeoff information into a custom-built spreadsheet. Once the spreadsheet is populated, costs are added and modified. This spreadsheet is then used to create the Operations (PM) project budget (by hand on paper)."

"No estimating software has proven as flexible and useful to us as our customized Excel templates. We have experimented with almost all of them."
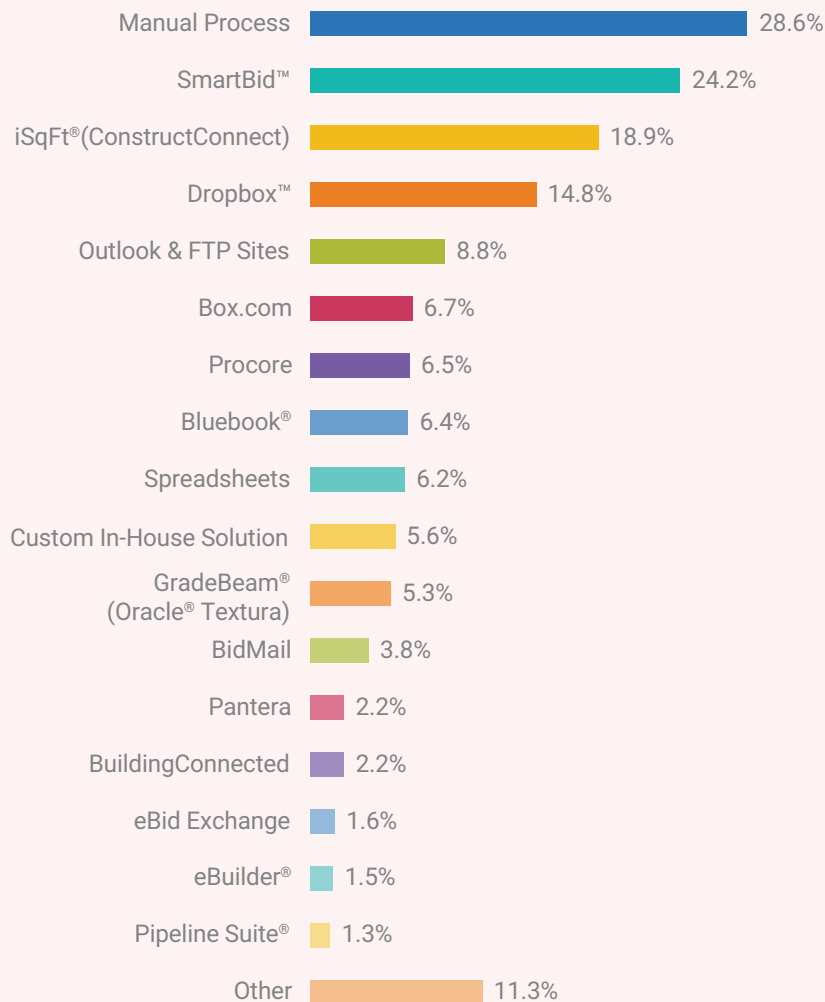
For this year's survey, the estimating and takeoff categories were separated to provide a more accurate view of the solutions in use. With 27% of participants using OST and 21% using Bluebeam, these two popular software tools continue to maintain their standings at the top of the takeoff list. However, 19% of contractors still rely on manual takeoffs, followed closely by spreadsheets at 14%. **Combine this heavy reliance on manual takeoff, with 29% of respondents using spreadsheets for estimating and 15% preparing manual estimates, and you have a recipe for a process that is both time consuming and fraught with opportunity for human error.**

Through the use of software tools, companies are able to increase the quantity and accuracy of bids, driving more opportunity into the sales funnel and leading to a higher win percentage as they become more competitive. There also seems to be hesitation to make the more tenured estimators abandon their manual process for new software, treating their process as more of a "craft" than analyzing it for efficiency and value to the company's pre-construction process. **Companies will soon be pushed into the next era of estimating and takeoff solutions when integrating BIM and estimating becomes more widespread.** Estimators will not be able to deny the value add and time savings, and owners will demand the insight and visualization that BIM provides for the entire process. Builders should keep a close eye on the effect of the recent BIM mandates in the UK.

INVITATION TO BID (ITB) / PLAN ROOM

INVITATION TO BID SOFTWARE

Software	Percentage
Manual Process	28.6%
SmartBid™	24.2%
iSqFt®(ConstructConnect)	18.9%
Dropbox™	14.8%
Outlook & FTP Sites	8.8%
Box.com	6.7%
Procore	6.5%
Bluebook®	6.4%
Spreadsheets	6.2%
Custom In-House Solution	5.6%
GradeBeam® (Oracle® Textura)	5.3%
BidMail	3.8%
Pantera	2.2%
BuildingConnected	2.2%
eBid Exchange	1.6%
eBuilder®	1.5%
Pipeline Suite®	1.3%
Other	11.3%

Survey Participants Commented:

"This isn't done very often. As we are a specialty contractor, we typically email or call our suppliers/subcontractors and request a quote - or worse - just "plug" a number based on what we "think" or based on cost history."
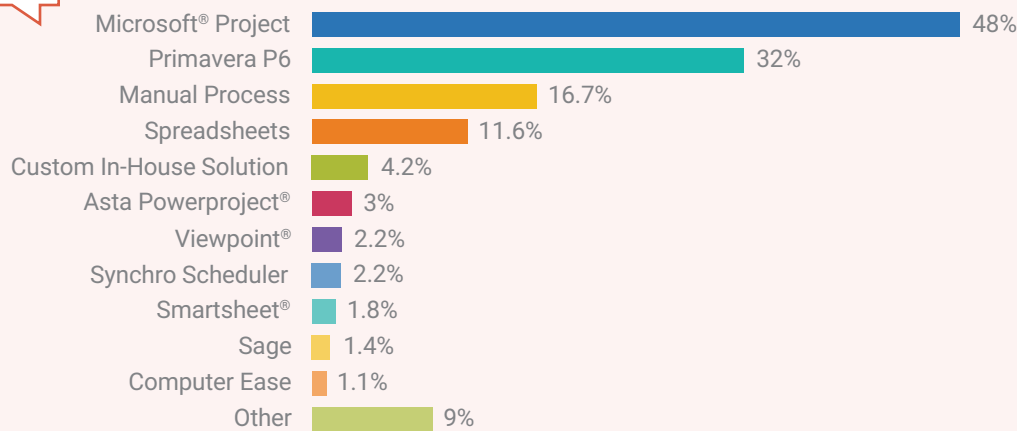
"Seems like we use something different on every project depending on the GC, owner, or construction manager."

Surprisingly, the number of construction professionals using a manual process for invitations to bid grew yet again in 2016 - the highest level since the survey was launched in 2012. No particular shift was seen in any of the other answer choices to account for this trend, so it is most likely due to the amount of subcontractors who participated in the survey this year. Since subcontractors are most often on the receiving end of bids, they are less likely to pay for a bid management software than a GC or prime contractor.

PROJECT SCHEDULING & MANAGEMENT

PROJECT SCHEDULING SOFTWARE

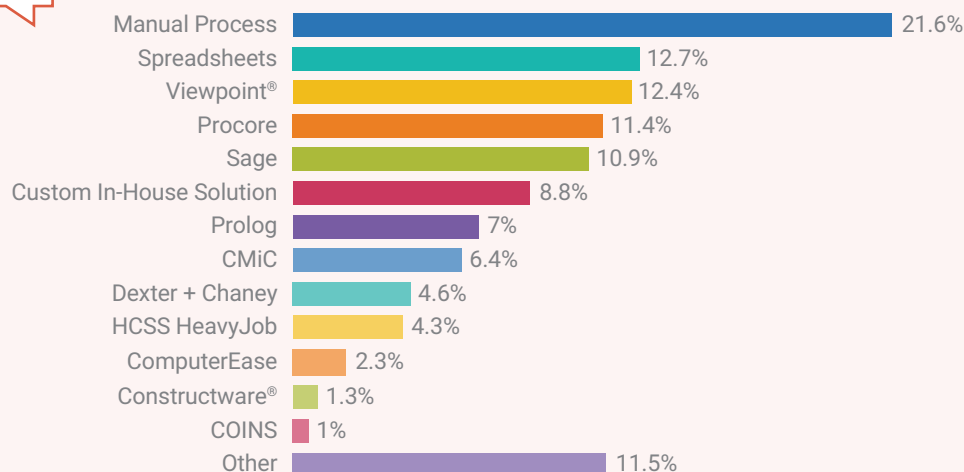| Software	Percentage
Microsoft® Project	48%
Primavera P6	32%
Manual Process	16.7%
Spreadsheets	11.6%
Custom In-House Solution	4.2%
Asta Powerproject®	3%
Viewpoint®	2.2%
Synchro Scheduler	2.2%
Smartsheet®	1.8%
Sage	1.4%
Computer Ease	1.1%
Other	9%

Other includes:

• SureTrak

Both Microsoft Project and Primavera P6 continue to hold their rank as the two most popular scheduling tools for construction companies. **Interestingly, the non-industry specific software, Microsoft, continues to take the top spot in this category.**

Manual scheduling efforts doubled since 2015, followed by an incremental increase in spreadsheet usage. The increase in subcontractors completing the survey explains this shift, as subcontractors are more often complying with a schedule managed by the general contractor, and therefore do not require the sophistication of a full scheduling tool. Comments in the survey confirmed that subcontractors use the scheduling system their client dictates.

PROJECT MANAGEMENT SOFTWARE

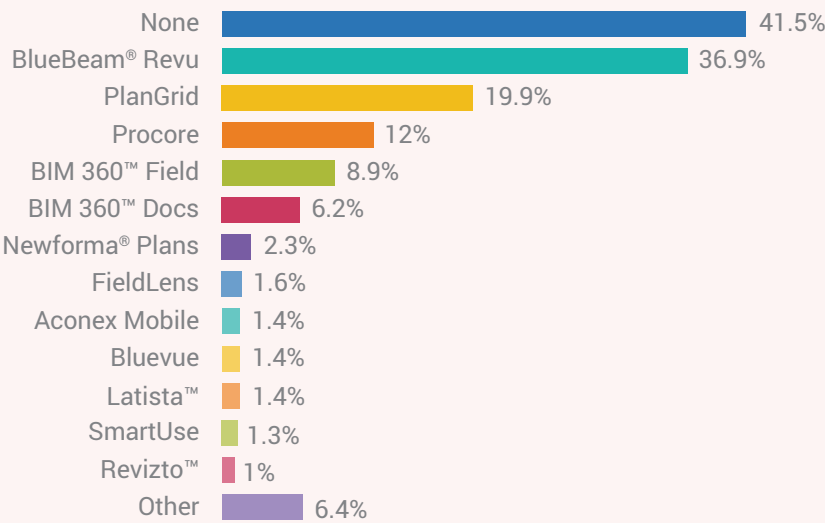| Software	Percentage
Manual Process	21.6%
Spreadsheets	12.7%
Viewpoint®	12.4%
Procore	11.4%
Sage	10.9%
Custom In-House Solution	8.8%
Prolog	7%
CMiC	6.4%
Dexter + Chaney	4.6%
HCSS HeavyJob	4.3%
ComputerEase	2.3%
Constructware®	1.3%
COINS	1%
Other	11.5%

Other includes:

• Newforma®

Survey Participants Commented:

"The majority of our Project Management work is done on paper - even when the form that needs to be completed is created digitally & could be emailed and completed via PC, tablet, or smartphone, it is instead printed out & left on the PM's desk."

"Still have a fair amount of offline spreadsheets that are utilized even after two years using our current project management software."

Project Management remains a highly manual and spreadsheet ridden process, with Viewpoint leading the way for those using a software solution. Manual processes jumped 5% from 2015, however Procore also made a 5% jump to bypass several other solutions that were ahead of them in last year's survey. **Since project management revolves around pricing quotes, product submittals, RFI's and change orders, less sophisticated trades will opt for a more manual process - fax, mail, courier, etc.** In fact, even many project owners will not accept digital documents, requiring paper workflows.

