

Civil Quarterly

Q4 2020 Business Conditions Update, Including Workforce Shortages

2021 Civil Construction Outlook

Awareness and Readiness for BIM and Digital Twins

Remote Inspections, Including a Test Case Demonstrating Their Benefits



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Message From the Publisher

Welcome to the third edition of the *Civil Quarterly*, Dodge's unique periodic research report focused solely on heavy/civil/infrastructure design and construction. As we move into 2021, we have decided to devote this edition to a glimpse of the future of civil construction.

Therefore, the two special topics this quarter both focus on where the industry may be heading, with Closer Look articles that provide insights from leaders in each of these areas:

- We find out about the familiarity and engagement with digital twins in civil construction. Owners of infrastructure assets are particularly well positioned to benefit from a digital, up-to-date real-time representation of them, but to get to that point, the industry needs to embrace digital design and construction tools like building information modeling (BIM).
- We also explore the industry engagement with and expectations for remote inspection, an approach that has garnered new interest during the pandemic. The Closer Look features a study that demonstrates the benefits achieved by owners and contractors from using technology to help with simple inspection tasks, increasing safety and helping to improve productivity.

The, **Dodge Economic Insights** section also features the Dodge forecast for 2021 for civil construction.

As always, we thank our funding and research partners, and we look forward to providing everyone associated with the industry a better understanding about the business of civil construction as it continues to evolve and adapt to a rapidly changing world.

Stephen Jones

Senior Director, Industry Insights Research
Dodge Data & Analytics

Message From the Founding Partner

We often speak about the future as if we are taking long, confident strides toward a location that is known and inevitable. The reality is more akin to taking countless tiny, incremental steps into the unknown. And as the knowledge of our surroundings increases, so does our understanding of our destination.

It's not unlike the process of creating a digital twin, one of the focal points of this quarter's report. The final product may appear absolute, but it's the result of thousands of tiny pieces of data from dozens of sources moving in concert to make real-time optimization possible.

As stewards of that data, we know the direction our incremental steps will take us. We're uncovering ways to make the data in our construction systems more accessible so we can seamlessly integrate with other systems. It's our part in evolving our industry into one powered by digital insights.

We all own a piece of the future of this industry. Those small steps you take to improve a process or increase safety add up fast. We hope that the insights and data trends found in this volume of *The Civil Quarterly* will provide a useful map as you tread further into the unknown.

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We Want Your Feedback!

What do you think about the findings and perspectives you see in this edition of the **Civil Quarterly**? What are your thoughts/hopes/concerns about the business of heavy civil construction? Do you have suggestions for what you'd like to see explored in future editions? We'd love to hear from you and will be

featuring reader comments and responses in future issues. Please send all comments to TCQ@construction.com.

We read all feedback carefully, but may not be able to respond to each submission individually. If you provide your email address, you agree that we may contact you to better understand the comments you submitted.

BUSINESS CONDITIONS

Each *Civil Quarterly* survey takes the pulse of civil contractors about a variety of business conditions they are experiencing, from backlog, revenue and profit margins, to project performance, costs and planned investments. This quarter, the data include the impact of workforce challenges on the businesses of civil contractors.

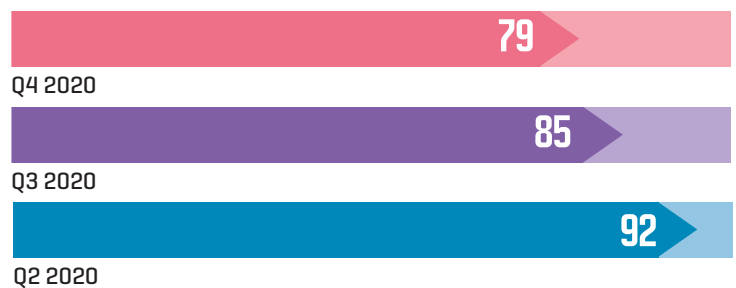
Current Backlog

Civil contractors were asked how many months of backlog they currently have and what their ideal figure would be. The ratio between those two figures for the last three quarters is represented in the chart at right, and it clearly shows that as the pandemic and recession have progressed, backlog levels have slipped. However, at 79 for Q4, the ratio is still healthy.

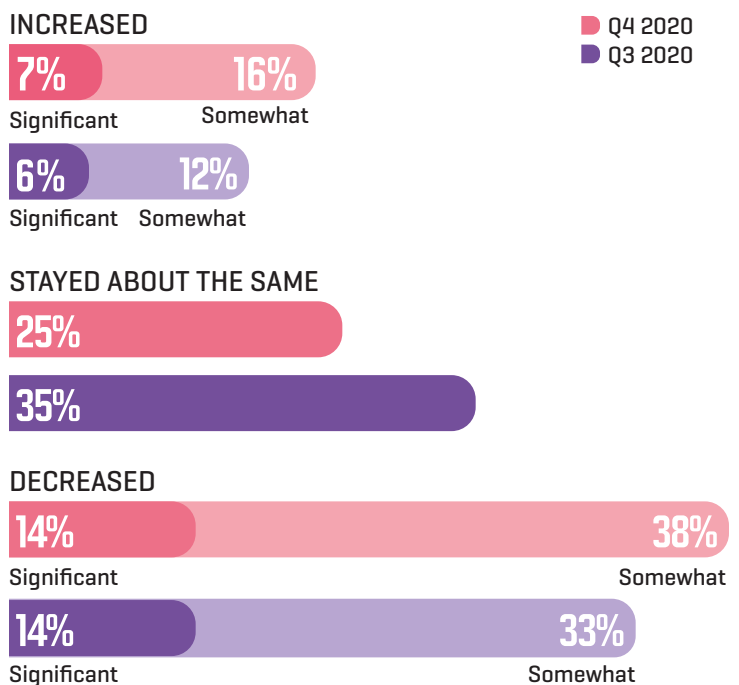
Contractors were also asked whether their backlog has increased, stayed about the same or decreased in the last six months. The findings demonstrate the volatility of the market because, compared with Q3, both the percentages with increasing and decreasing backlogs grew, while those who report stable backlogs shrunk significantly.

These findings suggest that the pandemic is increasing the state of flux for contractors, with some seeing even more work, but with more than half [52%] reporting decreased backlogs.

Ratio of Current to Ideal Backlog



Change in Backlog in Last 6 Months



New Business Confidence

Every quarter, civil contractors are asked to rate their confidence in the market’s ability to supply them with new business in the next 12 and 24 months on a 10-point scale. The chart at right compares their levels of confidence in the fourth quarter compared with the third quarter.

In the current study:

- Those with high/very high confidence in the market for the next 12 months increased 6 points to 58%.
- Those with a negative outlook dropped 4 points to 20%.

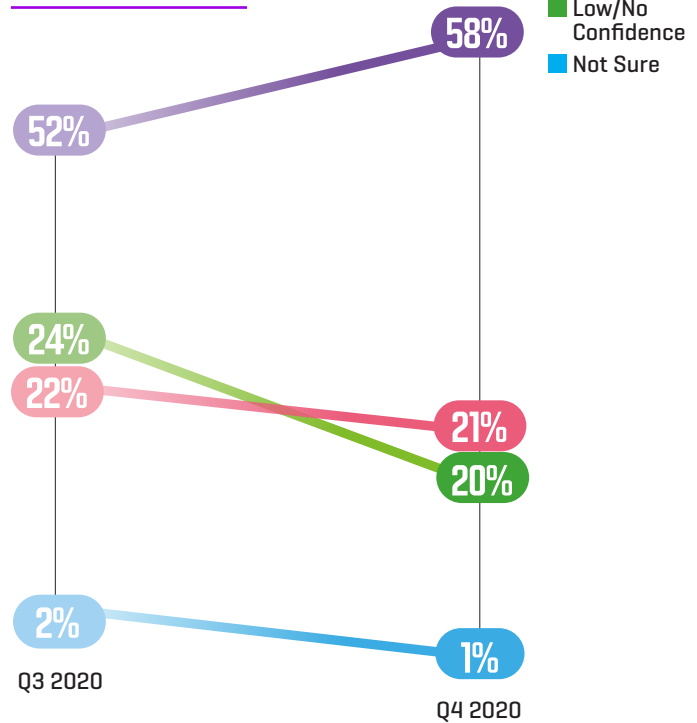
This increased optimism in their outlook for the next 12 months suggests that, despite an overall decline in backlogs, most contractors believe the market will be sufficient to support their needs in 2021.

While the percentages with high/very high confidence are up sharply from last quarter, they are still below Q2 levels, suggesting that more contractors may be expecting longer-term effects from the current economic downturn in Q4 than they were in the spring of 2020.

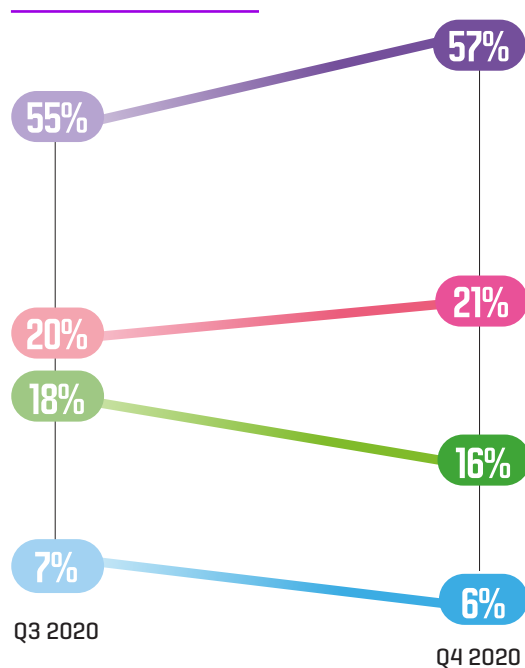
It is notable that the survey was conducted in October when surges in COVID-19 were still largely regional. It will be interesting to see how contractor confidence in the next survey launch in Q1 2021 will compare to this quarter, with the likelihood of increased pandemic challenges during the winter, but with the roll out of vaccines also providing some hope for more economic activity and stability in 2021.

New Business Confidence

NEXT 12 MONTHS



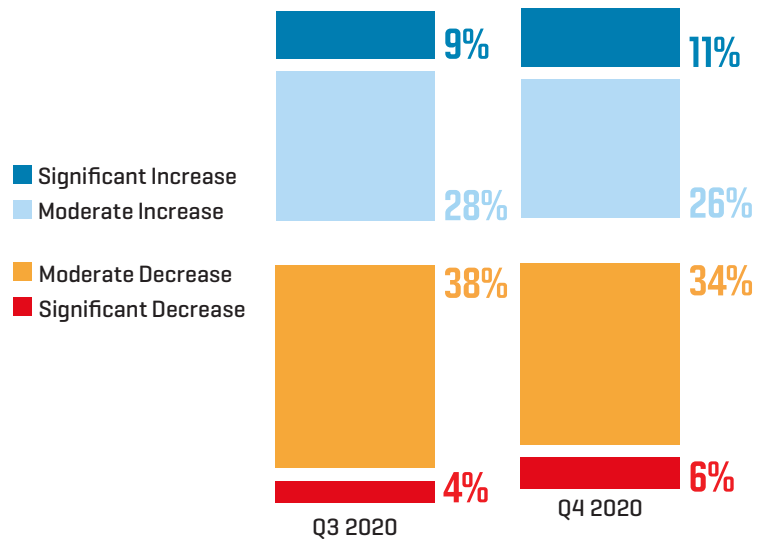
NEXT 24 MONTHS



Revenue Change

Civil contractors were asked to describe the change in revenue they expect in the next 12 months. For the most part, their responses in Q4 mirror those in Q3, with slightly more expecting decreases or increases to be more significant than in the previous quarter. Still in Q4, respondents are nearly evenly split between those expecting an increase [37%] and those expecting a decrease [40%], with the remainder expecting no change.

Expected Change in Revenue in 12 Months



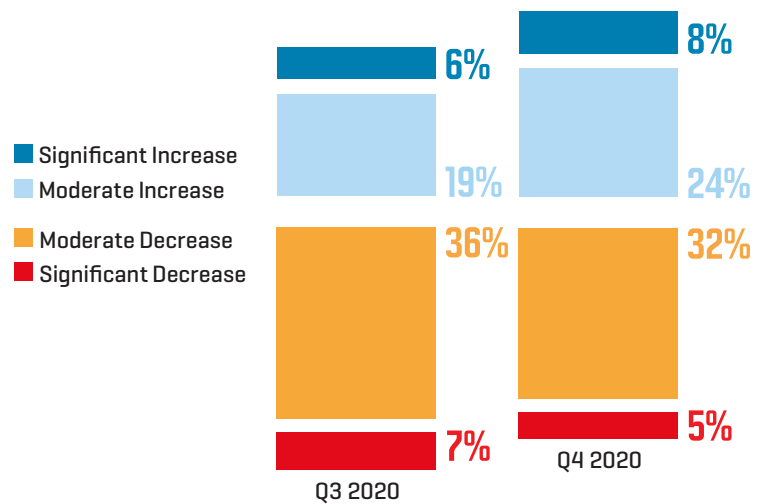
Profit Margin Change

Civil contractors were asked a similar question about how they expect their profit margins to change in the next 12 months. They are more optimistic this quarter than they were in the previous one, with 32% anticipating an increase, up 7 points from Q3, and 37% expecting a decrease, down 6 points from Q3.

The remaining respondents do not anticipate any change.

The findings may suggest that contractors' initial pessimism during the summer about the impact of the pandemic on their profit margins may have reduced somewhat, putting their estimates in Q4 about profit margins more in line with their revenue expectations than they were in Q3.

Expected Change in Profit Margin in 12 Months



Reasons for Reductions

Contractors who expect reductions in either revenue or profit margin were asked why they believe those reductions will occur. The list of options they could select are in the chart at right, which shows the contrast between the Q4 and Q3 responses.

While insufficient public revenue to support projects is still the top concern, it decreased this quarter while all others show increases, and it is now tied with a related worry about delays in new projects due to reduced public revenue. In addition, nearly as many cite an economic downturn reducing the number of private projects and an increased number of competitors bidding projects and pushing down pricing.

Even having a shorter construction season due to new virus outbreaks is selected in Q4 by a higher percentage than in Q3.