PLAN MANAGEMENT MOBILE APPS

App	Percentage
None	41.5%
BlueBeam® Revu	36.9%
PlanGrid	19.9%
Procore	12%
BIM 360™ Field	8.9%
BIM 360™ Docs	6.2%
Newforma® Plans	2.3%
FieldLens	1.6%
Aconex Mobile	1.4%
Bluevue	1.4%
Latista™	1.4%
SmartUse	1.3%
Revizto™	1%
Other	6.4%

Survey Participants Commented:

"We also utilize Dropbox™ with other contractors and our more savvy field personnel keep their own sets on GoodReader® because that is their favorite app for viewing PDF plans."
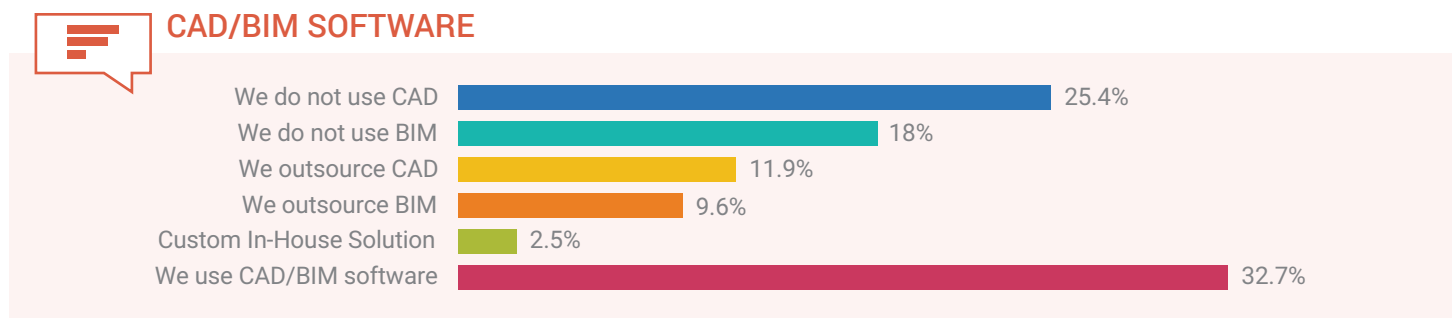
"Plans are all kept on server in-house."

"We mostly have to adapt to software that the different GC's are using."

Over 40% of the survey participants do not use a plan management app. While this is a significant percentage, it is encouraging to see a majority of builders are in some way making a transition to digital plan management. Bluebeam Revu holds a commanding lead over all other plan management apps, followed by PlanGrid and Procore.

With frequent changes published on the job site, digital plan management helps firms ensure field teams have the latest revisions in real-time, avoiding costly rework and change orders. PDF readers are incapable of dynamically relaying information between remote teams in real-time. The solutions represented in the top five spots, interestingly, represent a mix of specialty plan management apps, project management mobile apps, and BIM file specific management apps. Bluebeam, PlanGrid and Procore will most likely remain on top through 2017, as all of these apps continuously update with new features and integrations. This will hopefully drive at least a 5% reduction in the use of paper-based plans in the next year.

CAD & BUILDING INFORMATION MODELING (BIM)

CAD/BIM SOFTWARE

We do not use CAD	25.4%
We do not use BIM	18%
We outsource CAD	11.9%
We outsource BIM	9.6%
Custom In-House Solution	2.5%
We use CAD/BIM software	32.7%

The number of builders who do not use BIM fell by 30% in 2016 when compared to 2015 numbers. **The net increase in BIM usage signals that more companies are dipping their toes in the Virtual Design and Construction waters, whether internally or through outsourcing, as well as recognizing the value added in streamlining design, clash detection and scheduling in the preconstruction process.** A majority of professionals agree BIM is the future of the AEC industry, however, many are still struggling to make the transition from traditional CAD to BIM due to the comfort level associated with CAD solutions.
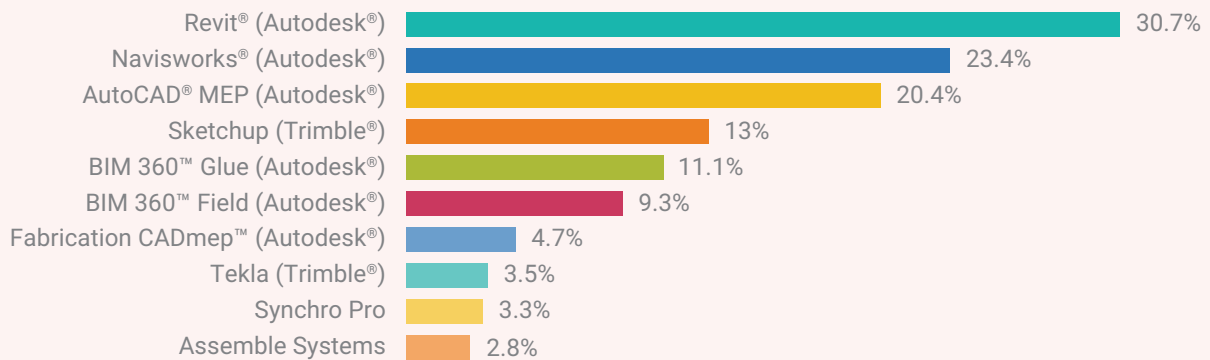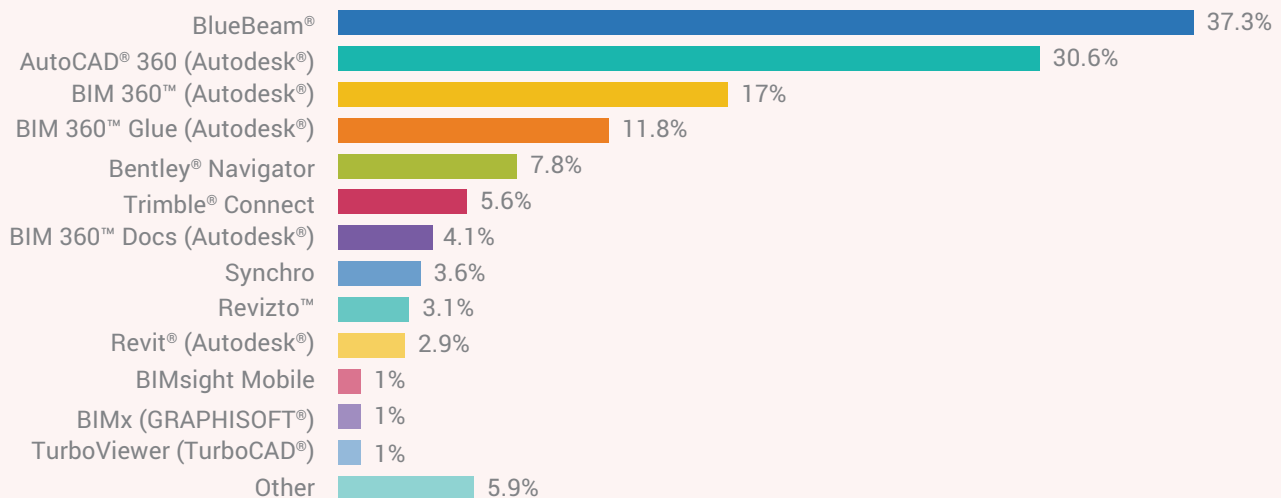
The rationale behind more companies outsourcing CAD rather than BIM is based on the fact that most construction professionals find CAD to be overly complicated and expensive for smaller projects. Ultimately, many firms continue to outsource their shop drawings using traditional methods. While the industry should hope to see more than 32.7% of companies using BIM software internally, it's understandable considering the severely low IT budgets companies have to work with. It's hard to invest time into learning a BIM solution. BIM is still not on the radar for most small contractors, and BIM experience is still few and far between among professionals. **Unless the industry trains more professionals on BIM workflows, or they train themselves, the 2017 survey is likely to see even more outsourced BIM and not a huge change in those not employing BIM.**

Survey Participants Commented:

"As the industry is changing, we are finally starting to see the need to have software capable of viewing (and editing) CAD/BIM, and personnel trained that know how to use it. We have 1 in-house drafter who uses AutoCAD 2016 and 1 PM who uses AutoCAD LT for extremely basic functions (essentially copy & paste and maybe add a few lines)."

"We don't design but want to integrate with our architect's models."

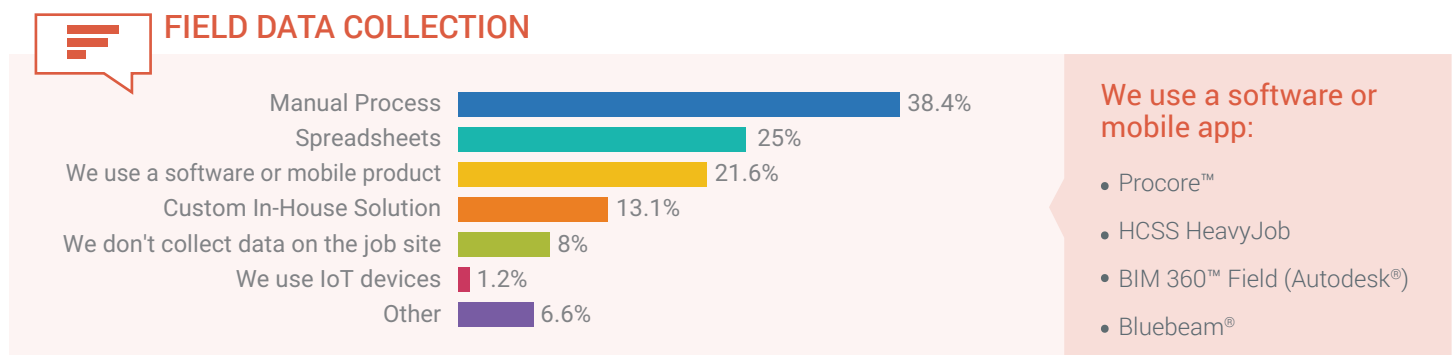*"I believe in the past we have outsourced but I know we are just now sending internal people to BIM training."*

TOP 10 CAD/BIM SOFTWARE

Software	Percentage
Revit® (Autodesk®)	30.7%
Navisworks® (Autodesk®)	23.4%
AutoCAD® MEP (Autodesk®)	20.4%
Sketchup (Trimble®)	13%
BIM 360™ Glue (Autodesk®)	11.1%
BIM 360™ Field (Autodesk®)	9.3%
Fabrication CADmep™ (Autodesk®)	4.7%
Tekla (Trimble®)	3.5%
Synchro Pro	3.3%
Assemble Systems	2.8%

CAD/BIM MOBILE APPS

App	Percentage
BlueBeam®	37.3%
AutoCAD® 360 (Autodesk®)	30.6%
BIM 360™ (Autodesk®)	17%
BIM 360™ Glue (Autodesk®)	11.8%
Bentley® Navigator	7.8%
Trimble® Connect	5.6%
BIM 360™ Docs (Autodesk®)	4.1%
Synchro	3.6%
Revizto™	3.1%
Revit® (Autodesk®)	2.9%
BIMsight Mobile	1%
BIMx (GRAPHISOFT®)	1%
TurboViewer (TurboCAD®)	1%
Other	5.9%

Revit and Navisworks solutions continue to lead the Building Information Modeling (BIM) software offerings. However, AutoCad MEP achieved a 20% share in 2016, after being absent from prior year results. This increase is likely due to the fact that more mechanical trades participated in this year's survey from MCAA distributions.

This year's survey also included a new question on what specific CAD/BIM mobile apps professionals are using on their projects. In the 2014 and 2015 Construction Technology Reports, Autodesk represented three of the top twenty mobile apps listed, so it's not surprising to see Autodesk tools dominating the BIM mobile app segment. Bluebeam has the highest individual ranks, however, Autodesk represents the largest share.

The adoption of BIM in the field is increasing due to the amount of mobile viewers that are now available to AEC professionals. These tools are getting easier to use and they're now capable of viewing larger and more complex models. There are a number of mobile solutions available that are compatible with Autodesk, Trimble, Bentley and other software providers, making it possible for users to view and work with many different file formats without being tied to a desktop.

COLLECTING DATA ON THE JOB SITE

FIELD DATA COLLECTION

Manual Process	38.4%
Spreadsheets	25%
We use a software or mobile product	21.6%
Custom In-House Solution	13.1%
We don't collect data on the job site	8%
We use IoT devices	1.2%
Other	6.6%

We use a software or mobile app:

- Procore™
- HCSS HeavyJob
- BIM 360™ Field (Autodesk®)
- Bluebeam®

This section revealed that construction professionals continue to use manual or spreadsheet processes to collect and transfer data in the field, even when it is least convenient. Builders even rely on paper forms for many daily tasks, such as timesheets, safety inspections and quality control checklists.

The few applications that are in use, according to the survey, are components of project, document or BIM management solutions that require data input from the field. **This reliance on populating spreadsheets from the job site or having to wait on access to a PC to complete administrative tasks creates costly information silos.** Until construction companies make a deliberate effort to move

towards digital workflows and the resulting bi-directional information sharing, much of the information collected will remain in "carbon lockers" unavailable for practical analysis.
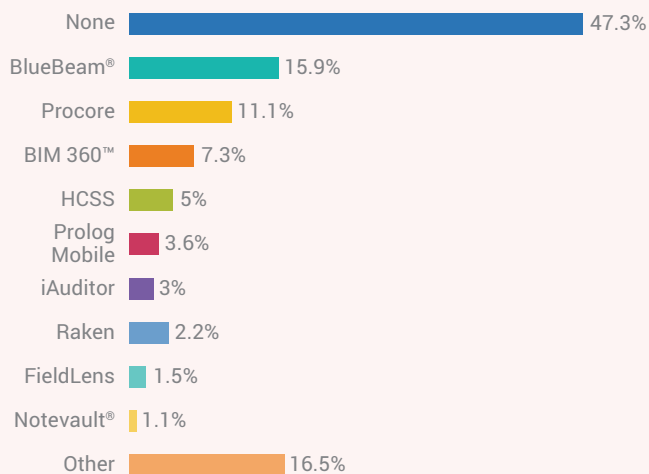
Survey Participants Commented:

"We're in the process of changing over to electronic data acquisition and integration from the field."

"The specific job sites handle this per project."

DAILY REPORTING MOBILE APPS

App	Percentage
None	47.3%
BlueBeam®	15.9%
Procore	11.1%
BIM 360™	7.3%
HCSS	5%
Prolog Mobile	3.6%
iAuditor	3%
Raken	2.2%
FieldLens	1.5%
Notevault®	1.1%
Other	16.5%

Survey Participants Commented:

"Some of our guys still hand write-in log books. Most do nothing. I've looked into a couple solutions, but nobody wants to pay for it."
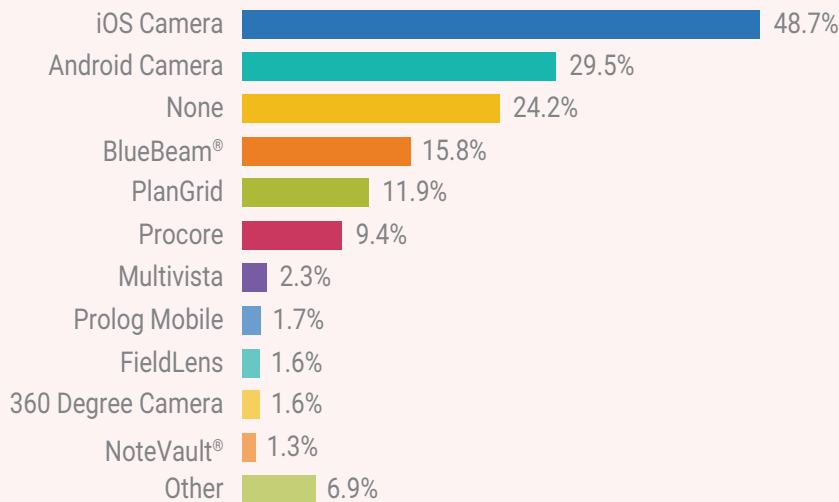
"We use spreadsheets on mobile phones."

"We manage this through email and Dropbox posting."

Nearly 50% of the construction professionals surveyed manually prepare and process daily reports. Bluebeam, Procore and BIM 360 are the most widely used daily reporting mobile apps, however, none of them rate above 16%. **Daily reporting remains a tedious manual process, providing project stakeholders little insight or record into daily progress on job sites - not to mention the lack of information for insurance claims or legal disputes.** Daily reporting falls into the category of prequalification and mobile device policies, companies don't realize how bad they need it, until they do.
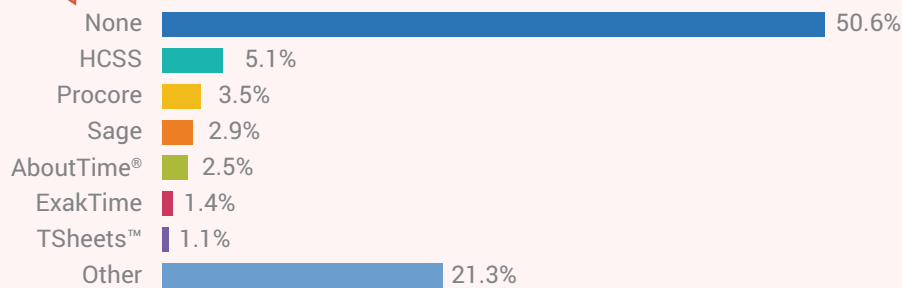
PHOTO MOBILE APPS

App	Percentage
iOS Camera	48.7%
Android Camera	29.5%
None	24.2%
BlueBeam®	15.8%
PlanGrid	11.9%
Procore	9.4%
Multivista	2.3%
Prolog Mobile	1.7%
FieldLens	1.6%
360 Degree Camera	1.6%
NoteVault®	1.3%
Other	6.9%

Survey Participants Commented:

"This is an area that we struggle with. I have not found a good app to make this happen smoothly."

The introduction of the smartphone revolutionized photo documentation on the job site. Before smartphones, superintendents would take a series of photos on a digital camera, download the images to their PC, upload them to a server, and then rename the files. The key thing to recognize is the sharing process required multiple steps, most often away from the job site. Now, many supers capture the photo with a smartphone then text or email the photo to the office. While this is more efficient for the super, it is merely shifting the workload to the office and removing a frame of reference to the subject of the photo. On the other hand, dedicated photo apps or functionality within an ERP mobile app automatically tag and file the photo for easy searching in the future.

When it comes to mobile apps for photo documentation, survey participants were 30% more likely to use the iPhone native camera than any specific photo mobile app. Bluebeam, PlanGrid and Procore were the top three apps listed in this category. Interestingly, 360 degree photo capture only made up 1.6% of the responses, with Ricoh Theta the clear product winner of 360 degree photo write-ins. **It's surprising that more project management systems do not incorporate this functionality or partner more heavily with a provider that specializes in this area.**

TIME ENTRY MOBILE APPS

App	Percentage
None	50.6%
HCSS	5.1%
Procore	3.5%
Sage	2.9%
AboutTime®	2.5%
ExakTime	1.4%
TSheets™	1.1%
Other	21.3%

Other includes:
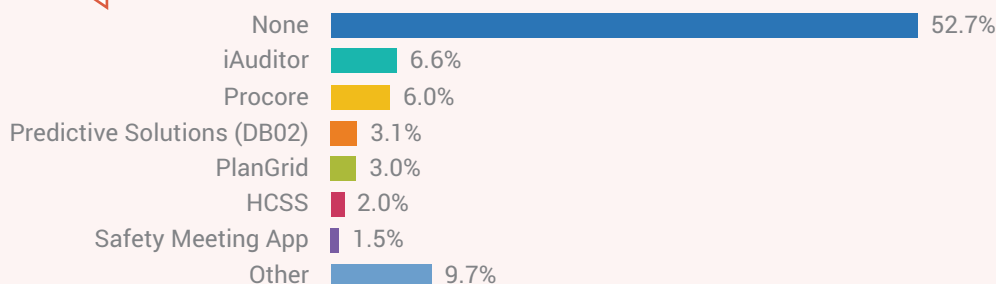
- Custom In-House Solution
- Viewpoint®
- HH2

Survey Participants Commented:

"At one point we were "exploring" the creation of a custom solution for mobile time reporting (most requested mobile function/capability from the field), however it stopped when we realized that the software used by our Estimating, Project Management/Operations, and Accounting/Payroll departments have ZERO integration capability. The "plan" was to report time on a spreadsheet, email it to the PM who then reviews, approves, and converts it to a CSV file, and emails it to Payroll/Accounting to import into their (outdated DOS-based) software."

Time entry is a workflow seemingly ripe for improvement through the use of mobile technology. Unfortunately, complexity of job codes and integrations with legacy accounting systems make integrated time entry and tracking difficult or expensive to achieve. Only 50% of survey respondents use a mobile app for time collection. While a group of apps make up 21% of the responses, the majority of these responses are for mobile apps included with ERP or integrated platforms. **As noted in the comments, the number of departments that require access to this data, i.e. accounting, HR, and others, feel that solutions available are not mature enough to meet cross-departmental collaboration needs.**

SAFETY MOBILE APPS

App	Percentage
None	52.7%
iAuditor	6.6%
Procore	6.0%
Predictive Solutions (DB02)	3.1%
PlanGrid	3.0%
HCSS	2.0%
Safety Meeting App	1.5%
Other	9.7%

Other includes:

- Custom In-House Solution

Survey Participants Commented:

"We employ a full-time Safety Manager, but do not currently utilize software in this effort."

"This is another area we struggle with, we are in the process of trial and error to find what is best suited for us."
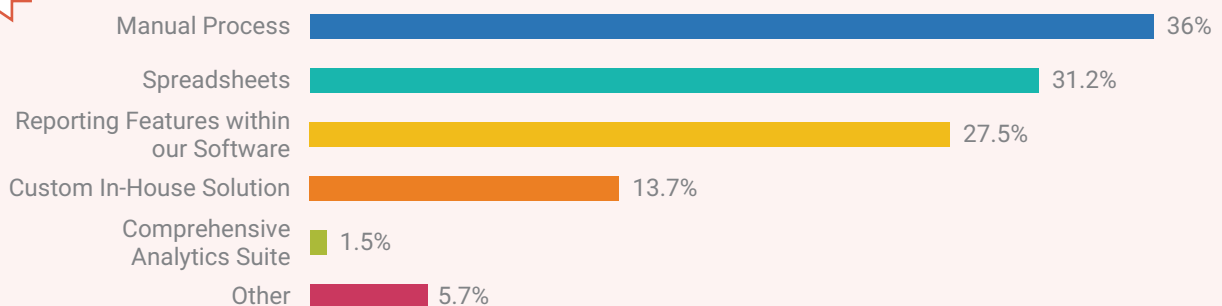
As expected, 53% of survey participants do not use safety mobile apps on their construction sites. The two highest ranked apps, iAuditor and Procore, only received between 6%-7% of the responses. **A majority of companies have an employee in charge of safety, however, have not allocated additional budget to supplement their efforts with technology.**

There are two main components to consider when managing safety through mobile apps: Compliance versus Performance. Simple compliance means completing a safety checklist or documenting a Tool Box talk. This is "CYA" insurance to show OSHA when the need arises. Performance is using a system that can analyze stats and trend data to look for patterns in movement on the job site, worker location and more. Some new platforms, like Safesite, are even using AI to predict job site conditions based on the environment and location. **But according to the survey, builders still need a lot of convincing to employ safety mobile apps.**

TRACKING PERFORMANCE METRICS

PERFORMANCE TRACKING SOFTWARE

Manual Process	36%
Spreadsheets	31.2%
Reporting Features within our Software	27.5%
Custom In-House Solution	13.7%
Comprehensive Analytics Suite	1.5%
Other	5.7%

Methods of tracking performance metrics were added to the survey this year to gain a sense of how construction companies are leveraging the data they collect on projects to gauge how well they are performing and improving on future projects. **Respondents report that manual methods are the most prevalent at 36%, followed closely by spreadsheets at 31%, so it's likely they use a combination of the two.** Participants who have this functionality built into their software solutions are not far behind at 28%. Other solutions like Business Intelligence or analytics suites are still in their infancy with construction companies, yielding only a 1.5% response.

None of these data points are particularly surprising. Calculating performance metrics are dependent upon collecting the activity and completing data at the source of the work. Throughout this report is evidence of the lack of traction in automated, mobile and real-time data collection. **Tracking metrics are either limited because it is too hard to compile the data to analyze or builders are limited to analyzing the data within existing legacy systems.**

Survey Participants Commented:

"We have a mix of solutions in place, ranging from spreadsheets to custom web sites."

"We are in the midst of developing our own solution after several years of providing program and project performance metrics services for large federal agencies."

CLIENT RELATIONSHIP MANAGEMENT (CRM)

For the 4th year in a row, the survey showed little to no adoption of CRM software in the construction industry for tracking and nurturing project leads, managing prospect information and keeping up with previous or current clients. In 2016, 39% of respondents use a manual process for client relationship management, and those using a dedicated CRM software are below 10%. This may be because there are few construction industry-specific solutions available, and many companies find it easier to customize their contact database in invitation to bid and project management software.