Reasons for Reductions

According to Those Anticipating Reduced Revenue or Profit Margins



Insufficient Public Revenue to Support New Projects



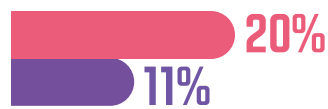
Delays in New Projects Due to Reduced Public Revenue



Economic Downturn Reducing Number of Private Projects



Increased Number of Competitors Bidding Projects and Pushing Down Pricing



Shorter Construction Season Due to New Virus Outbreaks

■ Q4 2020
■ Q3 2020

Reasons for Expected Increases in Revenue and/or Profit Margin

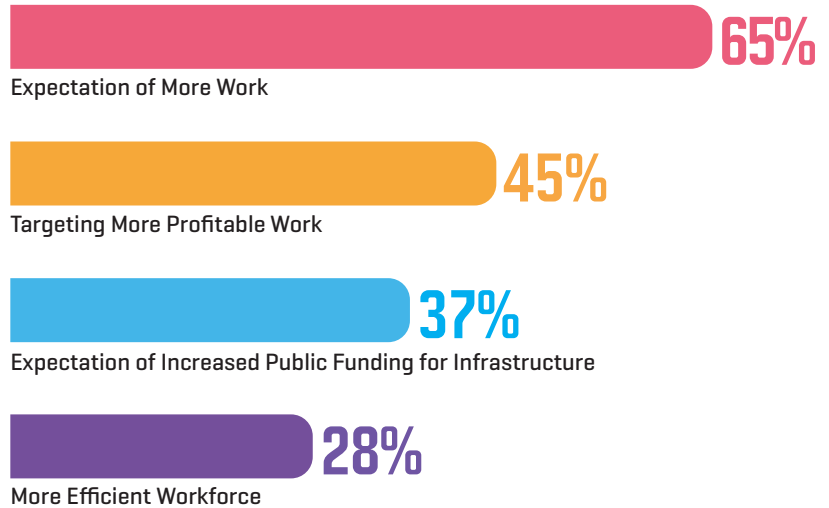
Contractors who expect increases in revenue and/or profit margin were asked why they believe those increases will occur. They could select all options that applied that are listed in the chart at right. While this question was asked in Q3, the low number of contractors who qualified to respond prevented quantitative analysis. Therefore, only the Q4 responses are reflected in the chart.

The combination of the top two reasons (expecting more work and targeting more profitable work) suggest confidence in having sufficient opportunities available to target the most profitable ones.

Over one third (37%) believe that there may be increased public funding for infrastructure, as the US moves past the election, and over one quarter (28%) believe their workforce will be more efficient, which bodes well given ongoing concerns about the availability of skilled workers.

Reasons for Expected Increase

According to Those Expecting an Increase in Revenue and/or Profit Margins



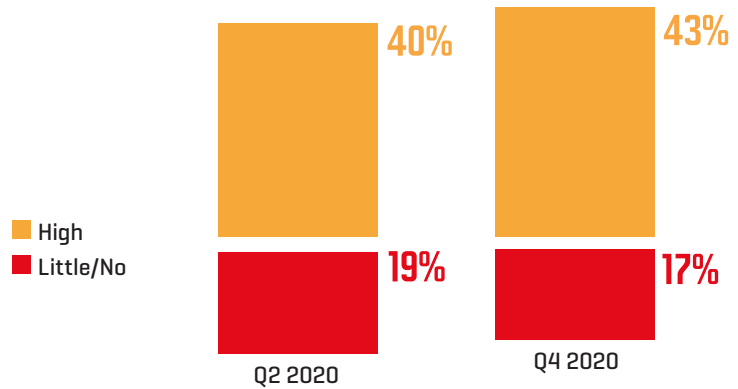
Need to Hire and Availability of Workers

Every other quarter, contractors are asked about workforce concerns. In this instance, civil contractors were asked in Q2 and Q4 about their need to hire skilled workers in the next three months and the difficulty they experience in finding skilled workers.

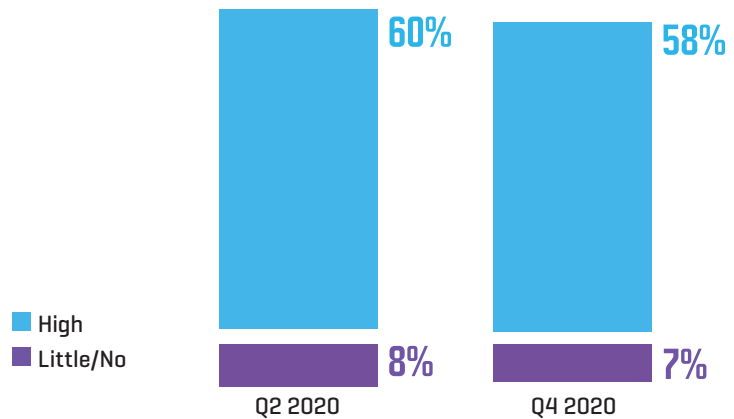
In another positive sign toward recovery, demand for skilled workers is trending slightly upward, with nearly half of contractors in Q2 (40%) and Q4 (43%) reporting a high need and fewer saying they have little or no need.

Although the majority of civil contractors still cite high difficulty in finding skilled workers, the percentage has decreased slightly between Q2 (60%) and Q4 (58%). So overall, the ongoing pandemic is not causing much change in the need for workers or in their availability.

Degree of Need to Hire Skilled Workers



Degree of Difficulty in Hiring Skilled Workers



Types of Skilled Workers Most Difficult to Find

The civil contractors who report challenges in finding skilled workers were asked which trades were the most difficult to find.

- Concrete is the only category in which the share of contractors experiencing difficulty increased between Q2 [51%] and Q4 [58%].
- In contrast, far fewer contractors in Q4 report challenges finding skilled utility workers than in Q2 [27% and 40%, respectively]
- Site work and paving also both dropped by nine percentage points.

Workers Most Difficult to Find



■ Q4 2020
■ Q2 2020

Effects of Skilled Worker Shortages

Contractors who are experiencing skilled worker shortages were asked what impact those shortages had on their businesses.

Nearly three quarters [71%] report that the skill levels of available workers do not match their needs. While this is down from 79% in Q2, it still suggests that increasing the number of workers with the right skills is important to the health of civil construction.

Nearly two thirds [63%] report that they are challenged to meet schedule requirements due to skilled worker shortages, and almost half [47%] put in higher bids because of the shortages. These impacts have serious implications for the cost of and likely availability of the new and updated infrastructure needed in the US. And as cited on the previous page, skilled workers remain hard to find.

Slightly fewer contractors [37% compared with 41%] also turn down opportunities for work due to skilled worker shortages, which could have negative impacts on the cost of construction because of fewer competitive bidders.

Effects of Skilled Worker Shortages

According to Those Reporting Difficulty Finding Skilled Workers



The skill levels of available skilled workers do not match our needs.



We are challenged to meet schedule requirements because of a shortage of skilled workers.



We are putting in higher bids due to a shortage of skilled workers.



We are turning down opportunities for work due to a shortage of skilled workers.

- Q4 2020
- Q2 2020

Expected Changes in Skill Levels and Cost of Skilled Workers

Contractors were asked about their expectations that either the skill levels of available workers or the cost of those workers would change in the next six months.

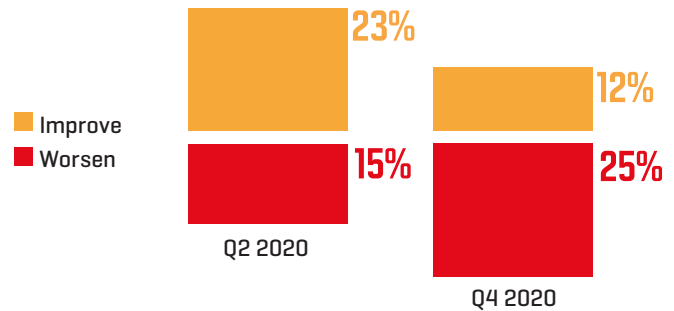
While far more than half do not expect any significant changes to skill levels in the next six months, the contractors who do are notably more pessimistic than they were in Q2.

- Those expecting improvement has dropped sharply, from 23% to just 12%.
- The percentage who believe skill levels will worsen has nearly doubled from 15% to 25%.

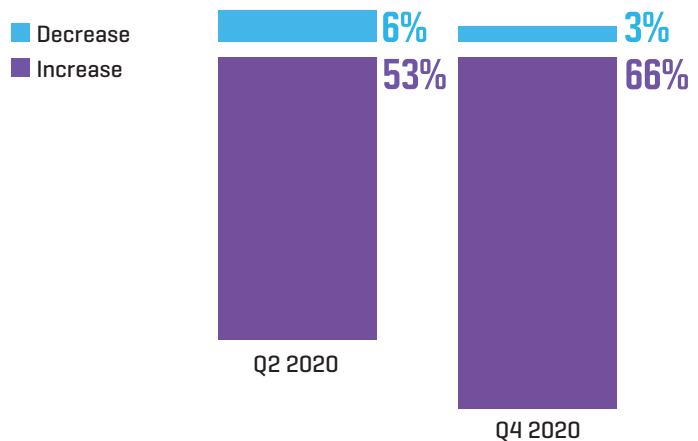
Contractors are also more downbeat in Q4 on expected changes to the cost of skilled workers than they were in Q2. Two thirds (66%) expect the cost of skilled workers to increase in the next six months, compared with 53% in Q2.

The increased pessimism about the cost of workers could be due to a number of factors. Some may be expecting the pandemic to take a toll on available workers. Others may be expecting the amount of work to increase in 2021 [as the confidence measures suggest on page 3], and therefore the need for workers to increase, taxing an already short supply of workers with the right skills.

Expected Change in Skill Levels of Skilled Workers in Next 6 Months



Expected Change in Cost of Skilled Workers in Next 6 Months



Effect of Higher Costs for Skilled Labor

Civil contractors who expect increases in the cost of skilled labor were asked about how the costs would affect their businesses.

The top concern of these contractors is meeting project budget requirements because of higher skilled labor cost, which has jumped from 43% in Q2 to 54% in Q4.

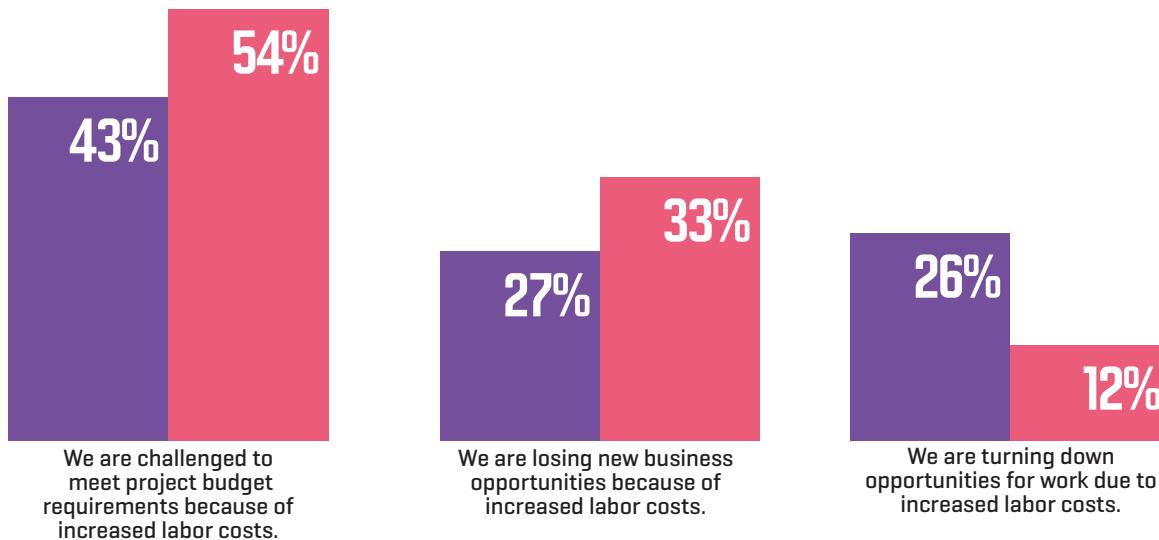
A bigger share of contractors in

Q4 (33%) also believe that they are losing new business opportunities because of increased labor costs than in Q2 (27%). This is notable because in an era when concerns about the need for public austerity in funding could reduce the pipeline of upcoming projects, many contractors may need greater flexibility to pursue new business opportunities than in a more typical time.

Similar to the reduced number turning down work because of labor shortages (see page 9), fewer contractors in Q4 (12%) than in Q2 (26%) report that they are turning down work due to increased skilled labor costs. These trends are not surprising, given the steady decline in the ratio of average current to ideal backlog since Q2 (see page 2).

Effect of Higher Cost of Skilled Labor According to Contractors Who Think Cost Will Increase

■ Q2 2020
■ Q4 2020



IN THE PIPELINE

The amount of work in planning provides a glimpse into the volume of work contractors can expect to be released for bidding. Therefore, every quarter, civil engineers are asked about their backlog of work, as well as their confidence in the market to supply them with new work.

Backlog

Engineers were asked about their current level and ideal level of backlog. The ratios between these two for Q3 and Q4 are shown in the chart at upper right. Similar to the contractors, civil engineers experienced a decline in the ratio of average current to average ideal backlog between Q3 and Q4, suggesting the challenges with backlog that contractors are experiencing right now are likely to continue.

Focusing just on their current backlog:

- A larger share of the engineers (32%) than contractors (23%) have experienced increases in their backlog in the last six months.
- Fewer engineers (37%) than contractors (52%) have experienced a decrease.

Thus while engineers are nearly evenly split between those experiencing increases and decreases in backlogs, far more contractors are experiencing a decrease than an increase. This may be a hopeful sign that, while contractors are likely to continue to face declining backlogs over the next six months, they may not be as severe as those experienced during the last six months.

Ratio of Current to Ideal Backlog

ENGINEERS

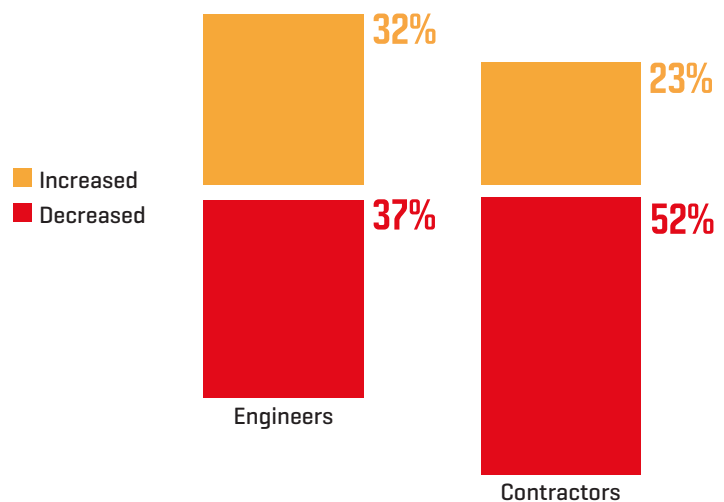


CIVIL CONTRACTORS



■ Q4 2020
■ Q3 2020

Change in Backlog in Last 6 Months



New Business Confidence

Engineers, like contractors, were also asked to rate their confidence in the ability of the market to provide them with new business opportunities in the next 12 and 24 months on a scale of one to 10.