CRM SOFTWARE

Manual Process	39%
Outlook	14.9%
Spreadsheets	11.1%
SalesForce®	8.2%
Cosential®	7.5%
Custom-In-House Solution	7.5%
Microsoft® Dynamics	5.5%
Act!™	3.6%
SageCRM	1.2%
SAP®	1.1%
Other	11.8%
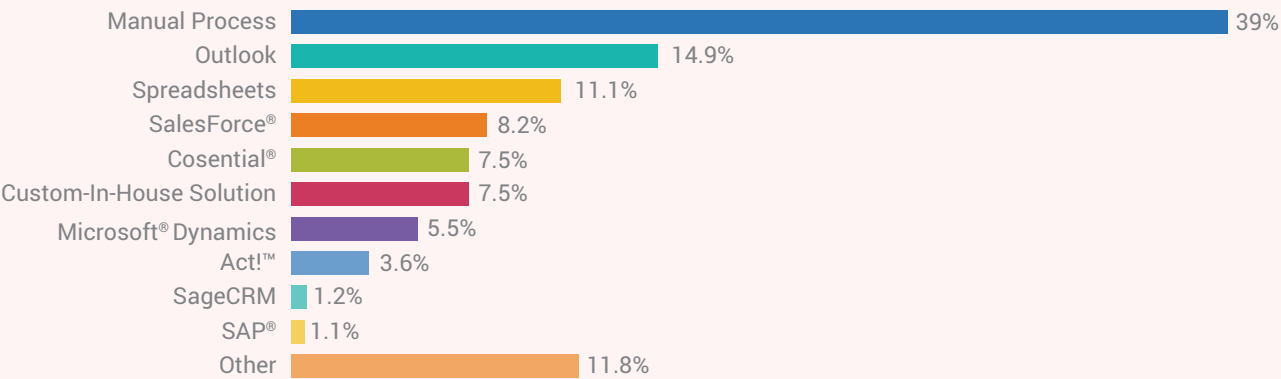
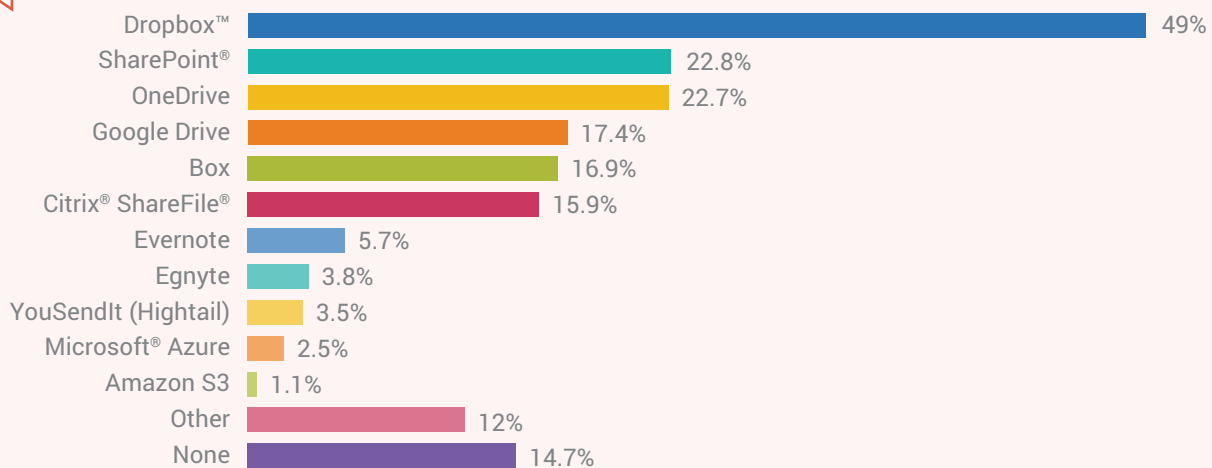*Survey Participants Commented:*

"We have repeat customers and have created strategic relationships which has reduced the need for a CRM. We have less than six potential new clients at any given time."

This is a common software category to have low adoption across many industries, only heavily sales-based professionals who have truly used and built out a system like Salesforce can understand its value in tracking and maintaining relationships. Companies are missing a major opportunity to prospect, nurture, close and maintain customers. CRM software like Salesforce and Cosential allow for companies to not only accurately track and close clients, but also keep their information up-to-date and sync with other system databases.

FILE STORAGE & SHARING

CLOUD STORAGE SOFTWARE

Software	Percentage
Dropbox™	49%
SharePoint®	22.8%
OneDrive	22.7%
Google Drive	17.4%
Box	16.9%
Citrix® ShareFile®	15.9%
Evernote	5.7%
Egnyte	3.8%
YouSendIt (Hightail)	3.5%
Microsoft® Azure	2.5%
Amazon S3	1.1%
Other	12%
None	14.7%

Survey Participants Commented:

"Our Project Management/Operations department uses Box for document storage, sharing & collaboration. Each PM has their own Box account. As we have not yet graduated to an enterprise Box account, our estimators use whatever they know how to use or have been told "works." Our company had a fear of "the cloud" for a long time, so this is very fragmented."

Dropbox and Sharepoint maintain their top rankings for file storage and sharing solutions. The ranking of solutions remained mostly the same as 2015. Survey participants commented that moving from one file storage system to another is a trivial effort. Once users choose a file storage system, it makes sense for them to implement for a while. OneDrive, however, did receive nearly a 10% increase over last year. We would most likely attribute this increase to its zero cost inclusion with the Microsoft Office 365 platform, which continues to gain popularity in the construction industry - especially as the Windows OS, Surface Pro and Microsoft Project gain adoption among builders as noted earlier in this report.

It is important to note how file storage and tools are being used, according to the survey comments. Since the point of entry for cloud storage is frequently a collaboration point on a construction project, it is easy for users to start adopting cloud storage internally and create "shadow IT." **These pockets of information in personal accounts make it extremely difficult, if not impossible, for companies to maintain proper data security, analytics and maintenance.**

Construction companies need to evaluate how to leverage cloud storage tools both internally and externally to make it easy for employees to collaborate while maintaining proper control at the corporate level. Some of the most widely damaging phishing and malware schemes in 2016 came in the form of an email that looked like someone sharing a file from Dropbox or Google Drive - if there isn't a company standard (and phishing perpetrators do their homework) it's easy to maliciously get into corporate information via employee email.

Survey Participants Commented:

"Dropbox is not officially sanctioned by IT nor the company. It's used 'off-label.'"

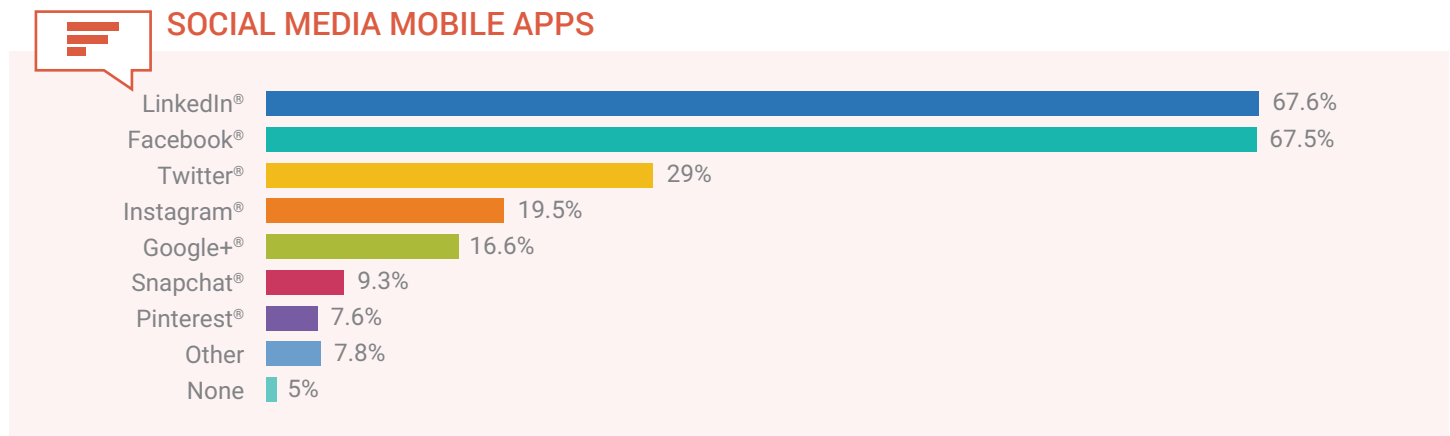## CONFERENCING & COMMUNICATIONS

CONFERENCING & COMMUNICATIONS SOFTWARE

Software	Percentage
GoToMeeting™	55.9%
Skype™	30.7%
WebEx™	22.8%
None	15.5%
FaceTime	12.4%
Microsoft® Lync	10.8%
Join.Me™	10.1%
Polycom™	6.8%
Google Hangouts	4.3%
Zoom	2.3%
InterCall®	1.8%
Adobe® Connect™	1.7%
Other	6.9%
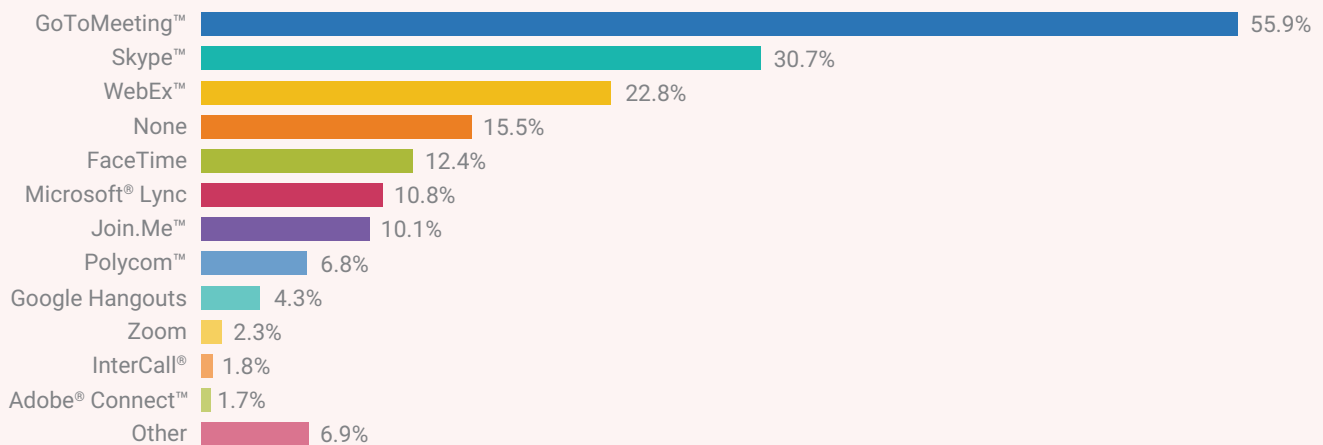
Survey Participants Commented:

"We almost always provide separate audio conference calling to better facilitate video conferencing (less lags due to bandwidth)."

GoToMeeting is the clear favorite for construction professionals to conduct web conferencing and communications. This year, respondents chose Skype as their second most preferred software, jumping ahead of Webex by 10%. Many respondents commented that they depend on the other party, i.e. a general contractor requesting a meeting with a subcontractor, or an owner requesting a meeting with a GC, to set up the conference line and then use whichever is provided to them for the call or meeting. **Perhaps an underlying motivation for using these tools, irrespective of which conferencing tool construction professionals choose, is to preserve project documentation through recording meetings.** Stakeholders can reference these recordings to clarify conflicting information.

SOCIAL MEDIA MOBILE APPS

App	Percentage
LinkedIn®	67.6%
Facebook®	67.5%
Twitter®	29%
Instagram®	19.5%
Google+®	16.6%
Snapchat®	9.3%
Pinterest®	7.6%
Other	7.8%
None	5%

Construction has a reputation of being behind the times when it comes to tech. However, 93% of the respondents are using some form of social media daily, most likely for personal use. There is still opportunity in this space for users to incorporate social applications into more professional workflows. **LinkedIn and Facebook are by far the most used social media platforms by survey participants, with 68% of participants using one or both social channels.** Twitter follows behind at 29% and surprisingly, only 5% of participants do not use social media daily.

As the "Millennial" generation is moving into construction management roles, these percentages may continue to rise. In next year's survey, it would be interesting to extract more data on how builders are using social media professionally, if at all.

BIM/VDC Strategy

Dive into how companies are approaching BIM & VDC on projects and what challenges they face.
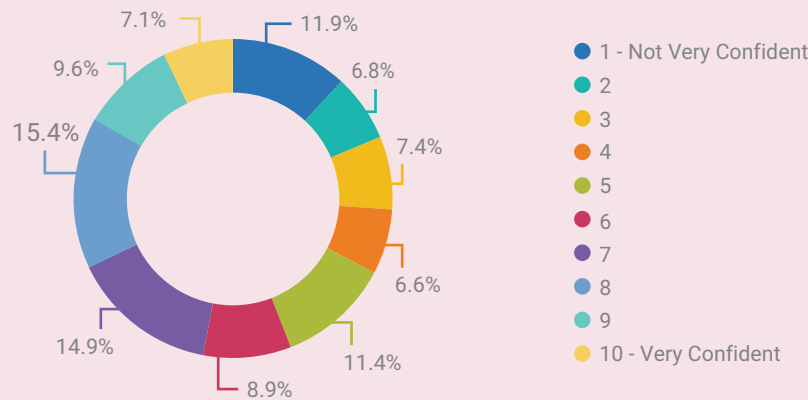
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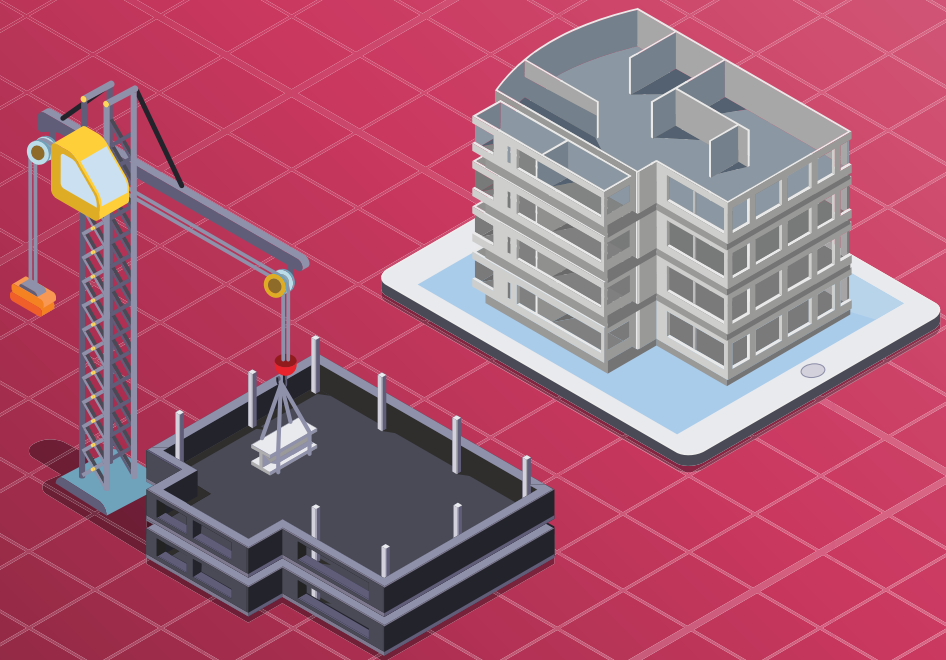
ĀĪM®
CONSTRUCTION SCIENCE
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CONFIDENCE IN ABILITY TO MAXIMIZE VDC

Legend:
- 1 - Not Very Confident
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 - Very Confident

Chart values: 11.9%, 6.8%, 7.4%, 6.6%, 11.4%, 8.9%, 14.9%, 15.4%, 9.6%, 7.1%

Survey Participants Commented:

"We need more reliable input and collaboration from subcontractors and design teams or it's no use."

"Ability is high, PMs buying our service as internal clients? Not so high."

"I have the knowledge, but my staff doesn't. I am too busy doing the work to effectively manage and train them."

"Oddly, the GC side of our family of companies is fairly low on the spectrum, whereas, our program management arm is an industry thought leader on BIM turnover to Facilities, Operations and Maintenance."

"Superintendents are VERY skeptical about implementing."

"BIM is supposedly the most important parts of the building process, but the time allowed to complete the modeling and coordination is decreasing along with the quality."

Throughout this section we'll mention VDC, Virtual Design and Construction, which is a more comprehensive term for the workflows, staff and solutions that optimize BIM. **Many companies are even combining IT, BIM and VDC departments in favor of a more cohesive Construction Technology Department.**

When asked about their confidence in their company's ability to maximize the VDC process, survey participants most often reported a 7 or 8 on a scale of 1 (Least Confident) to 10 (Very Confident). **This is a surprisingly positive self-diagnosis, especially considering that comments throughout the BIM section of the survey indicated that training, collaboration and staffing is not in place to properly use BIM.** Maybe this is why after 7 and 8, the third most likely answer in confidence level was a 1.

The comments on this particular question were extremely insightful. **Builders admitted they are having a hard time completing BIM on time and before construction starts, because the time to BIM**

completion is not understood by all parties and is not incorporated into scheduling with sufficient amounts of time as it should be. BIM then becomes the laggard in the preconstruction process, and scrutinized severely for cost. Commentary also suggested that design firms struggle with contractor competency to input BIM data, while contractors feel they are not given the space/opportunity to contribute fully on BIM as needed.

Consistent file-sharing methods and keeping up with the latest software evolutions is also difficult for builders, one survey participant commented "BIM - The ever evolving software - UGH!" With few hours and staff to dedicate to learning BIM, it doesn't help that BIM is constantly evolving and requires continuous education and training.

PERCENTAGE OF PROJECTS USING VDC WORKFLOWS

Category	Percentage
None	20.6%
0 - 25%	33.4%
26 - 50%	7.8%
51 - 75%	3.6%
75 - 99%	0.1%
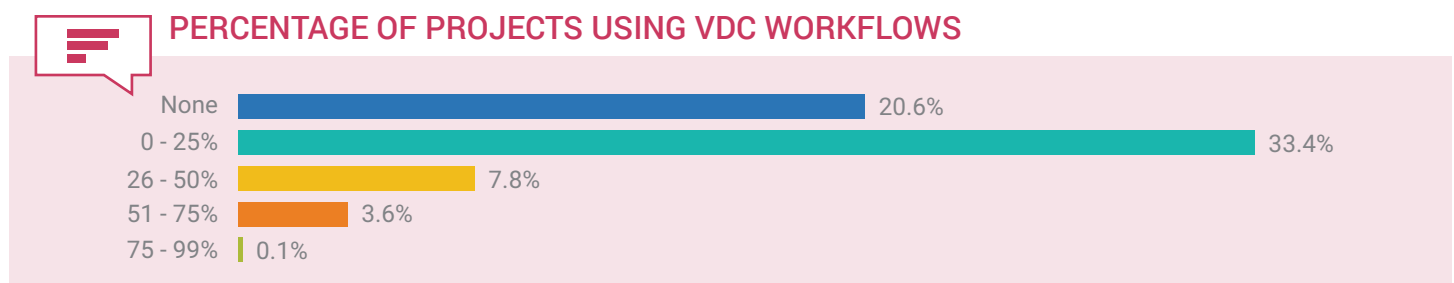
In 2016, only 4% of the construction professionals surveyed said they use BIM on more than 50% of their projects. It's easy to correlate the lack of IT resources to the lack of BIM resources within construction companies. Companies that do have dedicated BIM professionals provide limited resources, and so those individuals are forced to focus resources on specific projects to maximize their efforts. Comments indicated they feel that they have little time to train others on their BIM knowledge or scale up their BIM efforts.

In the foreword of this report, CEO of JBKnowledge, James Benham, attributes low IT budgets to the fact that construction companies have a hard time measuring return, not necessarily that they doubt technology's value. **However when it comes to BIM, owners still do not fully understand its value and so there is no top-down driver for adoption**. BIM adoption numbers in this report will only increase slowly until owners really push for BIM workflows and value-add.
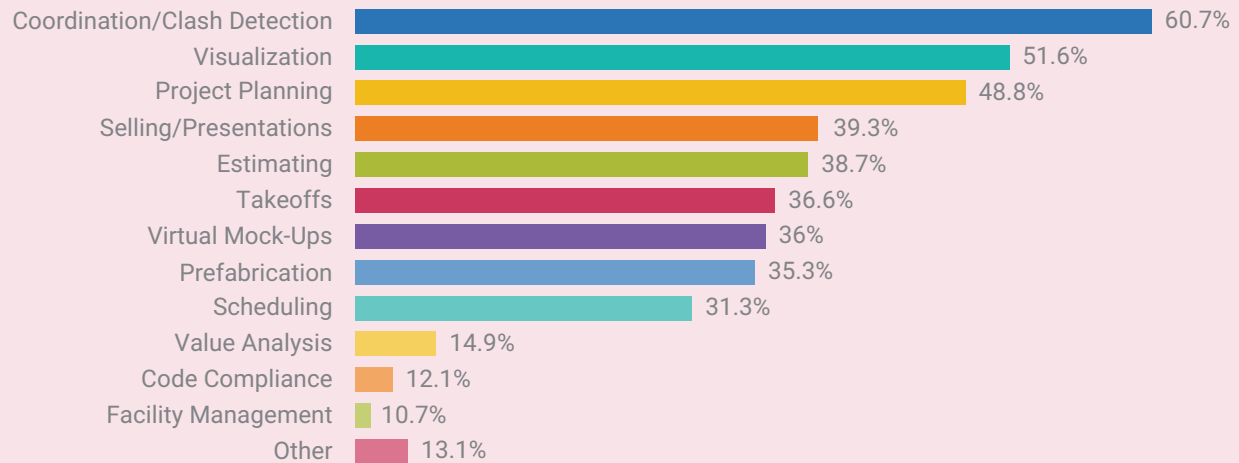
Survey Participants Commented:

"Only projects in our 'small projects division' don't use BIM - when the model takes longer than the entire project."

"Level 2 BIM on roughly 30%, however we utilize BIM processes on all projects for clash detection and coordination purposes in house."

58

HOW COMPANIES USE VDC

Category	Percentage
Coordination/Clash Detection	60.7%
Visualization	51.6%
Project Planning	48.8%
Selling/Presentations	39.3%
Estimating	38.7%
Takeoffs	36.6%
Virtual Mock-Ups	36%
Prefabrication	35.3%
Scheduling	31.3%
Value Analysis	14.9%
Code Compliance	12.1%
Facility Management	10.7%
Other	13.1%

So for those companies that are implementing VDC, how are they using it? **61% of builders use VDC for Coordination and Clash Detection. Visualization and Project Planning are not far behind at around 50%.** Low numbers for Value Analysis, Code Compliance and Facility Management show the lack of collaboration across departments/teams to input and analyze data throughout the life cycle of the project - all three processes require multiple project departments on board with VDC to input, transfer and analyze data.

It was surprising to see VDC used only 30% of the time for Scheduling - but emerging 5D software products should change that over the next year. Scheduling with BIM will also grow in importance as more companies leverage technology like robotic total stations to improve the layout process and match progress to design. BIM for Prefabrication may also increase in the next year as more companies use improved laser scanning and photogrammetry solutions to optimize prefab accuracy.

Survey Participants Commented:

"We want to add more capability, but they want to play around without having a goal. We don't have the personnel to dedicate to testing products."

"Our next goal is to utilize it for estimating."

"BIM used for our oil & gas construction division as all piping models are designed by the customer. General Construction division does not currently use BIM."

Future Tech - What's Next?

Get a glimpse of what the future of construction projects will look like and how builders are preparing for the shift.
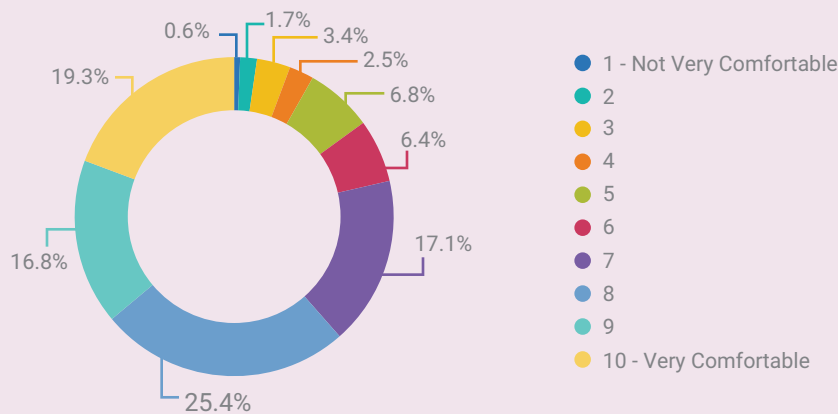
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EMERGING TECH

HOW COMFORTABLE ARE BUILDERS WITH NEW TECH?