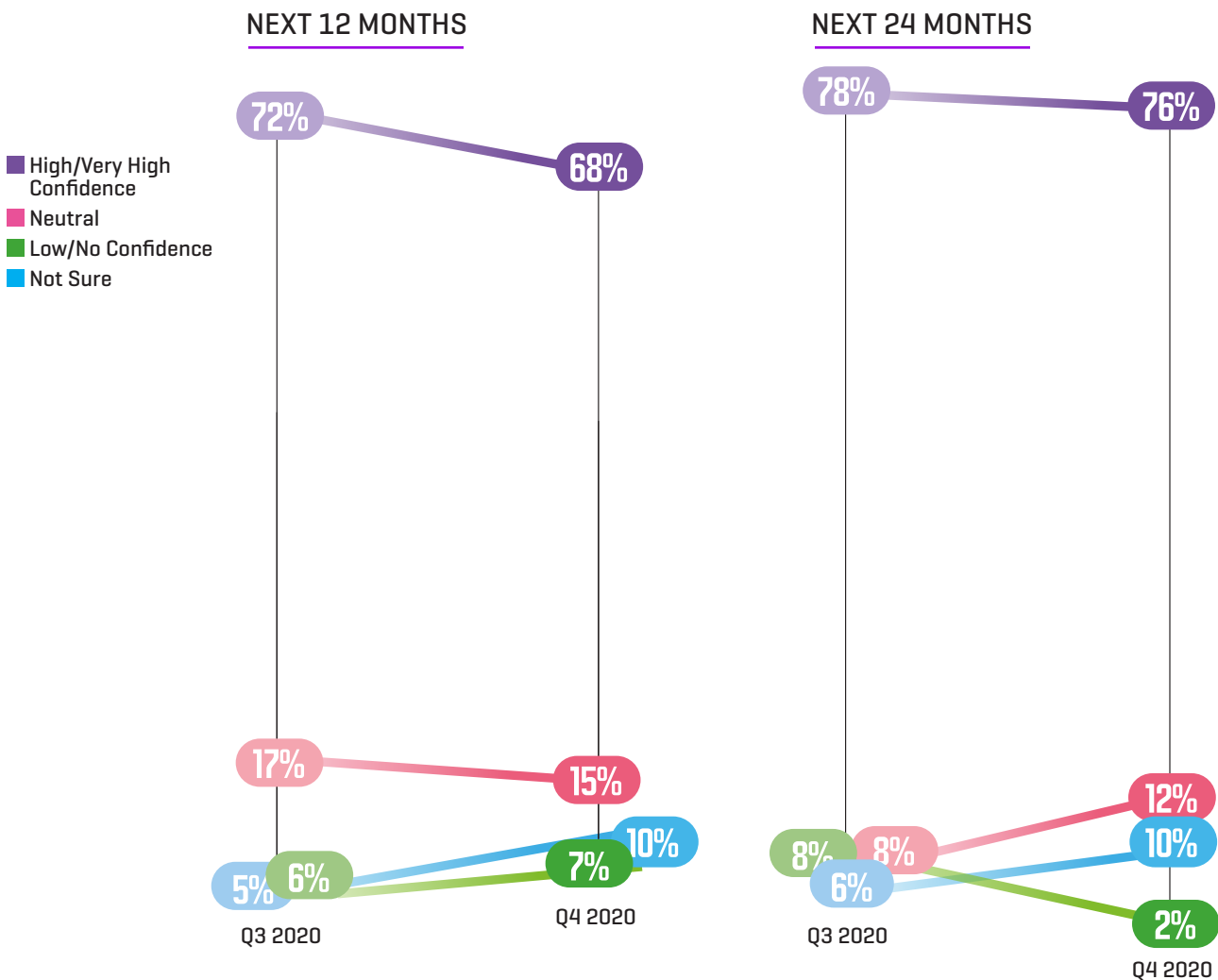
In the 12-month outlook:

- Fewer engineers in Q4 [68%] reported high confidence in the market than did so in Q3 [72%].
- Nearly the same small share [7%] report low confidence as did so last quarter [6%].
- The biggest increase is among

those who are not sure of what the market will bring, from 5% to 10%.

The increase in uncertainty extends to the 24-month outlook, but with 76% with high/very high confidence, engineers generally continue to be optimistic about their prospects for work in the next two years.

New Business Confidence Engineers



BIM and Digital Twins

BIM skills will be essential to support the creation of Digital Twins for owners in the future.

Use of BIM

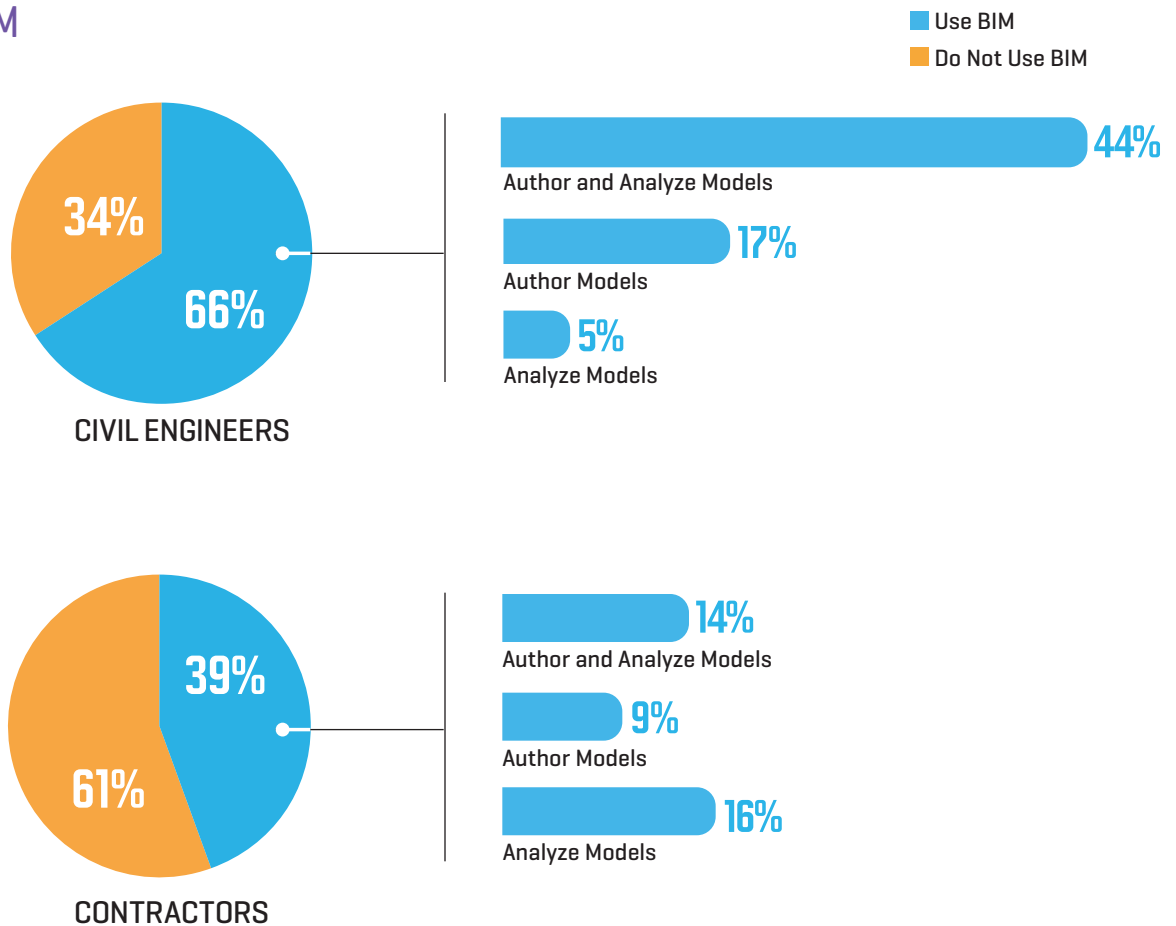
Civil engineers and contractors were asked if and how they use BIM on their projects. Two thirds [66%] of the engineers do so, with nearly all those who use it reporting that they author models.

Civil contractors have not yet adopted BIM as

widely as engineers, with only 39% reporting that they use it. Size of company makes a notable difference in the level of use: only 20% of small companies [revenues under \$10M] use BIM, but over half [52%] of large companies [revenues over \$50M] do so.

Civil contractors also author models far less frequently than do engineers. Only 23% report authoring models, with the remainder [16%] reporting the use of BIM for analysis only.

Use of BIM



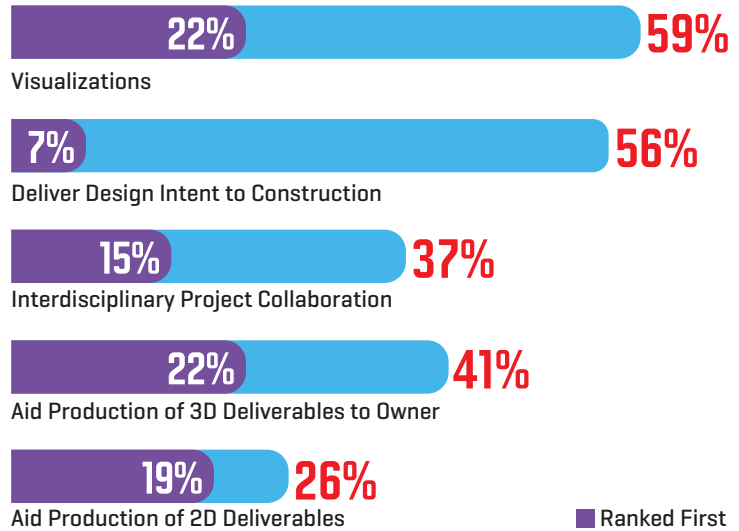
BIM and Digital Twins

BIM Users: Common Uses of BIM Models

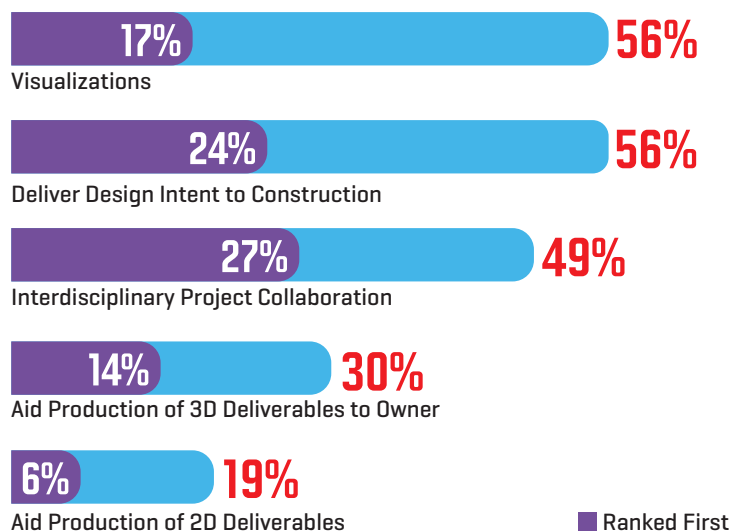
Civil engineers and contractors who use BIM were asked to rank up to three of the most common ways they use it from a list of five options shown in the charts at right.

- Visualizations:** Visualizations are the most common use reported for BIM by engineers [59%] and contractors [56%]. A larger share of engineers [22%] rank this first than do contractors [17%]. The value of improved visualization to aid collaboration across the project team and with project owners is frequently cited by BIM users in many Dodge studies.
- Deliver Design Intent to Construction:** 56% of both civil engineers and contractors rank this in their top three, but far more contractors [24%] rank it first than do engineers [7%].
- Interdisciplinary Project Collaboration:** This use for BIM is ranked first by the highest percentage of contractors [27%], although in overall use, it only ranks third. This would suggest that the potential for wider implementation is strong. Among engineers, only 15% rank it first, and only 37% in the top three
- Aid Production of 3D Deliverables:** 3D deliverables are tied for first among engineers [22%], and placed in the top three uses by almost half [41%]. While fewer contractors [30%] rank it in their top three, nearly half of those who select it at all [14%] rank it first.

Most Common Uses of BIM Models and Data by Civil Engineers (Ranked in Top Three)



Most Common Uses of BIM Models and Data by Civil Contractors (Ranked in Top Three)



BIM and Digital Twins

BIM Users: Benefits of BIM

Civil engineers and contractors who use BIM were asked to select the benefits they gain from its use from the list of options in the chart at right.

Established Benefits

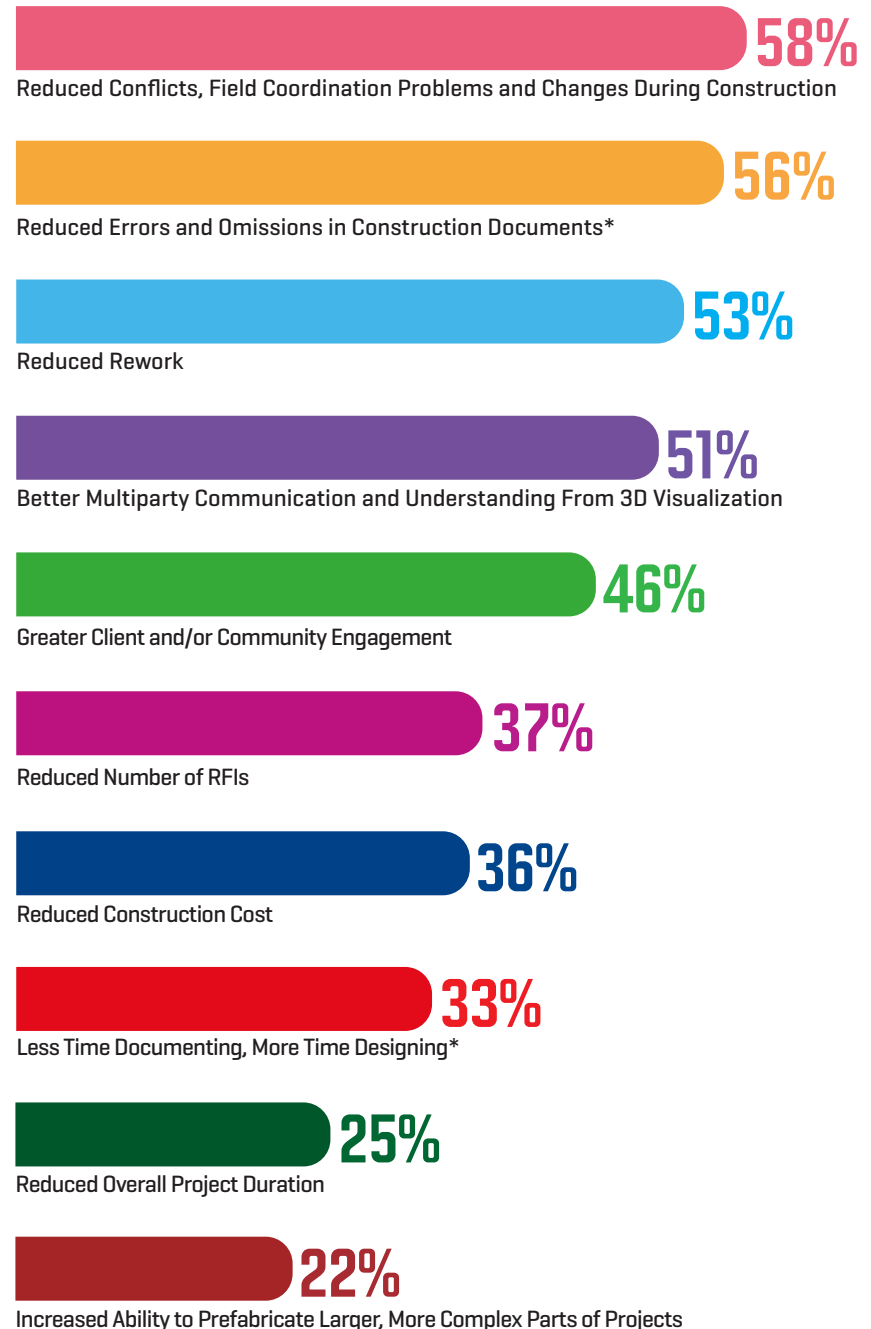
Over half of BIM users cite four benefits from their use of BIM: reduced field conflicts, reduced errors and omissions in construction documents (engineers only), reduced rework, and better multiparty communication and understanding from 3D visualizations. These productivity and collaboration benefits are frequently acknowledged by BIM users globally.