0.6%
1.7%
3.4%
2.5%
6.8%
6.4%
19.3%
17.1%
16.8%
25.4%

- 1 - Not Very Comfortable
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 - Very Comfortable

Survey Participants Commented:

"Updates are merely patches on faulty, messy code that typically offer "advantages" the programmers think are cool but do not serve people doing the work. We should require all programmers to work in the field using the software they design so they gain real world experience, also require all upgrades to be vetted by the grandmothers of the programmers."

"Comfortable but the problem is that I can only recommend or show it, there are no champions in our organization that take ownership."

"We consider ourselves "fast followers.""

"Because of our aging workforce it would be difficult. Once our older work force retires, we'll be in better position to implement."

Nearly 62% of builders say on a scale of 1-10, 10 being "Very Comfortable" with new technology, that they are at least an 8. It appears the construction industry is embracing new technology, as the top four responses by percentage were between 7 and 10. **It seems that embracing new technology isn't the issue in this industry, as much as the strategy for how to implement it, who will own the process and how to calculate the return in order to get budget approval.**

THE MOST LIMITING FACTOR IN ADOPTING NEW TECHNOLOGY

Lack of IT Staff — 39.7%

Budget — 37.2%

Employee Hesitance — 31.6%

Lack of IT Experience — 29.6%

Management Hesitance — 28.3%

Maturity of Technology — 16.4%

None - We try it all — 9.4%

Other — 5.4%

I don't know — 5%

- 2016
- 2015
- 2014

Other includes:
- Not enough time to try new tech.
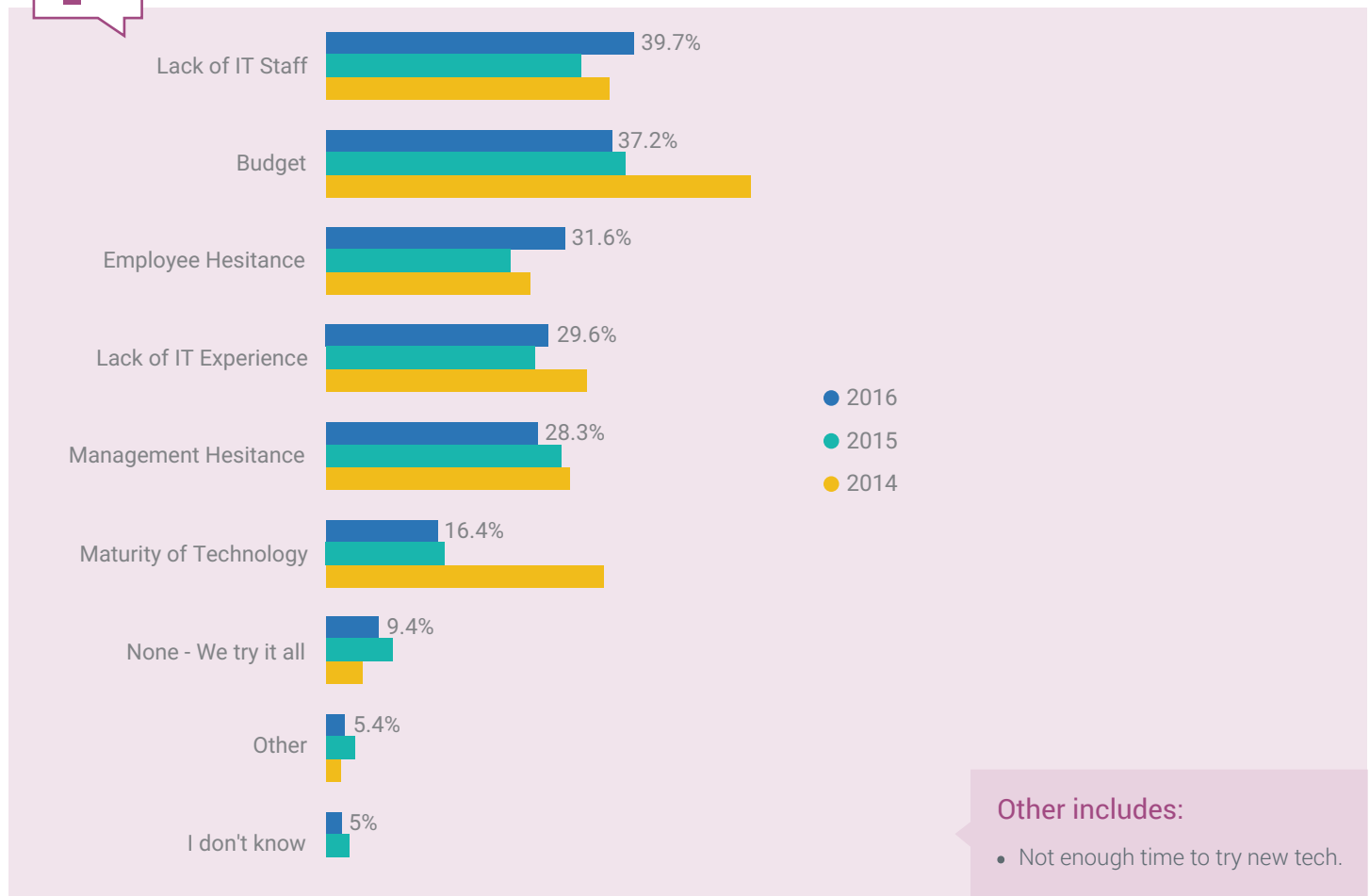
Survey Participants Commented:

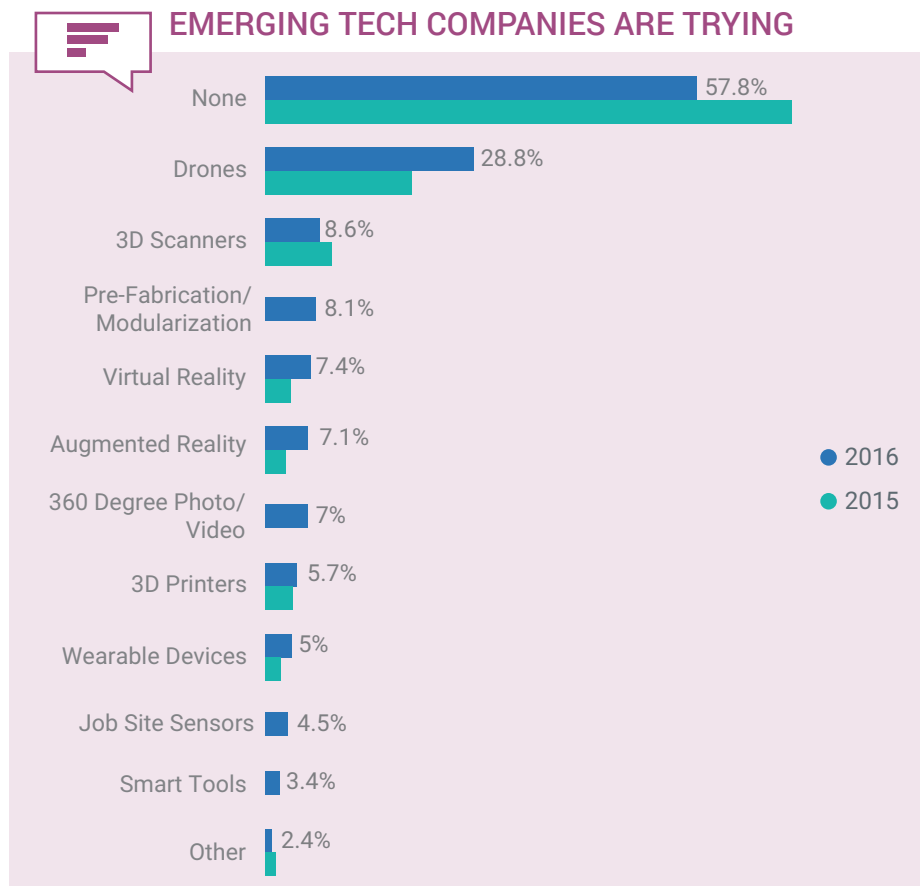*"Technology is simply moving too fast for us to keep up with internally."*

"Truth is the software package will only be used to about 30% of it's capacity...however, we will pay for it all."

"I try to gather as much information as possible and present new technology so I feel like I'm doing my job and staying on top of things. It seems to take years before anyone will listen to a new idea, and by then it's not new anymore."

After establishing a strong comfort with trying new technology, survey respondents were asked to identify the most limiting factors in their companies adopting new technology. **Lack of staff to support the technology was the most common answer in 2016 at 40%, followed closely by budget at 37% and employee hesitance at 32%.**

Employee hesitance replaced last year's third most prominent answer, management hesitance. **Perhaps this shift is attributable to management finally seeing value in technology investments and extending implementation but since they took so long to come around, users are now fairly deep into their current solutions.** It's interesting to note that the survey participants who said they "try everything" were from the smallest companies surveyed, with 51-100 employees. Smaller companies have enough people and processes to want to try new tech to improve efficiencies, but also have an agile mindset of research, development and testing - it really only takes one champion to get tech on the company's radar and considered at a smaller company.

EMERGING TECH COMPANIES ARE TRYING

Technology	2016
None	57.8%
Drones	28.8%
3D Scanners	8.6%
Pre-Fabrication/Modularization	8.1%
Virtual Reality	7.4%
Augmented Reality	7.1%
360 Degree Photo/Video	7%
3D Printers	5.7%
Wearable Devices	5%
Job Site Sensors	4.5%
Smart Tools	3.4%
Other	2.4%

● 2016
● 2015

Survey Participants Commented:

"It is EXTREMELY difficult to get our management team/ company officers to see the benefits of these "toys." Regardless of how many employees are asking for something, and no matter how sound your argument, overcoming the fear of change is a great hurdle. Until we accomplish that company-wide, I don't foresee any resources being allocated for R&D, emerging technologies, or anything that relates to 21st century construction."

While nearly 60% of construction companies are not investigating any new technologies, 29% of those surveyed are testing drones. Drones also led last year's most popular emerging technology. Prefabrication/Modularization and 360 Photo/Video were added to this year's survey and rank among AR/VR as they gain traction within the industry.

Survey participants were then asked "If you could have any tech today to implement, what would it be?" The responses were all very practical and/or specific solutions, such as BIM software, integrated project management, automated time capture and something to help capture job site progress with photos. There were very few dreamers mentioning IOT, robotics, biometric readers, smart helmets or

other emerging, novelty tech. **Builders are awaiting approval on the solutions they needed yesterday before looking to the next generation of tech.** Also, without R&D departments, as noted in the next segment, most companies don't have anyone empowered to dream about and investigate the use cases for that new tech.
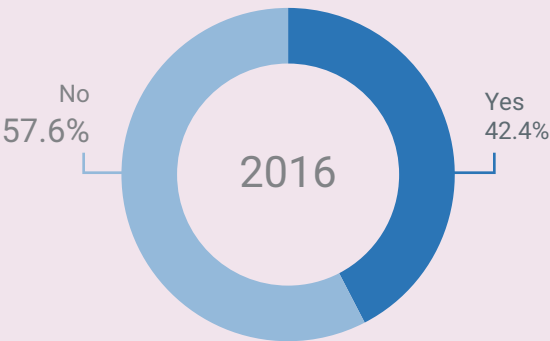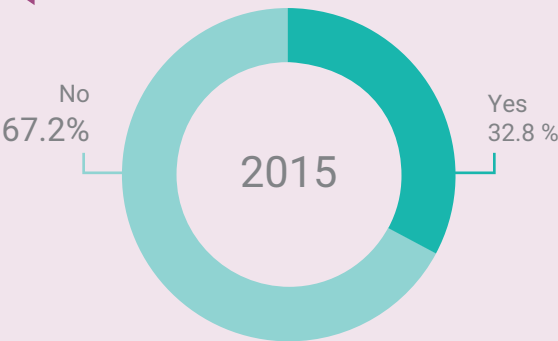
Survey Participants Commented:

"We have partnerships with our area universities to explore these and more at our Innovation Center."

RESEARCH & DEVELOPMENT

DEDICATED R&D BUDGET

No
67.2%

2015

Yes
32.8 %

No
57.6%

2016

Yes
42.4%

No, because:

- Budget reasons.
- Our company is not big enough.
- It's never been considered.
- Not a priority.

- We outsource R&D.
- Handled by the IT department.
- Approved on a case by case basis.
- Good question.

- We use mostly off-the-shelf solutions.
- Can't get it approved.
- Lack of time.

Survey Participants Commented:

"Sorry, can't expect a company that doesn't offer paid holidays or vacation time to invest in R&D."