Emerging Benefits

At least one third of BIM users experience four benefits from their use of BIM, suggesting that these benefits may be emerging as contractors and engineers gain more experience with BIM. These include such critical issues as greater client engagement, reduced number of RFIs, reduced construction cost and spending less time documenting and more time designing (engineers only).

Benefits of BIM Use

According to Civil Engineers and Contractors Using BIM



*Engineers only

BIM and Digital Twins

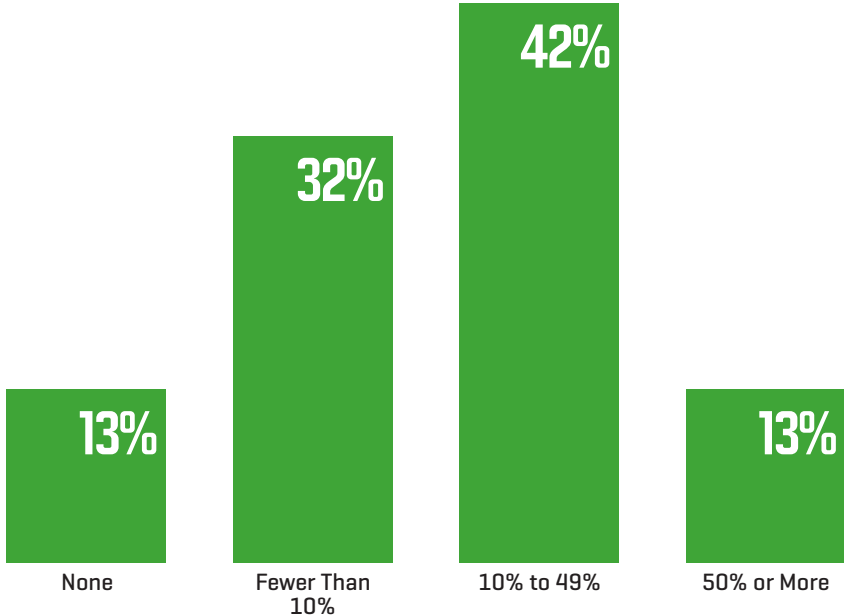
BIM Users: Owners Requesting/Requiring BIM Models at Handover

Civil engineers and contractors who use BIM were asked how many of their owners request or require BIM models as part of the project handover.

Among these BIM users, it is quite common for them to have worked with at least some owners who have this requirement, with nearly all [87%] reporting that this occurs on projects. However, most of them [74%] report that these owner requests occur on less than half of their projects, and nearly a third [32%] on fewer than 10% of projects.

These findings suggest that their BIM capabilities may provide a competitive advantage for these companies with some owners already, and that as more owners start to request digital handoffs, that advantage should grow.

Percentage of Owners Who Request/Require BIM Models as Part of the Project Handover
According to Civil Engineers and Contractors Using BIM



BIM and Digital Twins

Nonusers

Several questions were directed to the civil engineers and contractors who do not currently use BIM, including questions about their attitudes toward BIM, the factors that would encourage them to adopt it and the issues preventing them from using it now. With use much higher among engineers, this analysis focuses on contractors.

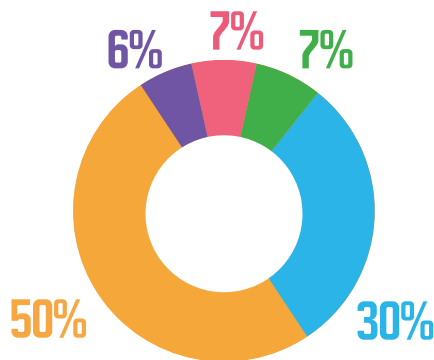
44% of contractors not using BIM have a positive attitude about it, and are either actively considering

it, aware of its value to their company or open to exploring its value. However, there is resistance to BIM use among more than half of the nonusers.

They would be most interested in BIM if it could be demonstrated that it would reduce construction costs and schedules, or if owners demand it.

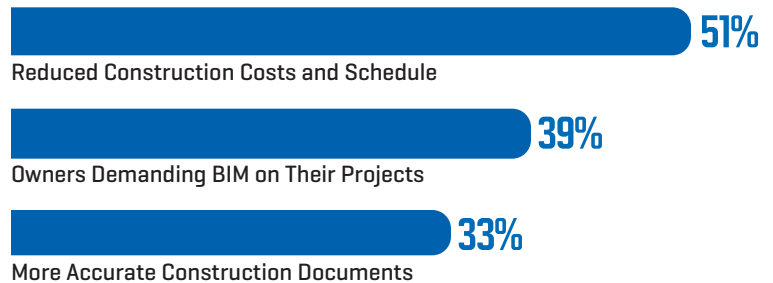
The lack of owner demand is also selected by nonusers as the single biggest reason why they are not using it now, far more frequently than any other option.

Contractor Nonuser Attitudes About BIM

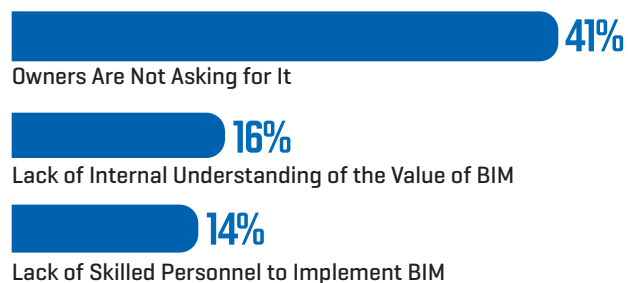


- We have not used it but are actively evaluating it.
- We have not used it and believe it will be valuable for us but have not begun evaluating it.
- We have not used it but are open to exploring its potential value for us.
- We have not used it and have no interest in using it.
- We have used it but decided not to use it any more.

Most Influential Factors for BIM Adoption According to Contractor Nonusers



Top Factors Impacting Why Contractors Are Not Using BIM



BIM and Digital Twins

Familiarity With Digital Twins

Civil engineers and contractors were provided with the following definition of a digital twin and then asked if they were familiar with this concept:

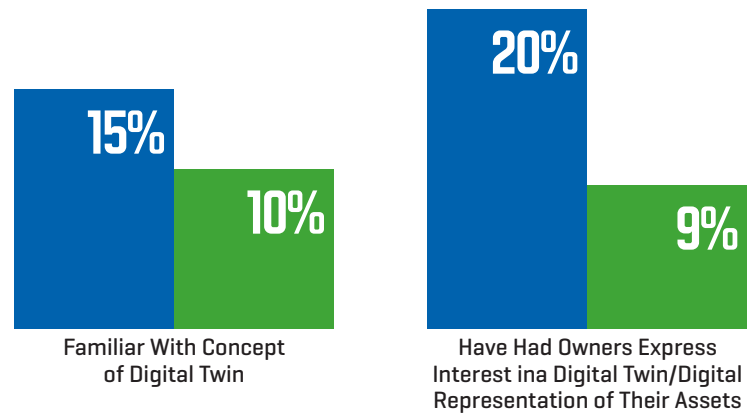
A digital twin is a virtual representation of a physical asset, process or system. The digital representation is continually updated with data federated from a variety of sources [often including sensors] so that it is always a representation of the asset, process or system as it evolves through time. It can be used to support virtual design and construction processes and by owners to optimize operations and maintenance.

Only a small percentage of civil engineers [15%] or contractors [10%] report that they are familiar with this concept.

However, a higher percentage of engineers [20%] report that owners have expressed interest in this concept, suggesting that this is an area owners are starting to investigate. Fewer contractors [9%], however, have seen similar owner interest so far in digital twins.

Familiarity With and Owner Interest in Digital Twins

■ Engineers
■ Contractors



BIM and Digital Twins

Future Owner Interest in Five Years in Digital Handover Materials to Support the Development of a Digital Twin

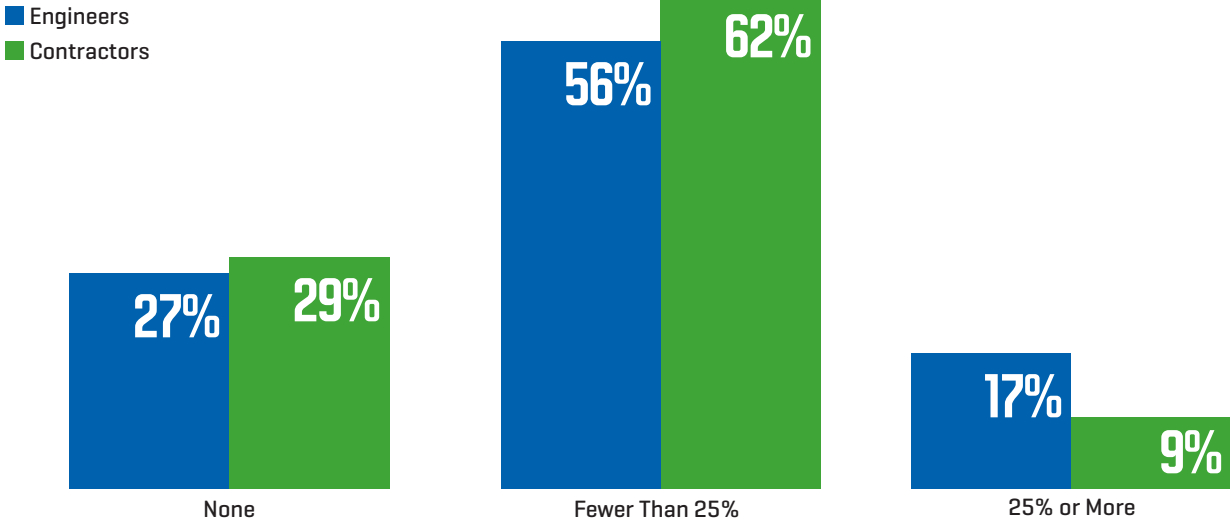
All civil engineers and contractors, regardless of their previous familiarity with the concept of a digital twin, were asked what share of owners they believe will be looking for digital materials in five years that can support the development of a digital twin.

Notably, most civil engineers [73%] and contractors [71%] agree that at least some owners will be seeking these digital materials. Most of them expect only one quarter or fewer owners to be

interested in that time frame, suggesting that they still think digital twins will be an emerging concept among owners in five years. Still there is a relatively high expectation that this is an area in which some owners will be likely to be seeking support.

Therefore, improving their digital capabilities and data may help provide a key market advantage with the vanguard of owners they expect to be heading in this direction.

Percentage of Owners That Engineers and Contractors Believe Will be Seeking Handover Materials That Support the Creation of a Digital Twin



BIM and Digital Twins

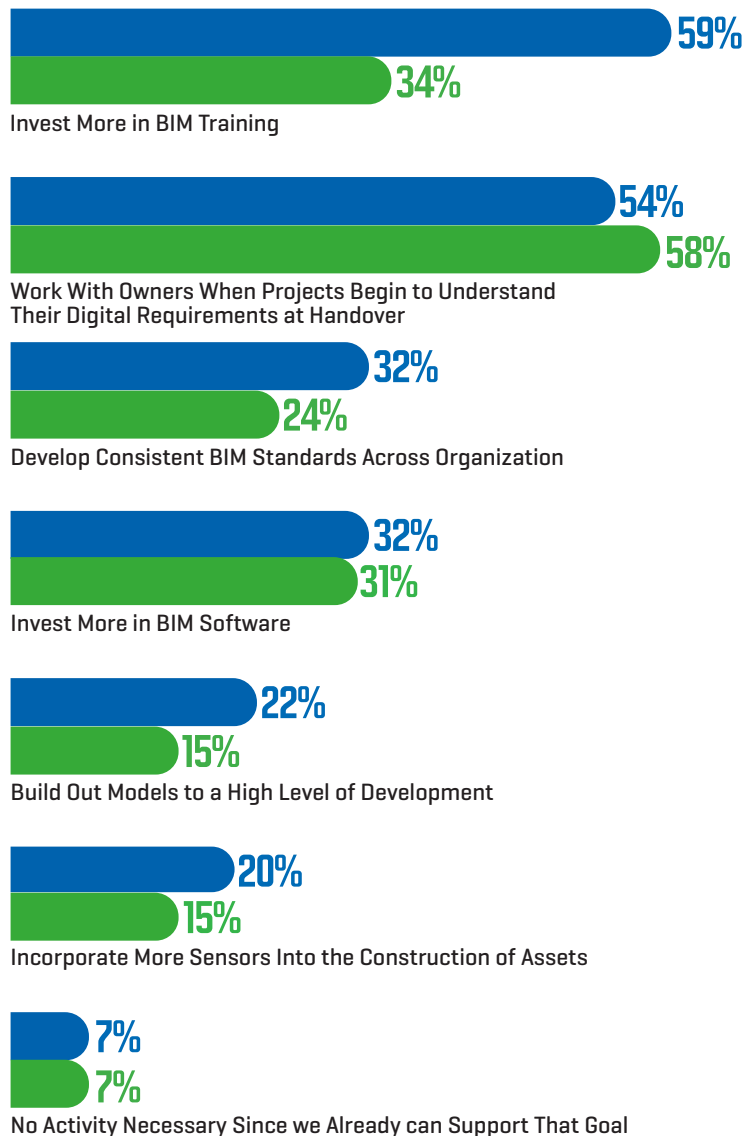
Actions Needed to Prepare for Owner Shift to Digital Twins

Civil engineers and contractors were asked how they would need to prepare to work with owners who are pursuing digital twins of their assets.

- Most of these respondents (93%) believe that they will need to take some actions to prepare for this, should it occur.
- Civil engineers place the highest emphasis on investing in more BIM training and working with owners at project start to understand their digital requirements.
- Understanding the digital requirements of owners is also the top action reported by contractors by far, with 58% who regard this as important.
- In contrast, investing more in BIM training, which ranks second among contractors, was only selected by 34%.

Other than BIM software investments, which are selected by about one third of engineers and contractors, most of the other options, which include developing BIM standards, building out models to a high level of development and incorporating sensors, are selected by more engineers than by contractors. This may suggest that engineers have a better sense of what is needed to help owners build digital twins due to their wider use of BIM.

Actions Needed by Engineers and Contractors If Owners Want to Pursue Digital Twins of Assets



- Engineers
- Contractors

Remote/Virtual Inspections

Remote/virtual inspections are still emerging in the civil construction industry, but interest in them has grown during the pandemic.

Frequency of Remote/Virtual Inspections

Contractors were asked a series of questions to gauge the utilization of remote/virtual inspections in civil construction. They were asked whether any remote/virtual inspections were conducted on their projects, whether they began doing inspections before or after

March 2020 and the number of projects on which those inspections were done.

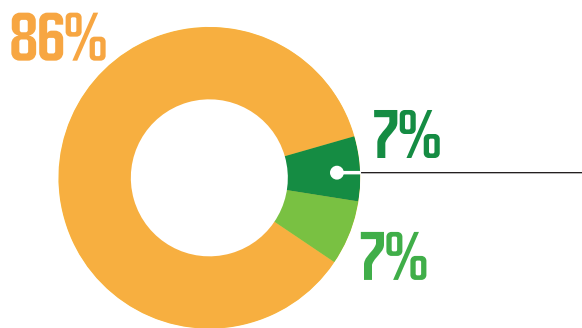
Only 14% of contractors have any experience with remote/virtual inspections, with half already experienced before the pandemic started and half only

using them since March 2020.

Among this 14%, the majority [62%] have only had one or two projects on which these inspections occurred since March 2020.

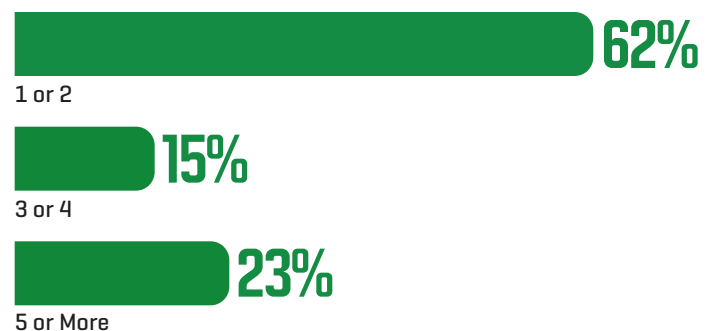
These findings suggest that remote/virtual inspections are still emerging in the construction industry, but that the pandemic has given a boost to their use and visibility. The degree to which adoption continues after the pandemic, though, still is undetermined.

Percentage of Contractors Who Have Had a Remote Inspection Done on a Project



- Have Done Remote/Virtual Inspections Before March 2020
- Began Doing Remote/Virtual Inspections During/After March 2020
- Have Not Done Remote/Virtual Inspections

Number of Remote/Virtual Inspections Done Since March 2020



Remote/Virtual Inspections

Users: Benefits of Remote/Virtual Inspections

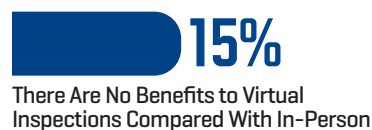
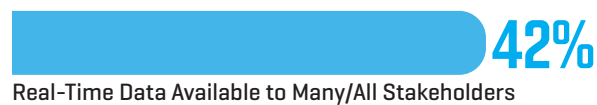
Contractors who have had remote/virtual inspections conducted were asked whether they had experienced a few potential benefits from this approach.

The vast majority [85%] report that they did see some benefit from the use of remote/virtual inspections on their projects, which bodes well for wider use in the future. Interestingly, though, there was no single benefit reported by the majority of those contractors. Instead, many report different benefits.

- Half agree that remote/virtual inspections are less time-consuming.
- Over 40% note increased safety due to better social distancing and the ability to provide real-time data to many/all stakeholders as benefits.
- 39% consider this to be a more efficient process than in-person inspections.

These top benefits are the ones that will most likely drive wider use of this approach in the future, especially since they benefit both owners and contractors.

Benefits Reported by Contractors From Having Remote/Virtual Inspections



Remote/Virtual Inspections

Users: Challenges

Contractors experienced with remote/virtual inspections were also asked about the challenges posed by these compared with in-person inspections.

Most contractors with experience [88%] do find that there are challenges, which is not surprising for this early stage of digital adoption of a previously more manual process.

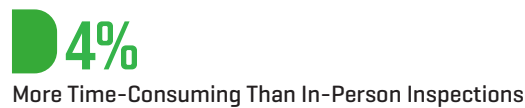
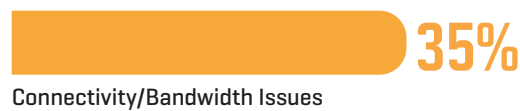
Most contractors [62%] agree that the inspections are not as thorough as those done in person. This is the only challenge selected by more than 50% of the contractors asked.

Other obstacles are less widely experienced. Over one third find that connectivity/bandwidth issues cause challenges with these inspections, a challenge that needs to be addressed for many other aspects of digital construction as well.

Only 23% believe these inspections are less efficient, a much lower percentage than the 39% who believe that they are more efficient. This bodes well for eventual wider use.

Challenges in the Process of Doing Remote/ Virtual Inspections

According to Contractors



Remote/Virtual Inspections

Users: Obstacles to Wider Use

Contractors experienced with remote/virtual inspection were asked to rate the degree to which a series of factors are preventing wider use of them. The chart at right shows the factors rated as moderate to major obstacles by contractors.

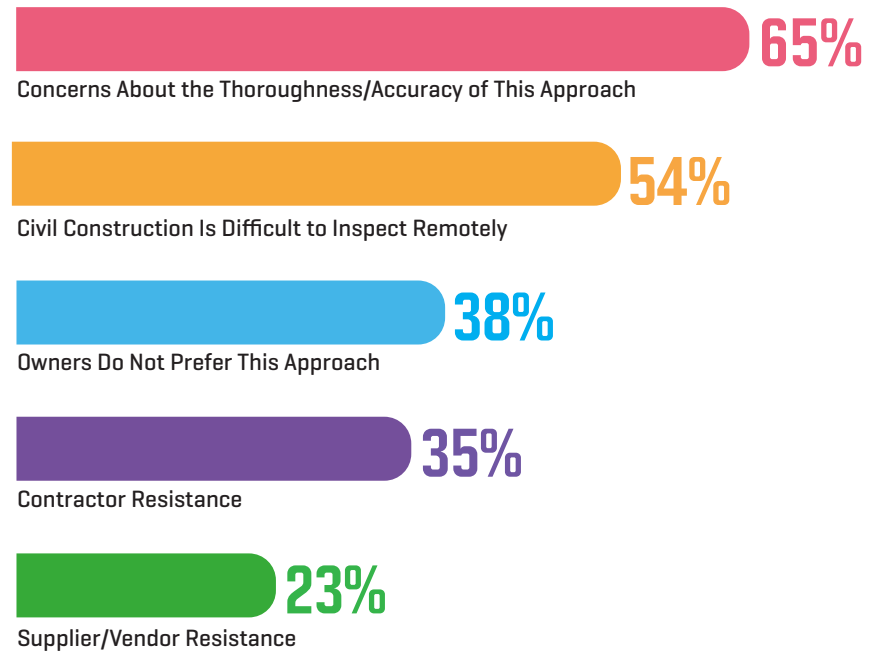
Nearly two thirds [65%] believe that concerns about the thoroughness/accuracy of remote/virtual inspections are a notable obstacle, echoing the biggest process challenge, and demonstrating that this issue must be addressed for wider use of these approaches in the civil construction industry.

Over half [54%] also believe that civil construction is difficult to inspect remotely. Fortunately, there are many approaches that are addressing some of those challenges. [For more information, see the article on a study conducted about remote inspection starting on page 33.]

Over one third also report resistance from owners [38%] and contractors [35%].

Obstacles to Wider Use of Remote/Virtual Inspections

Rated Moderate/Major Obstacles by Contractors



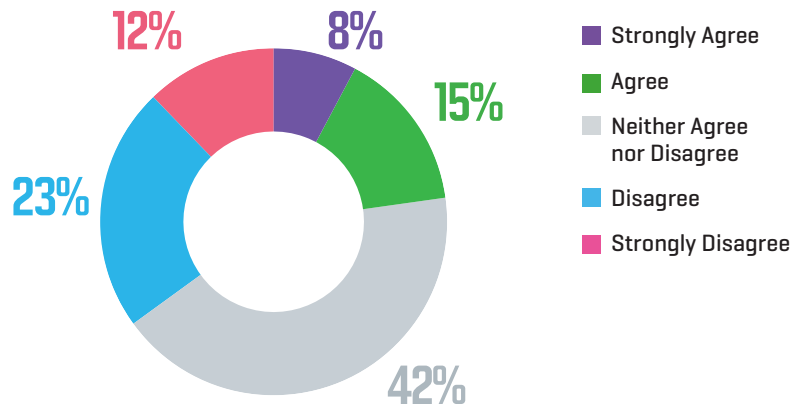
Remote/Virtual Inspections

Users: Attitudes About Remote/Virtual Inspections

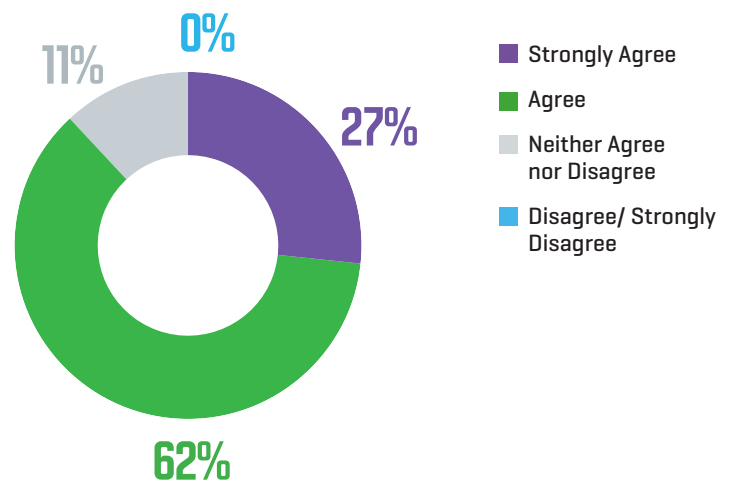
Contractors experienced with remote/virtual inspections were asked to what degree they agree with two statements: that they would prefer to have more remote/virtual inspections in the future and that the usefulness of these methods depends on the type of work being inspected.

The fact that the contractors overwhelmingly [89%] agree with the latter statement about the applicability of this approach being related to the type of work is probably an important factor influencing why most contractors are neutral [42%] or disagree [35%] with the desire to have more remote/virtual inspections in the future. Since over 80% experience benefits from using this approach [see page 23], some of the reluctance about wider use is likely tied to concerns about cost, implementation and applicability to the type of work they are doing, as well as their stated concerns about the thoroughness of the inspections conducted.

Prefer to Have More Remote/Virtual Inspections in the Future



Usefulness of Remote/Virtual Inspections Depends on the Type of Work Being Inspected



Remote/Virtual Inspections

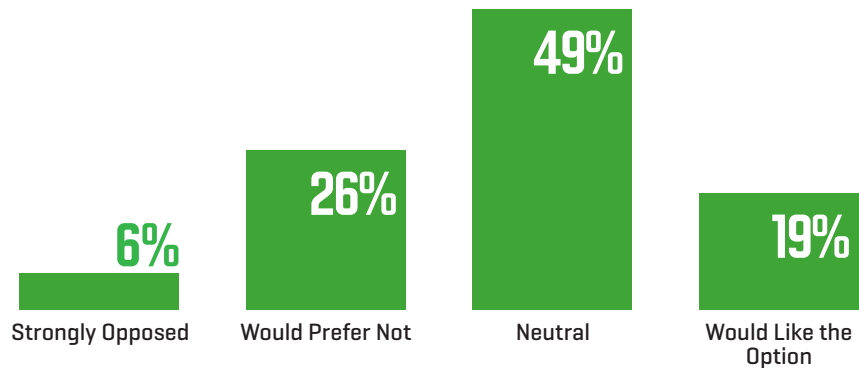
Nonusers: Interest in Remote/Virtual Inspection

Contractors with no experience with remote/virtual inspections were asked to what degree they would like to use this approach, and their responses are shown in the chart at right. The highest percentage [49%] are neutral, echoing the response of the users, and just under one third [32%] would prefer not to have to engage in it.

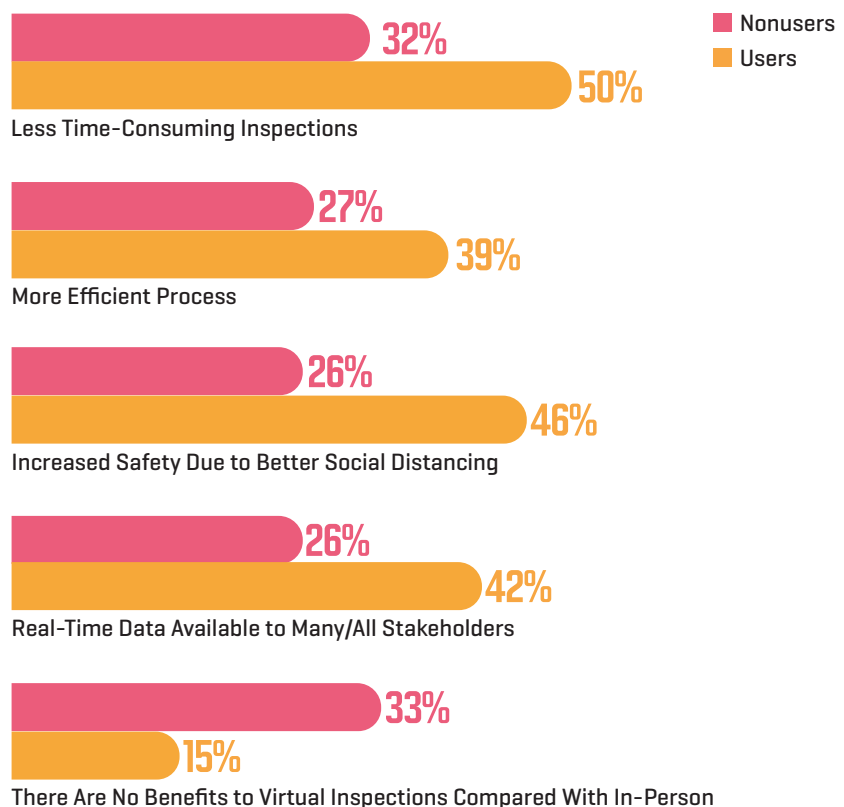
Nonusers were also asked about the benefits they would expect from remote/virtual inspections, and they were provided with the same list of benefits as those with experience. The chart at right shows the degree to which their responses align.

Although at least a quarter of nonusers expect they would receive each of the benefits, these percentages are far short of the actual share of users who report receiving them. This underestimation of the potential value of remote/virtual inspections may lessen as the benefits become more widely known.