"Our IT has been the same since 1985."

"At my company, bonuses are awarded for not spending money on new tech/software."

"As a builder working in Public Works, it is a low margin business with very little budget that can be devoted to R&D. If it was a higher margin industry and our margins depended on R&D breakthroughs, then we would revisit."

It is important to note that the 2015 survey question was "Do you have a R&D department?" Due to last year's comments, the question was changed on this year's survey to R&D budget, as many companies noted they are allowed some funds to put towards R&D, but not necessarily towards a dedicated department. **The majority of those companies who answered Yes to having a R&D budget are from companies with more than 1,000 employees, have a dedicated IT department, and have over $500 million in sales volume**. However, they still spend less than the survey average of $500,000 annually on IT. Many participants cited cost of R&D in a low margin business as a barrier. Some mentioned that they will spend money on R&D only selectively when presented with the right opportunities.

When builders maintain the aforementioned perspective, construction companies miss the opportunity to select a technology champion, empower this individual to research and test new technology and find measurable results that can positively impact their operational efficiency. A small, speculative R&D budget can go a long way in improving the IT budget by identifying and testing solutions before impacting significant spend and operations.

Survey Participants Commented:

"We spend money on R&D in that our users buy things they try on credit cards, but there is no structure that allows us to share the information - they all keep the info to themselves and the "innovation" is kept to single projects. We very much want to develop a way to do this within a framework where we can track what we spend and spread the technology to the right people."

NUMBER OF EMPLOYEES DEDICATED TO R&D

19.6%

25.8%

- None
- 1
- 2 - 5
- More than 5

34.8%

19.8%
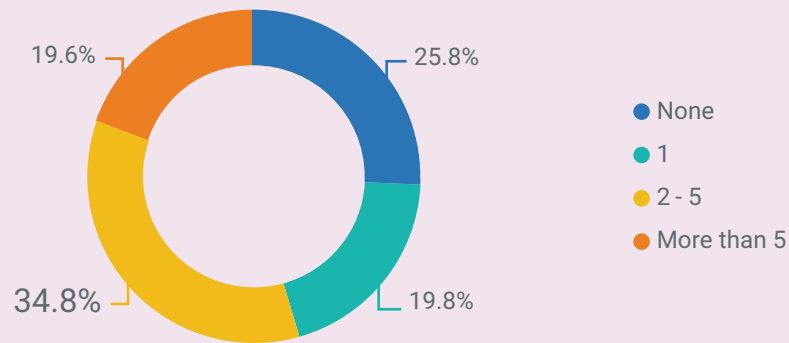
Approximately 35% of survey participants with a R&D budget have 2-5 people in full time R&D roles. Survey comments in this section echo those from the R&D budget segment, stating that they rely on team members across departments, either part-time or on their own time, to seek out new technology. Surprisingly, the construction companies with 2-5 dedicated R&D staff members were most likely to only have 1-5 total IT employees on staff. **Consequently, R&D is most likely a defined role of the IT staff for those companies, instead of in addition to**. It will be interesting to dig further into R&D staff in the 2017 report and learn their job titles and chain of command.

Survey Participants Commented:

"I, the BIM Manager, research and implement new technology, but it is not my full time position."

"There is no full time employee. This responsibility is shared by the business group who would benefit from IT."

DEFINED R&D PROCESS

15.7%

43.2%

- Yes
- No
- I don't know

41.1%
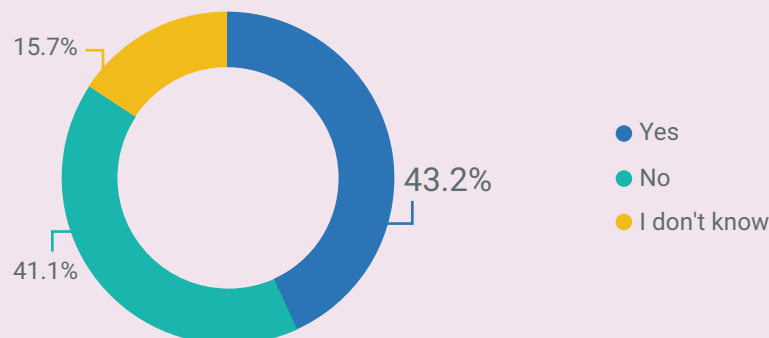
The number of survey respondents who said their company has a well-defined process for testing and implementing new tech barely edges out those who don't, 43% to 41%. **Those who answered yes were likely to come from companies with over 1,000 employees and were only slightly more likely to have**

dedicated R&D budget than those that said no, which was surprising. This supports the fact that companies spread R&D efforts to the individual departments, instead of having a centralized individual or staff objectively finding, reviewing and analyzing new tech for implementation.

Survey Participants Commented:

"We have a technology committee that will research and evaluate the usefulness of new products. If they see that it will help improve performance or enhance operations they will come up with a recommendation to the Executive staff for implementation."

"Tools get introduced at all levels of the organization but there is no standard for evaluating, validating, integrating and implementation."

VISUALIZATIONS & WEARABLES

How are construction companies using hardware and software for project visualization? Here's an overview of what the 2016 Construction Technology Survey participants are using, along with some other emerging solutions that builders should know about.

360 Degree Photo/Video Solutions In Use:

360 degree photo and video is providing the industry a better way to document construction projects. **This type of technology also requires little to no training, as it's normally point and click, so any employee can use effortlessly.** It helps if the hardware is used with a software like HoloBuilder that allows builders to create a virtual 360 degree job walk to capture current conditions.

Construction professionals are able to streamline documentation, speed up as-built designs, and collaborate on projects quicker with on demand, up to date imagery.

Matterport's low-cost device is a tripod-based scanner that produces traditional point clouds as well as Google Street View-esque walk-throughs of captured reality data. Bentley Systems Acute3D offers

a turnkey solution to capture, edit and enhance the documentation of real job site conditions.. From laser point clouds to photo processing in 3D, Bentley's solutions leverage field data collection to help construction professionals improve their performance assets. The Ricoh Theta S high-spec model captures job site photos in a 360° view. The Theta S is also equipped with advanced functions, such as HD live streaming, full HD video capture (up to 25 minutes), and a high resolution lens. GoPro's Omni scanner, while more expensive, captures extremely high quality 360 degree photo spheres.

3D Scanning Technology in Use:

3D laser scanning is the second most widely used emerging technology among construction professionals who took the 2016 Construction Technology Survey. **This is not surprising, considering scanning technology produces as-built point clouds of a structure in significantly less time and substantially higher detail than traditional surveying.** Point clouds are a format to show exact, measurable dimensions of a captured space. Existing conditions can be captured accurately and comprehensively in a point cloud for review, and then BIM models can be built to exact dimensions on top of the point cloud for later modeling use.

Faro offers competitively priced scanners that are easier than most to operate, with simple software that integrates well with the Autodesk suite. Trimble is new to enter the scanner market, previously having white-labeled Faro scanners. Trimble's scanners integrate well with their software suite. Leica offers some of the most premium scanners on the market, with high durability and high scan quality. Matterport's scanner is an optical scanner rather than using a traditional LiDAR laser, and produces lower quality scans but at a significantly lower price point than their competition. Paracosm is entering the market with low cost handheld scanning solutions to make capturing job site progress in point clouds affordable and easy to do regularly.

Keep Google's Project Tango in mind: Google is starting to partner with smartphone manufacturers to bring scanning technology to mobile devices. The Lenovo Phab 2 Pro is already available with the Project Tango platform included. Even though few software vendors have released job site-ready

software for the Google Project Tango platform, in the next few years the platform is poised to make scanning extremely low-cost and more accessible for documentation of job sites.

Augmented Reality Technology In Use:

Augmented reality (AR) is the use of glasses, goggles or a mobile device camera to overlay computer-generated graphics over real vision. **Augmented reality is often used in construction to project BIM models or information over a builder's view of floor plans, the job site, or to bring models into a room to "set them on a table," for example.** The use cases for AR in the AEC industry have grown rapidly in the past several years.

The latest buzz around augmented reality stems from the Microsoft HoloLens headset, which can extend interaction with 3D models beyond the confines of a 2D computer screen, creating new ways for construction teams on complex projects to visualize, share ideas, and manage change requests. The headset allows visual overlay combined with manual gesture tracking, it's a great example for what comes next after touchscreens. Trimble even developed an app for it's SketchUp product to be used in HoloLens to markup construction projects via the headset.

Virtual Reality Technology In Use:

Virtual reality is an immersive, three-dimensional, computer-generated environment that can be manipulated by human interaction, most often through a wearable device. **Builders are most often using VR combined with BIM models to walk through project designs and specifications and better plan and understand the work to be done.** In construction, change orders are extremely expensive and

time-consuming. By using a combination of BIM and virtual reality, construction companies can better coordinate schedules, detect clashes in design, and better visualize the stages of a project. Virtual reality is also an incredible tool to show design intent and plans in a pitch to owners and developers.

Virtual reality solutions in use by builders start at the very cost effective Google Cardboard, a platform of low cost headsets, some made from cardboard, that was launched by Google to make virtual reality easily accessible. Builders with a slightly larger budget are exploring the Samsung Gear VR and those with an actual IT budget are looking into more advanced and more expensive Oculus Rift and HTC Vive virtual reality platforms.

It's important to note that in October 2016, Microsoft announced it would be working with its partners to sell headsets integrated with the Windows 10 operating system, which has been enhanced for holographic capabilities. Starting at only $299, the headsets will include the inside out tracking sensors pioneered by the HoloLens that allow objects to stay anchored in space, even with user movement, and feel more like "reality." This boost in availability of low cost hardware is big news for builders skeptical of IT costs.

There are also other solutions out there, like Revizto, who don't produce VR hardware but are helping companies convert CAD and BIM files into virtual environments with software. They often integrate with hardware like Oculus and HTC Vive to allow for easy consumption of the virtual environments they help build.

Wearable Technology In Use:

In regards to wearable technology, construction companies are using a wide variety of devices including arm bands, gloves, watches, helmets, headsets, glasses, and exoskeletons. **These technologies allow for hands-free usage (well, minus the gloves and any manual gesture tracking), real-time environmental data capture and integration with human input and sensory data.**

The Daqri smart helmet has received a lot of hype as the next generation of safety and job site wearables. The helmet delivers real-time job site data to the wearer, letting them see thermal hot spots,

guided instructions, remote assistance and more. While Daqri's technology is already in production via HUD (heads up displays) in automobiles, the prototypes for construction helmets are still being tested. Many construction companies are anxiously awaiting their release, but are especially eager to see the price tag attached to them. The Heads Up Safe is another great visual wearable in use by construction professionals. The Heads Up system allows operators to receive personal safety and time critical updates while maintaining focus by providing alerts within their peripheral vision.

Sensory wearables are the most common among participants, they aim to collect and analyze the wearer's biometric data. Sensory wearables can range anywhere from fitness trackers, like the Apple Watch and Virgin Pulse, to safety vests. Fitness trackers are equipped with GPS, heart rate monitors, temperature sensors, perspiration sensors and more. **If this type of technology were implemented on every job site and regularly monitored, the impact on risk management could be huge.** Imagine telling a workers compensation insurer about your ability to track workers' current health status and daily work conditions.

Even though tactile wearables were not represented in this year's survey responses, it's important to note this trend is on the rise. Exoskeletons, like Hyundai's 'Iron Man' Suit and Ekso Bionics, are created with the construction industry in mind and are equipped with hydraulics, which make humanly impossible tasks easy for a job site laborer.

Ultimately, wearable technology enables construction workers to work more efficiently and empowers companies with data to make sure costs decline as productivity goes up.

DRONES, SMART TOOLS & JOB SITE SENSORS

Drones, smart tools and job site sensors are rewriting the rules on a construction job site. Learn about the solutions builders are using to capture job site data from the air and on the ground.

Drones in Use:

Drone Apps in Use:

As the most widely used emerging technology, companies are employing a variety of drone hardware and software to capture aerial data for imaging, topographical mapping, video recording and much more. The prevalence of UAV usage has increased exponentially within the last couple of years. **With this increased drone air traffic, the Federal Aviation Administration (FAA) finally released their** first commercial drone regulations **in 2016 - as predicted in the 2015 Construction Technology Report.**

Kespry aerial drones are highly regarded in the construction industry. Their ability to fly a 150 acre site in less than 30 minutes, measure any distance or volume in less than one minute and provide millions of data points in each 3D model, make them an optimal tool to track progress and conduct site surveys on the job site. Parrot drones are one of the most affordable options because they capture less dynamic data but still produce HD photo and video for project progress tracking and surveillance. The DJI Phantom 4 drone is quite possibly the most intelligent drone on the market. In the Phantom 4, DJI has incorporated precision hovering, an optical sensing system, visual tracking, multiple flight modes and a 28-minute fly time.