Interest in Having Remote /Virtual Inspections Done According to Contractors With No Experience in Remote Inspections



Benefits of Remote /Virtual Inspections Expected by Nonusers and Reported by Users



Remote/Virtual Inspections

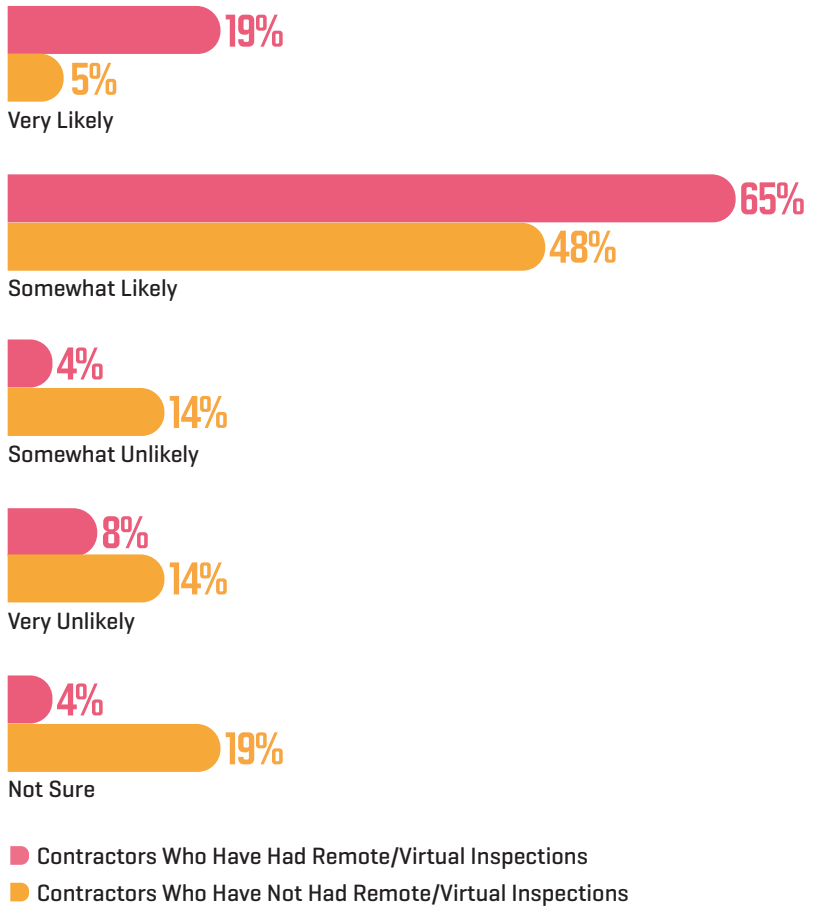
Likelihood of Increased Use of Remote/Virtual Inspections

All civil contractors, whether they have experience with remote/virtual inspections or not, were asked to rate the likelihood that remote/virtual inspections will be done more frequently in the next three years.

Most of the contractors agree that more virtual/remote inspections is at least somewhat likely. Nearly all [84%] of those with experience with them agree that the increase is likely, and over half [53%] of those without experience concur.

This suggests that they believe owners and public agencies using these methods are seeing value in them. It also indicates that most contractors should consider what they need to do to prepare for wider use of these approaches.

Likelihood That the Share of Inspections Done Remotely/Virtually Will Increase in Next Three Years



A Closer Look

The Drive Toward Digital Twins

In a reversal of the infrastructure sector’s initial general hesitance to switch from two-dimensional drawings to BIM, the last couple of years have seen a growing client appetite for taking BIM to the next level through data- and analytics-driven digital twins, according to Cory Dippold, a vice president in Mott MacDonald’s New York office who heads the company’s new Digital Twin solutions group in North America. “We’re pushing against an open door,” he says.

Digital twins are data-animated 3D models of real-world assets. They generate value over the lifecycle of the asset, from design and construction through operations and maintenance, by generating

insights that inform decisions to improve outcomes in the physical world.

What distinguishes a digital twin from any other model is its near-live link to its real-world twin. The digital entity is continually updated with data federated from a variety of sources—sensors, SCADA systems, customer billings, images, drone or laser surveys, GPS, manufacturers’ data and others—so that it always offers a realistic representation of the asset (or process or system) as it evolves through time.

The twinning sets up a feedback loop in which information flows from the physical asset to the digital version. There data is cleaned, structured and



Digital twins are data-animated 3D models of real-world assets.

A Closer Look

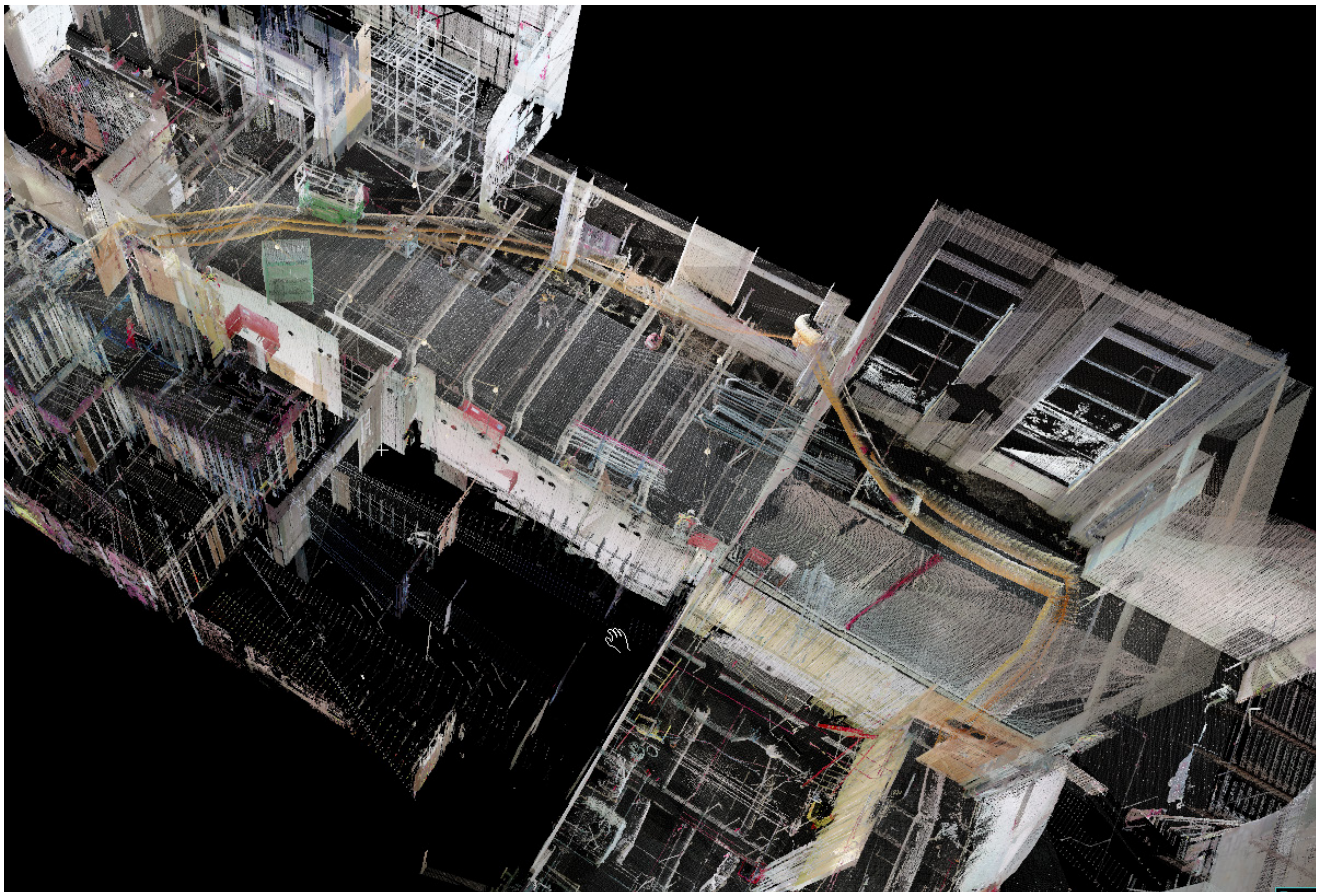
analyzed to generate insights, which lead to decisions that travel back to the physical asset in the form of interventions. The interventions lead to outcomes, which generate data, and the cycle begins again.

Project types that are especially well positioned to benefit from having a digital twin share some common characteristics, says Dippold. They are often logistically complicated, they may generate high volumes of real-time data, their shut-downs could be operationally difficult and physical access may be limited, where downtime carries significant costs—common traits in the infrastructure

sector. Waiting to react can prove expensive compared with proactive interventions.

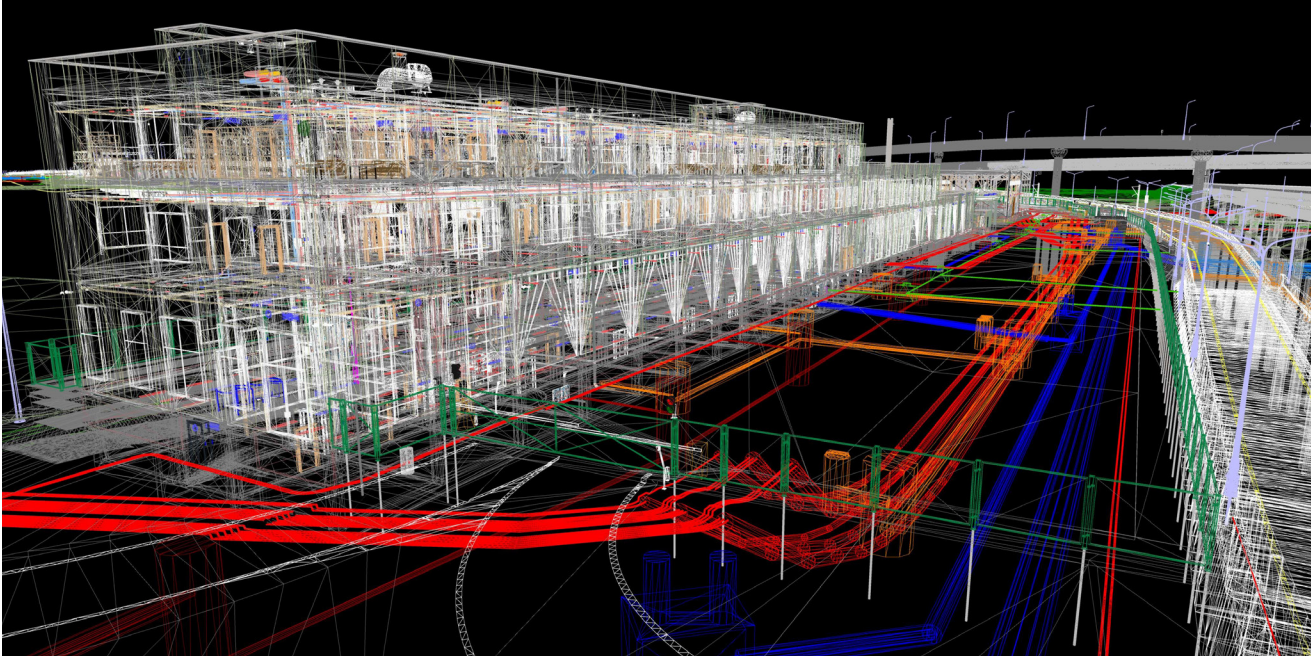
Pioneering Examples

Pioneering examples of digital twins include a representation being created by Black & Veatch [B&V] for Anglian Water, a British utility that serves six million customers from a 27,500 square-kilometer operating area, with 1,257 water and recycling treatment facilities and 112,833 kilometers of water and sewer pipes. The twin represents a subregion that is piloting the utility's "future water company, today" initiative. The initiative targets seven goals: zero leakage and



A digital twin is continually updated with data federated from a variety of sources, including sensors, SCADA systems, customer billings, images, drone or laser surveys, GPS, manufacturers' data and others.

A Closer Look



What distinguishes a digital twin from any other model is its near-live link to its real-world twin.

bursts, 100 percent customer satisfaction, water consumption reduction to 80 liters per person per day, zero pollution and flooding, 100 percent compliant and chemical-free drinking water, carbon neutrality and the creation of a circular economy that eliminates the concept of waste from the processes. To support these goals, the digital twin will provide historical, current and AI-enabled predictive analysis in near real time.

“For a water utility, a digital twin offers the prospect of helping to enhance customer experience—without increasing bills to fund improvements—by optimizing the performance of existing assets and increasing the efficiency with which they are operated and maintained,” says Chris Steele, head of Data Science and Analytics for B&V Europe. A digital twin’s effectiveness comes from supporting systems thinking, he says, combining multiple internal and external data sources across the asset base

with predictive analytical techniques served through multiple functional views. “This enables improved insights that support better decisions, leading to better outcomes in the physical world,” Steele adds, reiterating the core value proposition of digital twins.

In another example, Mott MacDonald worked with the University of Sheffield’s Urban Flows Observatory to develop a digital twin as part of a program to boost Sheffield’s health outcomes. The project digitizes urban infrastructure and integrates live data feeds—including air quality and weather—to sharpen the focus on factors affecting local health and to enable better-informed decision-making. Because this project is intended ultimately to form part of a larger, connected ecosystem of digital twins, it has been created in keeping with the Gemini Principles. These are a set of foundational definitions and guiding values that have been proposed by the Digital Framework Task Group [a board of government, industry and academic stakeholders that advises Britain’s National Digital Twin program] to foster the interoperability

A Closer Look

A digital twin offers [a water utility] the prospect of helping to enhance customer experience—without increasing bills to fund improvement ...

— CHRIS STEELE, B&V EUROPE

and durability necessary for digital twins to generate their highest value.


According to the Gemini Principles, a digital twin must first have a clear purpose: It must be used to deliver genuine public benefit in perpetuity; it must enable value creation and performance improvement; and it must provide determinable insight into the built environment. Second, it must be trustworthy: It must enable security and be secure in itself; it must be as open as possible and it must be built on data of an appropriate quality. And third, it must function effectively: It must be based on a standard connected environment; it must have clear ownership, governance and regulation; and it must be able to adapt as technology and society evolve. Figures from Deloitte and the UK Office of National Statistics suggest that greater data sharing could release an additional £7 billion per year of benefits across the UK's infrastructure sectors, equivalent to 25% of total spend. The Gemini Principles aim to provide an industrywide foundation for realizing that value.

Money's Worth

Unlocking value for clients entails a choice as to which of two types of digital twin will best serve

a given project. The first type is purpose-built to address specific issues in an existing asset. This twin does not need to represent every part, piece and component; rather, it needs to model the elements that are engaged in the problem and to incorporate the datasets that are pertinent to solving it. The second type is a comprehensive representation of an asset from first principles. Its developers may not be able to anticipate all of the ways the entity will be used to optimize a project's construction, management and maintenance, but they design the model from the get-go to allow it to contribute to the full gamut of possibilities.

Even though industry interest in the potential of digital twin technology is increasing, some challenges to broad uptake remain. "One of the early obstacles for all of us will be to prove the business case: that the digital twin can provide more value than the cost of creating it," says Dippold. Although, he adds, new service delivery models will likely lower the barrier. For example, rather than the transactional model in which clients pay upfront for the development of a digital twin as a product, structuring the relationship as a subscription to a service could offer a low-risk alternative. In this case, the provider creates a twin and runs analytics to which the client buys access on a predictable cost model.

And while examples that have paid for themselves dollar-for-dollar in construction economies or operational savings may take a while to find, a reduced risk of catastrophic failure, improved workforce safety or information taken out of file cabinets and structured to become searchable, functional and actionable all represent significant forms of value beyond a dollar-for-dollar equivalence. As infrastructure projects contemplate the adoption of a digital twin, "the name of the game is not necessarily money," says Dippold. "It's value." 

A Closer Look

A Remote Inspection Test Case

The findings in this report suggest that remote inspection is still emerging in civil construction [see page 22], but studies have been conducted on promising technologies for remote inspections. One such study, conducted by the University of Kentucky Transportation Center with the Kentucky Transportation Cabinet (KYTC), looked at using three e-construction technologies to gather data normally gathered by inspectors—e-ticketing, paver mounted thermal profilers and intelligent compaction—on a series of pilot projects.¹ According to one of the researchers, Roy Sturgill, assistant professor at Iowa State University, one of the Cabinet officials, Ryan Griffith, formerly director of construction at KYTC, and one of the contractors, Brian Billings, vice president of ATS Construction, the study shows that e-ticketing already provides major benefits, and it reveals ways to improve the efficacy of the other two technologies.

About the Study

KYTC was interested in participating in the study in part because the number of their inspectors has dwindled over time, and they saw the potential for remote inspection to address gaps caused by those reduced resources. Griffith, in particular, believed that e-ticketing could help his inspectors focus on more high-value tasks, such as “watching the mat go down, checking the depths, checking the yield on the pavement and more important things that we couldn’t measure electronically.”

Sturgill also points out that Kentucky was a good candidate for participation because they were already using the other two technologies, the paver



Data from e-ticketing helped the contractor improve productivity.

mounted thermal profilers and intelligent compaction. Sturgill describes how he and Griffith concluded that “if we couple intelligent compaction, the paver system and e-ticketing, you can get most of what your inspector is going to do on a resurfacing project.” In the study, the remote tools were tested against the measures from inspectors in the field to ascertain the usefulness of these tools to assist inspections.

Sturgill states, “One of the more simple yet important pieces of the study was very early on, we put together a table that listed the types of information we wanted to collect, how an inspector does it and the technology that can duplicate that effort.”

Findings and Challenges

According to Sturgill, the data from the study showed that “e-ticketing was a no-brainer.” He also saw promise in the use of the other two technologies, but more value in their case came from what

¹ Full study findings are available at https://uknowledge.uky.edu/ktc_researchreports/1625/

A Closer Look

the study revealed about challenges that need to be addressed for them to be used more successfully.

E-Ticketing: Overcoming Initial Challenges

E-ticketing had its own set of challenges at the start. For one, while the KYTC contracts directly with paving companies, it does not have a contract with the truck drivers delivering the material. According to Griffith, this caused some initial concern about who was responsible to supply the equipment and raised the question of privacy concerns as the trucks were installed with GPS trackers. However, privacy ended up not being a major issue in the pilots, and both Griffith and Sturgill credit the transparency of the KYTC about its goals for this pilot and how it planned to use the data. Sturgill says, “To me, that was a huge lesson learned: talk to your contracting community and let them know what’s going on, how you are using the data.”

In fact, Billings from ATS Construction reports, “Our truck subcontractor, they were very cooperative. They actually really liked the technology and were even able to use it after the project.” Rather, it was his own company that had the bigger challenge, since they had to upgrade the hardware and software at their plant in order to be able to support e-ticketing. Billings states, “I think they had to buy a brand-new computer that controlled the load-up portion of our scales in our silos,” but he also adds “a computer today is not a lot of money compared to a project this size. The \$3,000 we had to pay to upgrade and get the software installed was pennies compared to the overall project amount.”

E-Ticketing: Benefits to Contractor

Billings reports that ATS Construction was able to use the data provided by the e-tracking system to improve their productivity. He says, “We do our best

on a day-to-day basis to manage how many trucks we need, or if the trucks are late, or if the plant is not producing asphalt or if there is downtime with the crew working in the field, or vice versa.” However, using the data, they were able to improve their visibility into all these issues. In fact, ATS realized from the data they could access that “we have an undersized plant for the amount of work that we try to do, and we learned through this project how much downtime [that creates] for the person in the field versus having a big enough plant to serve that crew ... we could clearly see where the trucks sat the longest, and we were able to determine where we were having a backup or inefficiency in our production.”

Billings reports being surprised at the ease of being able to track the information with the e-ticketing system. “If you pulled it up at any point throughout the day, you could tell where a load of asphalt was at. You could tell how much material had been loaded out ... Our inspector, our foreman and people like myself who sit behind a computer, we were all looking at the same information in real time.”

E-Ticketing: Benefits to the Owner

Griffith, from the Cabinet’s perspective, also saw great value in the real-time data, and in being able to access the tickets at any time. He states, “Normally, if you wanted to see how many times we are late or what material was late, you would go back to the office and dig those out. Now we can log in anywhere [and get specific data, such as tons of surface or tons of base].” Another benefit Griffith reports is the ability to track the yield. “We know a truck should go three hundred feet, and that is what our inspector does, makes sure they are not laying too deep or too thin ... [When] you build a geofence around your paver, we know [when the truck backs in and when it pulls out of that geofence], so we can measure how

A Closer Look

many feet it went and can track yield remotely.”

Another benefit mentioned by both Griffith and Billings is improved safety. With simple inspection tasks done remotely, fewer inspectors need to be at risk on the site. Billings says, “Paving is fast moving, it’s dynamic. Trucks are backing in, there are traffic hazards. Anything you can do to have one less person in that environment improves safety.”

Intelligent Compaction and Paver Mounted Thermal Profilers: Current Findings and Future Potential

The findings of the study for intelligent compaction and paver mounted thermal profilers suggested the need to be prepared to use these technologies to avoid inconsistent data. Sturgill explains, “[The technologies] have a lot of promise, but they have to be set up correctly, which requires training and understanding of the technology.”

However, despite these initial challenges, Griffith sees great potential for remote inspection in the future. The combination of the data from e-ticketing, the temperature measurements and the intelligent compaction offers the opportunity for process improvements and improved future performance.

He imagines a scenario where the asphalt mix

was done slightly differently in loads 25 through 50 than it was in the previous 24. Then he says, “we get 10 years down the road, we know exactly where each load was put, and we start to see failure in a certain area. [We can look at this data and determine that this section was paved with] loads 25 through 50. We can say that mix was not a good idea: It didn’t work well for durability. [Or if another area fails we can] look at the rolling and see that was one little patch that didn’t get rolled five times. It only got rolled four.” He concludes that having this data “opens up possibilities to monitor our pavement and its durability and the future of it.”

CQ



The pilots all focused on resurfacing projects as the simplest test cases.

Dodge Economic Insight

Nonbuilding Construction Outlook Dampened by Burgeoning Public Debt

- ▶ *Nonbuilding construction starts were destined to see a soft year in 2020 even before COVID-19 hit the US. Now, starts are expected to slide 18% over the year to \$172.6 billion. Public works will drop 9% to \$141.7 billion, but the larger decline will come from utility starts, which are expected to plummet 43% to \$31.0 billion—in response to both last year’s unsustainable [123%] surge as well as this year’s nosedive in energy prices. Energy prices slid as pandemic-related stay-at-home orders and shutdowns of nonessential businesses caused demand to plummet.*
- ▶ *Nonbuilding starts will rebound 7% in 2021 to \$183.9 billion as the economy begins to slowly reopen. The public works sector will remain little changed at \$142.1 billion while electric power/utilities will surge 35% to \$41.8 billion—although the sector will remain well below its elevated 2019 level of activity.*
- ▶ *The greatest risk associated with the current nonbuilding forecast lies with a potential inability of the government to fund public works projects due to burgeoning public debt. The passage of the 2017 Tax Cuts and Jobs Act, which provided short-term economic stimulus by cutting taxes but undercut longer-term funding needs of government programs, has created an increasingly serious debt problem over time. That issue has now been severely exacerbated by the trillions of dollars the federal government has needed to provide [and will still need to provide] in economic stimulus to respond to the COVID-19 pandemic, virtual shutdown of the economy, and the dire economic problems that individuals and businesses are now facing.*

By Kim Kennedy and Richard Branch

The nonbuilding construction sector, which consists of public works and power/utility construction, is unique in the construction world. Unlike building activity, which is largely funded by the private sector, nonbuilding construction is a mix of public and quasi-public projects. This means the sector is more often driven by legislative and regulatory initiatives than by economic trends. Because of this, the sector frequently deviates from trends in construction for residential and nonresidential buildings. The power/utilities subsector also consists of extremely large [multibillion-dollar] projects, which can cause surges and plunges in activity from year to year.

Coronavirus, however, has besieged the normal workings of the construction sector. This year—even though many public works construction projects were declared “essential business” and allowed to continue even during the months the economy was shuttered—nonbuilding construction starts are expected to decline 18% to \$172.6 billion. Public works construction starts are expected to drop 9% this year to \$141.7 billion due to weakness in several environmental [water] categories and a

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Richard Branch is Chief Economist at Dodge Data & Analytics

This article was excerpted from Dodge's Construction Market Forecast Service [CMFS].

Dodge Economic Insight

pullback in pipeline construction. Electric power/utility starts are expected to plummet 43% in 2020 to \$31.0 billion, following last year's 123% surge and this year's sharp decline in energy prices as demand tumbled during the shutdown.

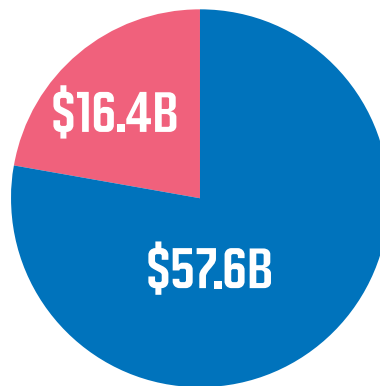
In 2021, nonbuilding construction as a whole will begin to recover as starts increase 7% to \$183.9 billion. Gains, however, will come entirely on the power/utility side of the market, which is expected to bounce back 35% to \$41.8 billion—still 23% below the 2019 high—as demand and energy prices revive. Public works, however, are expected to remain virtually unchanged from 2020 at \$142.0 billion. Very modest gains in streets and bridges as well as environmental public works will be overwhelmed by a continued decline in other public works.

Streets and Bridges

In 2020, COVID-19 has changed the outlook for streets and bridges just as it has for all other types of construction. But street and bridge construction had two things in its favor that other sectors did not have. First, Congress had finalized annual appropriations for FY2020 in December, raising appropriations for highway programs by 2% to \$46 billion and increasing funding for BUILD grants [Better Utilizing Investments to Leverage Development] by 11% to \$1 billion. Passage of these key funding mechanisms eliminated the uncertainty that in recent years had prevented some highway and bridge construction projects from moving forward.

In addition to secure funding, street and bridge

2020 Street and Bridge Construction Starts



■ Street/Highway Starts ■ Bridge Starts

CHANGE FROM 2019



construction was classified as “essential business” during the COVID-19 shutdown, which largely insulated the sector from the steep declines that have plagued many other construction segments. Physical distancing rules, state-level financial problems, and in some cases the virus itself interfered with normal operations, slowing down projects in the planning process and those already underway. Still, street and bridge construction starts are expected to inch forward by 1% this year to \$74.0 billion as street/highway starts gain 1% to \$57.6 billion and bridge starts grow 2% to \$16.4 billion.

Several massive street and bridge projects that broke ground in the first nine months of 2020 helped to create positive momentum for the year. The largest of these were two related projects located in Texas: the \$1.7 billion September start of Texas DOT's massive IH 635 (aka LBJ East) redevelopment project and the \$1.3 billion May start of improvements for the same LBJ East highway.

Dodge Economic Insight

Washington State DOT's \$705 million I-405 Renton to Bellevue Widening and Express Toll Lanes was the third largest project to break ground in the first nine months of 2020. These projects were followed by California's \$673 million I-10 Corridor construction and Maryland's \$463 million replacement for the Harry W. Nice/Thomas (Mac) Middleton Bridge.

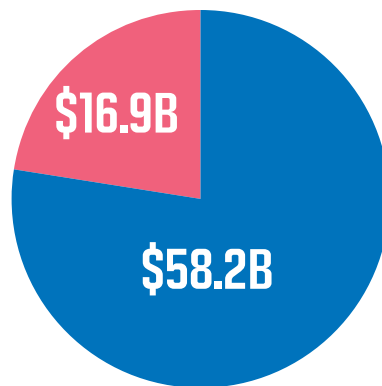
New complications were introduced for street and bridge construction expected in 2021 as it became clear that reauthorization of the legislation that provides federal funding for streets and bridges would be delayed until sometime next year. The FAST Act, which currently authorizes federal funding for highways and bridges, expired at the end of FY2020 (Sept. 30, 2020). Many thought that this year Congress would finally pass the reauthorization on time since the two sides of Congress had bills ready and waiting for conference committee. With Congress failing to act on that legislation, they instead attached a one-year extension of the FAST Act onto the stopgap continuing resolution spending bill that funded the government through Dec. 11. The full, one-year extension of the FAST Act essentially ensures funding for surface transportation construction throughout this fiscal year.

In addition to the FAST Act extension, Congress transferred \$13.6 billion of funding from the general fund to the Highway Trust Fund to keep it solvent. Solvency of the trust fund has been questionable for several years, but this year's coronavirus created special hazards for the fund. To inhibit the spread of COVID-19, the US public was encouraged

to stay at home. In doing so, vehicle miles traveled during the first seven months of 2020 plummeted 15.7% [almost 300,000 miles] according to the U.S. Department of Transportation. Because the federal gas tax provides the money for the Highway Trust Fund, fewer miles traveled mean fewer dollars entering the fund to provide improvements to the roads and bridges traveled.

Declines in vehicle traffic had serious consequences for highway funding. The federal government pays for road and bridge construction with funds from the Federal Highway Trust Fund, which is financed by federal taxes on gasoline and diesel fuel. With fewer people on the road traveling, revenues from these sources plummeted. The federal highway trust fund was already in jeopardy of running out of funds [and had been for several years], but COVID-19 restrictions accelerated the problem. In January, the Congressional Budget Office estimated that the fund would run out of money in 2021 but newer estimates suggested the trust fund would need an

2021 Street and Bridge Construction Starts



■ Street/Highway Starts ■ Bridge Starts

CHANGE FROM 2020



Dodge Economic Insight

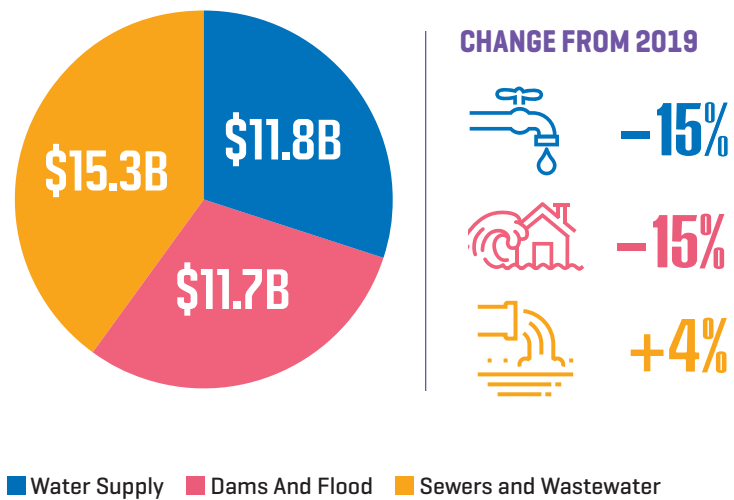
infusion of funds from the Treasury to keep it solvent in 2020. As a result, Congressional action that boosted the trust's funding was essential to construction both for late 2020 and 2021.

Without new authorizing legislation that was expected to provide a funding boost for the next five years, the outlook for streets and bridges in 2021 may be less favorable. At the same time, the extension of the FAST Act does provide some certainty for state DOTs that was dearly needed. On balance, construction starts for streets and bridges are expected to once again be able to inch up by a slight 1% in 2021 to \$75.1 billion as streets climb a similar 1% to \$58.2 billion and bridges gain a somewhat stronger 3% to \$16.9 billion.