Skycatch and DroneDeploy are the top drone software applications used in the AEC industry. Professionals use Skycatch drone data for project management and tracking. Using the Skycatch software, builders are able to access their digitized daily workflows and calculations, integrate with their CAD/BIM software and create instant 2D measurement and 3D volumetric tools to track project progress. Not to mention Skycatch automates drones to deploy and recharge completely autonomously. Similarly, DroneDeploy is a drone mapping app that allows the user to make interactive maps and models. DroneDeploy features include live stream first person view, the ability to make flight plans for your drone and automate takeoff, flight, image capture and landing as well.

Smart Tools In Use:

Smart tools are on the rise in construction as project managers realize that the more data they can get from the job site, the more they can optimize. By integrating innovative tool electronics with custom-built mobile applications, hardware producers like Milwaukee, are offering solutions like One-Key that give workers and superintendents a new level of control on the job site. With One-Key, construction companies are able to catalog their tools, track tool performance in real time, remotely control and automatically program the tool according to the type of work they do. In addition, solutions like DEWALT Tool Connect allow construction professionals to have more control over their batteries. Users are able to identify, enable/disable and check their tool's battery diagnostics via a Bluetooth connection.

Job Site Sensors In Use:

Labor costs can contribute up to 40% of total project costs, requiring construction managers to have complete confidence in the sources of these costs. **With job site sensors, project leaders have the ability to clearly see and analyze construction operations in real-time**. Most sensors serve as indoor GPS, allowing professionals to accurately locate people and assets in real-time, from early job site preparations through to post-construction walk throughs.

Redpoint Positioning provides commercial contractors the ability to improve security and employee safety with smart badge/safety zone alerts, worker tracking (within 8 inches of accuracy) and gain real-time visibility into job site operations. **Construction companies are seeing dramatic reduction**

in project delays by reconfiguring how they organize a job site - and they learned the best configuration by tracking wasteful worker movement over a period of time. Trimble CrewSight is another job site sensor used by builders, allowing users to track personnel while they are on site and account for workers when hazardous situations arise.

As noted in the Smart Tools section above, sensors are often put into tools and some companies are even tracking materials with solutions like ConCure that use concrete sensors to measure their temperature, strength and maturity. **Construction companies are also using movement sensors to simply track the job site when no one is around**. Solutions like tattletale give builders a portable security device that requires little installation or setup to make sure your job site remains secure.

PRE-FAB & 3D PRINTING

How are 3D printing and prefabrication impacting the construction process and materials? The 2016 Construction Technology Survey participants shared the technology they're researching and implementing to speed up construction.

Prefabrication & Modularization

Prefabrication is the process of assembling components of a structure in a factory or manufacturing site, and transporting complete assemblies or sub-assemblies to the job site for construction. Modularization involves constructing a finished project, or component of a project, offsite and then delivering it to the construction site to assemble with other modules to create the final structure. Prefabrication and modularization construction methods can reduce costs, enable process standardization, shorten lead times, improve construction quality, and reduce waste. According to survey participants, prefabrication and modularization processes are currently in utilization most often with metal framing and drywall, MEP trades, concrete formwork, bathroom/unit pods and particularly on hospital projects or projects in rugged environments.

This category is included in the future technology section of this report because it's an innovative process (supported by technology) that will continue to drive project improvement forward. **Prefab and modularization will also push 3D printing technology to the next level - so that not only can entire components of projects be assembled off site, but they can be assembled from materials printed in the same location.** Think about the impact prefabrication with 3D printers could have on material transportation storage and costs.

3D Printers In Use:

3D printing has the most potential to revolutionize the way that the construction industry views a project, from providing a greater range of design and material options to expediting the procurement and build process. The industry (both builders and tech providers) are just still trying to wrap their heads around the best way to implement and scale it.

With 3D printing, builders gain more control over the physical location and specifications of their building materials, allowing for fewer mistakes and more assurance of a successful procurement. Imagine a general contractor (GC) working on an office headquarters for a large company. The GC can order from a 3D printing company, much like on Amazon, and start the manufacturing process for the walls right away. Once the walls are completed, the 3D printing firm ships them to the job site, where a subcontractor assembles the walls. In this case, the GC would most likely have fewer subcontractors to manage and fewer materials to store and manage on site, streamlining costs from design through construction. What if the GC can print its own materials on-site?

The biggest constraint in employing 3D printing is the lack of products available for large scale manufacturing of construction ready materials. Unfortunately, costly, larger printers with such capabilities are only available to a small set of firms, because only a small set can pay the price but also because the printers often can't mass produce. 3D printing currently rests at the front line of construction technology, and though widespread use may still be in the distant future, companies can still benefit from exploring the technology through the small scale printers listed above. Applying R&D budget to actively monitoring 3D printing advances will ensure their company is savvy enough to employ the large scale 3D printers when, inevitably, they redefine the construction process.

Conclusion

What are the key takeaways from this report? Review the main points your company should consider when building your 2017 IT strategy.

CONCLUSION

Did builders advance their technology deployments in 2016? Yes. Did builders remain stagnant, clinging to manual workflows instead of introducing technology in 2016? Yes, again. **Unfortunately, there is no overarching metric to show the progress of an entire industry across the board**. In this report are the aggregate experiences of as many companies as would share them, from large companies to small companies, developers to mechanical subcontractors. In those experiences, can be found important averages, benchmarks and outliers that help construction professionals better understand where they and their company stand among technology adopters and optimizers.

Why Spreadsheets?

It's hard to predict in what year of this survey there will be a significant decrease in the amount of spreadsheets and manual process utilization rates, if ever. This year's survey revealed that companies are not allotting budget for technology and staff to support it, but also many still don't believe the right technology is available. One comment noted that their company only uses "30% of what the software was built for" and so it's hard to justify the investment year after year.

The increase of subcontractor respondents this year helped highlight the challenge of integration across internal systems and interoperability across job sites with multiple GCs, contractors and suppliers. Investments and efficiencies in a particular technology are lost when internal systems cannot integrate, or owners/general contractors mandate the use of their system. **It's not enough to purchase and optimize the technology, streamlining the data with other project participants is what makes or breaks the value of the software.** Builders believe the easiest solution for transferring data is a spreadsheet and manual process, especially for workflows during construction (i.e. on the job site) - so technology providers have a lot of work to do to challenge that standard.

BIM is Next

When it comes to confidence in the company's ability to maximize BIM, the survey shows a large divide industry-wide among those maximizing the VDC process and those that have yet to even consider leveraging the process. **There remains a significant number of industry professionals that feel BIM is only beneficial on large complex projects.** This perception is keeping many smaller companies from adopting BIM. As the BIM mandate in the UK takes hold and the US sees the results, owners will push more and more for BIM workflows in project scheduling, design, estimating and coordination. The

question is whether GCs and subcontractors alike can keep up by hiring and training BIM personnel and making sure they have the time they need prior to construction.

Mobile is Still Personal

Roughly half of the companies surveyed either do not know where to start in tying each of their mobile data collection processes together, automating them and going mobile, or they're not willing to spend additional money to do so. The amount of manual and spreadsheet data collected from a mobile device on a job site is surprising. **It seems builders are comfortable not having real-time, dynamic data available as long as when compliance agencies like OSHA come around, they can pull the spreadsheet records as needed.**

Builders are completely missing the daily analytics that could reduce job site error, waste and inefficiencies. Tablets have seen a spike in usage but the best of breed apps for them have not. Adopting more user-ready mobile applications would also help construction companies address the complete lack of cloud and mobile security policies this report shows for the fifth year in a row - many apps include their own data security features.

Find a Champion

It's easy to read this report and say that the problem is that there's no enough money for IT in construction companies. It's harder to ask: What is the ROI of IT? **The most innovative companies in construction don't necessarily have the biggest budgets, most experienced IT staff nor the best solutions - they may be a five person shop with just one technology champion, who is making all the difference**. Some companies look to outsource their champion, but it's equally important to find that champion within your company, give them any tools (monetary or other) available, and task them with helping identify and evaluate where technology could revitalize the company's construction projects.

FROM THE EDITOR

Thank you to every construction professional who has completed one of our annual Construction Technology Surveys since 2012. We sincerely appreciate you taking the time to help us build this resource for our industry.

Thank you to our partners, MCAA, CFMA and Texas A&M University's Construction Science Department. Your guidance and input on the production, distribution and analysis of the survey results were invaluable. We hope this report helps you continue to educate and lead the next generation of leaders in our construction industry.

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And last but definitely not least, thank you to the JBKnowledge staff who contributed tirelessly to the contents of this report, knowing that our industry deserves the best us nerds can offer.

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ABOUT JBKNOWLEDGE

JBKnowledge is a family of professionals building great technology since 2001. We develop web, mobile and wearable technology solutions for construction and insurance. JBKnowledge is the maker of the SmartBid commercial construction bid software, SmartCompliance certificate of insurance and compliance management software, SmartReality augmented and virtual reality mobile app for construction project visualization, and the SmartInsight construction network for searching, selecting and verifying contractors. We offer a range of professional services to help companies transform their technology solutions including: IT Staff Augmentation; Strategic Consulting; Enterprise Application and Software Development; Mobile and Wearable Applications; Research and Development Outsourcing; and BIM Services. JBKnowledge is based in Bryan/College Station, TX, and serves construction clients on an international basis. Subscribe to our blog and weekly construction technology podcast at jbknowledge.com. Follow JBKnowledge on Twitter, Facebook, LinkedIn and YouTube.

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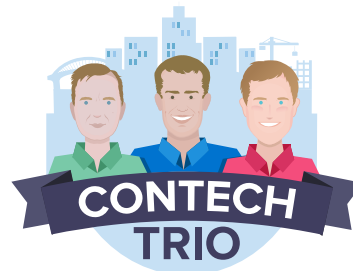
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The Mechanical Contractors Association of America (MCAA) serves the unique needs of approximately 2,600 firms involved in heating, air conditioning, refrigeration, plumbing, piping, and mechanical service. MCAA does this by providing their members with high-quality educational materials and programs to help them attain the highest level of managerial and technical expertise. Through their Construction Technology Initiative, MCAA has partnered with JBKnowledge to provide research, presentations and resources about the impact that technology is having on the built environment and its practices, helping contractors to leverage that information to continue to deliver the best results for owners. MCAA includes the Mechanical Service Contractors of America, the Plumbing Contractors of America, the Manufacturer/Supplier Council, the Mechanical Contracting Education and Research Foundation and the National Certified Pipe Welding Bureau. For more information about MCAA, visit www.mcaa.org. Follow MCAA on Facebook, Twitter and LinkedIn.

About Construction Financial Management Association

Founded in 1981, the Construction Financial Management Association (CFMA) is the only organization dedicated to providing construction financial professionals in North America with unparalleled career development and networking opportunities. Along with publishing the award-winning CFMA Building Profits, CFMA offers educational, professional, and connection programs through its 94 chapters, Annual Conference, and online learning to its more than 7,500 members. CFMA members are CFOs, controllers, and treasurers working at major commercial construction contractors in general, subspecialty trades, and heavy highway sectors, as well as those professionals who service these industry financial professionals, such as accountants, surety agents, bankers and IT specialists. For more information about CFMA, visit www.cfma.org. Follow CFMA on Facebook, Twitter and LinkedIn.

CONSTRUCTION SCIENCE
TEXAS A&M UNIVERSITY

About the Texas A&M University Construction Science Department

The construction education program at Texas A&M University was established in 1946, and now enrolls approximately 1,050 undergraduate students pursuing a Bachelor of Science in Construction Science and 75 graduate students pursuing a Master of Science in Construction Management. Both the undergraduate and graduate programs were among the first programs in the nation to obtain American Council for Construction Education (ACCE) accreditation. The program is serviced by approximately 34 full and part time faculty members, 20 of which hold Ph.D. or equivalent degrees, many of which have extensive construction industry experience. The program integrates principles of architecture, technology, engineering, business and project management, in order to prepare students to effectively manage the total construction process. Specialized course work in building systems, materials and methods of construction, scheduling, cost estimating, structures, construction management, law and business/labor relations are also taught. This interdisciplinary approach provides the student with the best possible exposure to the various tools needed to become a construction industry leader.

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