Environmental Public Works

Environmental public works construction is strongly tied to changes in federal, state and local legislation, regulations and funding levels for development of drinking water systems, storm sewers, water resources such as dams, levees, and harbor development and for the remediation of hazardous waste. For over a decade, federal appropriations for environmental construction were both lackluster and late. Congress was unable to pass appropriations bills on time, which means that most programs were funded through continuing resolutions (or CRs) that provided only short-term, stop-gap funding. Moreover, federal spending cutbacks were often focused on discretionary programs and federal agencies such as the Environmental Protection Agency (EPA) and Army Corps of Engineers (USACE) through which many environmental

2020 Environmental Public Works Starts



programs are funded. State and local governments, therefore, have increasingly been burdened with providing funds to meet the environmental needs of local communities.

This trend has begun to change over the past few years as an increasing number of environmental disasters—hurricanes, tornadoes, flooding and other natural catastrophes—have forced Congress to step up funding. The Water Infrastructure Improvements for the Nation (WIIN) Act, passed in 2016, set the stage for increased spending on environmental public works. The America's Water Infrastructure Act (AWIA), signed into law in 2018, included a reauthorization of the Water Resources Development Act (WRDA), which provided \$3.7 billion in federal funds for the U.S. Army Corps of Engineers to use for dredging, flood control and other projects. AWIA also authorized funding for state revolving loan funds, subject to the annual appropriations process.

Dodge Economic Insight

In fiscal year 2020, Congress raised the EPA's budget by 2% to \$9 billion.

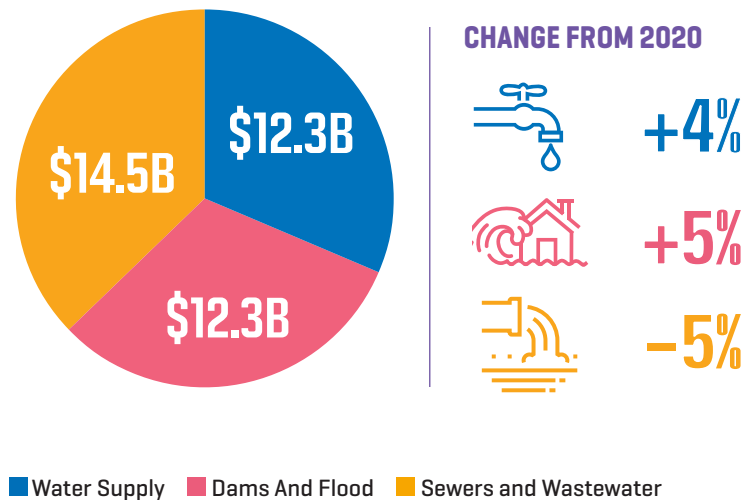
Federal funding for the EPA's state revolving loan programs (SRFs) included \$1.6 billion allocated toward Clean Water SRFs and \$1.1 billion set aside for Drinking Water SRFs. An additional \$25 million was provided to the WIFIA program, and \$83 million for the AWIA program. Additionally, the Army Corp of Engineers' civil works program received a boost of 9% to \$7.65 billion in funding.

In response to several natural disasters, Congress passed a disaster relief bill in June 2019 that afforded another \$19.1 billion in supplemental appropriations. The Army Corps of Engineers received \$3.3 billion for flood and hurricane protection projects, and the EPA received \$349 million to improve resiliency of water systems in states affected by hurricanes, typhoons, wildfires and earthquakes.

While not the comprehensive funding that environmental public works projects ultimately need, these packages have provided resources for important projects and remediations that have begun to flow to construction starts. In 2018 and 2019, construction starts for environmental public works rose 7% then 6% reaching \$42.0 billion last year.

COVID-19, however, is once again bringing uncertainty to this market. In 2020, starts of environmental public works are expected to pullback 8% to \$38.9 billion. Water supply projects will drop 15% this year to \$11.8 billion. The largest project contributing to this year's total is the \$200 million Thornton Water Project in Thornton, CO that broke ground in May. Dams and flood control projects are also on the decline this year with an expected 13%

2021 Environmental Public Works Starts



drop in activity to \$11.7 billion. The largest project supporting this category in 2020 is the \$390 million Kapalama Canal container terminal wharf and dredging project in Honolulu Harbor that broke ground in June. The one exception to this overall downward trend lies with sewers and wastewater projects. In 2020, this category is expected to increase 4% to \$15.3 billion thanks to the start of the \$1.3 billion biosolids digester that broke ground in San Francisco during August.

In 2021, environmental starts will hold fairly steady with a modest 1% increase to \$39.1 billion. Water supply starts will increase 4% to \$12.3 billion, and flood control projects will advance 5% to \$12.3 billion, but sewers/hazardous waste projects will drop back 5% following the 2020 gain to \$14.5 billion. One hope for higher levels of activity may come from the Biden administration that is more focused on meeting the challenge of climate change. The administration's litmus test, however, will be to convince a divided Congress to act. **CQ**

Dodge Economic Insight

Top 25 Infrastructure Projects in Planning

The projects listed in the table below are the top 25 projects by value still in the planning stages published in Dodge Construction Central from Sept. 1 to Nov. 30, 2020. Water/environmental

projects top the list this quarter, with a \$10 billion project in California and one in Colorado. Otherwise, there is a mix of pipeline, rail, bridge and road projects on the current list.

Data on the top projects in planning reported in Dodge for the previous three months will be an ongoing feature in the *Civil Quarterly*.

	STATE	DOLLAR VALUE	PROJECT NAME	CITY
1	CA	\$10 B	Bay Delta & Delta Habitat Conservation and Conveyance System	Sacramento
2	CO	\$10 B	Water Supply Transmission/Storage/Infrastructure/Hydropower	Wellington
3	NE	\$8 B	Keystone Pipeline Phase IV-Keystone XL [US Section]	Steele City
4	NY	\$5.5 B	Gateway Tunnel Project	New York
5	NV	\$4.8 B	High Speed Rail [Las Vegas to Victorville, CA]	Las Vegas
6	LA	\$2.2 B	Driftwood LNG Pipeline	
7	UT	\$2.2 B	Bear River Development	
8	MD	\$1.9 B	Susquehanna River Bridge Replacement	Havre de Grace
9	TX	\$1.6 B	TX/DOT: IH 820 Roadway Reconstruction	
10	FL	\$1.5 B	FL/DOT: Central Broward Transit East-West Light Rail Line	Ft Lauderdale
11	NY	\$1.5 B	LaGuardia Air Train [Design/Build]	New York
12	NJ	\$1.5 B	South Jersey Light Rail Line [Glassboro-Camden Line]	Glassboro
13	CA	\$1.3 B	Van Nuys Light Rail/East San Fernando Valley Corridor	San Fernando
14	PA	\$1.2 B	Norristown High Speed Line to King of Prussia	King of Prussia
15	NY	\$1.2 B	Gowanus Canal Combined Sewer Overflow Tunnel Facilities	Brooklyn
16	CO	\$1 B	Ph I Water Pipeline/Reservoir/Hydropower	Wellington
17	CA	\$850 M	High Desert Corridor	Victorville
18	LA	\$800 M	Mid Breton Sediment Diversion	Pointe a la Hache
19	NC	\$800 M	Railroad Alignment & Bridge	Wilmington
20	IN	\$728 M	I/69 Sec 6 Cont 5 DBBV-State Road/Bridge [Design/Build]	Indianapolis
21	CA	\$650 M	Poseidon HB Seawater Desalination Facility	Huntington Beach
22	CA	\$600 M	ACE Forward Altamont Corridor Express	
23	FL	\$532 M	Beach Corridor Transit Connection	Miami Beach
24	TX	\$500 M	TX/DOT: 10/69 Interchanges Project	Beaumont
25	CA	\$471 M	I-15 Corridor	San Bernardino

Dodge Economic Insight

Top 25 Infrastructure Projects in Start

The projects listed in the table below are the top 25 projects by value reported in Start in Dodge Construction Central from Sept. 1 to Nov. 30, 2020. While the majority of projects are road/

highway projects, due in part to the work on LBJ East in Texas, the top two projects are water supply and pipeline work.

Data on the top projects reported in the start phase in Dodge for the previous three months will be an ongoing feature in the *Civil Quarterly*.

	STATE	DOLLAR VALUE	PROJECT NAME	CITY
1	ND	\$1.19 B	Red River Valley Water Supply Project	Washburn
2	IL	\$948 M	Capline Marathon Pipeline Reversal	Patoka
3	FL	\$865 M	FL/DOT: I-275 Howard Frankland Bridge	
4	UT	\$795 M	RFP/DB: UT/DOT: West Davis Highway Improvement	Farmington
5	OH	\$709 M	Buckeye Xpress Pipeline	
6	KS	\$524 M	Northwest Water Treatment Facility	Wichita
7	TX	\$401 M	TX/DOT: IH 635 Lane & Reconstruct 4/8 - LBJ East	
8	TX	\$400 M	TX/DOT: IH 635 Lane & Reconstruct 4/6 - LBJ East	
9	IN	\$346 M	IN/DOT: I-69 Road & Bridge Improvements [C0205]	Martinsville
10	TX	\$301 M	TX/DOT: IH 635 Lane Improvement - LBJ East	
11	MN	\$276 M	MN/DOT: Grading Bituminous Resurfacing	
12	TX	\$226 M	TX/DOT: Widen & Add Lane Improvements	
13	MI	\$215 M	MI/DOT: Pavement Reconstruction [C0 701]	Marshall
14	TX	\$201 M	TX/DOT: IH 635 Lane Reconstruct - LBJ East	
15	TX	\$201 M	TX/DOT: IH 635 Lane Reconstruct - LBJ East	
16	TX	\$201 M	TX/DOT: IH 635 Interchange Reconstruct - LBJ East	
17	IL	\$194 M	IL/DOT US 150 War Memorial Drive Bridge Replacement	Peoria
18	IL	\$183 M	Tollway I-294 Roadway & Bridge Reconstruction	Downers Grove
19	MO	\$174 M	Lower Meramec River System Improvements	Fenton
20	CA	\$135 M	CA/DOT: Interstate 5 Improvements	Los Angeles
21	NV	\$130 M	NV/DOT: US 95 Lanes Improvements	
22	MO	\$127 M	Blue River WWTP Solids Processing Improve REBID	Kansas City
23	NY	\$124 M	NY/DOT: VanWyck Expressway Road Rehabilitation C0 076 REBID	
24	IL	\$124 M	Roadway and Bridge Rehabilitation	Downers Grove
25	IL	\$124 M	Tri-State Tollway I-294 Roadway & Bridge Reconstruction	Des Plaines

METHODOLOGY

Dodge Data & Analytics conducted an online survey from Oct. 19 to Nov. 16, 2020 of contractors and engineers active in civil projects. They were drawn from several sources:

- The DD&A Contractor Panel (over 2,700 decision-makers that includes general contractors, construction managers, design-builders and trade contractors)
- The DD&A database of contractors and engineers
- Outreach by Infotech, Hexagon, Command Alkon, Iowa State University, University of Florida and the Design-Build Institute of America

182 contractors and 41 engineers who work on heavy civil infrastructure projects responded to the survey.

Location

93% do most of their construction work in one of the four census regions:

- 23% in the Midwest
- 36% in the South
- 20% in the West
- 14% in the Northeast

Type of Contractor

- 68% general contractors, construction managers, design-builders
- 14% non-building contractors
- 18% trade contractors

Contractor Job Functions

- 38% of contractors identify themselves as executives (CEO/Owner/Partner/President/Principal/Other C-Level)
- 34% identify themselves as project leadership (Project Manager/Project Engineer, Project Executive/Construction Manager)
- 20% identify as estimators, and 9% as other

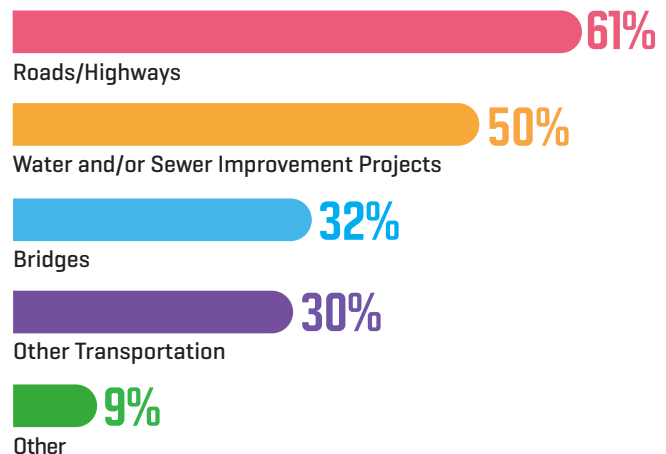
Contractor Size by Annual Revenue

- 24% small contractors (revenues less than \$10M)
- 29% midsize contractors (revenues from \$10M to less than \$50M)
- 47% large contractors (revenues \$50M and over)

Civil Engineers

Civil engineers were asked similar questions to those asked of contractors about their backlog and market expectations. Their responses are featured in the Pipeline section. Their responses are also included in the analysis of BIM and Digital Twins.

Project Types (Contractors)



RESOURCES

Additional Resources on the Heavy Civil Construction Industry

FOUNDING PARTNER

Infotech www.infotechinc.com

PLATINUM PARTNER

Hexagon <https://www.hexagon.com/>

GOLD PARTNERS

Command Alkon <https://commandalkon.com>

Digital Construction Works www.digitalconstructionworks.com

RESEARCH PARTNERS

Design-Build Institute of America <https://dbia.org/>

Iowa State University Civil Construction and Environmental Engineering
<https://www.ccee.iastate.edu/>

The University of Florida

- **M. E. Rinker, Sr. School of Construction Management**
<https://dcp.ufl.edu/rinker>
- **Smart Construction Informatics [SCI] Lab**
<https://my.dcp.ufl.edu/costin/sci-lab/>
- **UF Transportation Institute [UFTI]**
<https://www.transportation.institute.ufl.edu/>

OTHER RESOURCES

FHWA Resource Center <https://www.fhwa.dot.gov/resourcecenter/>

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We would like to thank our founding partner, Infotech, for their vision in joining us in this effort. We would also like to thank our platinum partner, Hexagon, and gold partners, Command Alkon and Digital Construction Works.

We appreciate the efforts of our research partners, Design-Build Institute of America, Iowa State University and the University of Florida.

We thank all those who participated in interviews for sharing their insights and experience with us on critical topics impacting heavy civil construction.

We Need Your Feedback!

What would you like to see on this report? What trends would you like to know more about? Let us know at TCQ@construction.com.

DODGE DATA & ANALYTICS

About Dodge Data & Analytics

Dodge Data & Analytics is North America's leading provider of analytics and software-based workflow integration solutions for the construction industry. Building product manufacturers, architects, engineers, contractors, and service providers leverage Dodge to identify and pursue unseen growth opportunities and execute on those opportunities for enhanced business performance. Whether it's on a local, regional or national level, Dodge makes the hidden obvious, empowering its clients to better understand their markets, uncover key relationships, size growth opportunities, and pursue those opportunities with success.

The company's construction project information is the most comprehensive and verified in the industry. Dodge is leveraging its 100-year-old legacy of continuous innovation to help the industry meet the building challenges of the future. To learn more, visit www.construction.com.

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