Managing Risk in the Construction Industry SmartMarket Report

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About Dodge Data & Analytics
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Introduction

Construction has always been an industry with a high level of risk. Increasing project complexity, large project teams and the inherent physical dangers of the work itself all contribute to this reality. However, too often the industry accepts high risk as a standard operating condition. As construction activity accelerates after the recession, improving risk management is as important as increasing productivity, safety and profitability, so we believe this study is both critical and very timely for the industry.

While built upon the foundation of the seminal risk management study Dodge Data & Analytics (then McGraw Hill Construction) conducted in 2011, this study takes a broader approach with over 500 respondents representing a wide range of building sectors, including general building, institutional, industrial and non-building (horizontal infrastructure).

The study reveals that risk continues to have an enormous impact on the construction industry, with three quarters (75%) of respondents reporting that they have experienced a dispute or claim in the last five years.

The findings also demonstrate that the experiences of risks differ between owners and contractors. Owners feel the greatest impact from planning/scope changes, schedule changes and cost escalation, while GCs and trade contractors are more concerned about labor procurement and contractual risks (from how risk is apportioned directly by the contracts, to issues like warranties, guarantees, etc.). These varying perspectives on risk lead to differing priorities when selecting the best risk evaluation and mitigation strategies.

One of the most important findings of the study examines which of the 10 risk evaluation and mitigation strategies respondents report experiencing from each. Not surprisingly, given the very different experiences of risk they report, owners and contractors also experience very different benefits from their use of risk management strategies.

That said, though, a clear pattern emerges in regard to the impact of collaboration on reducing risk. The two top strategies for all respondents—formal brainstorming with the team and regular project meetings with the full team focused on risk—enhance collaboration across teams and yield critical benefits like increasing reliability in overall project performance, reducing the cost of construction, improving project schedule and improving safety.

This is reinforced by the high value all players place on project delivery methods that encourage greater team integration as a means to drive expanded future use of risk management practices. Likewise, contractors in particular find the lack of cooperation among project team members to be a critical obstacle to their increased future use of these practices.

The most telling finding, though, comes from directly asking the respondents whether increased collaboration reduces risk. There is resounding agreement that this is the case, with 91% affirming this statement.

However, the concern about contracts also demonstrates that effective risk mitigation begins from the start, with how the project team is contracted and the delivery method selected.

We would like to thank our premier partner Alliant for helping us to bring these important findings to the industry. In addition, we thank Procore and e-Builder for their support, and we also thank all of our research partners for their efforts to engage the industry in the study.
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Executive Summary

The biggest risks faced in the construction industry can be addressed through better risk management and more collaborative approaches. With three quarters of owners and contractors reporting that they have experienced claims and disputes, it is clear that ineffectively managed risks take a high toll on the construction industry. As the data in the research demonstrate, risk evaluation and mitigation strategies can yield specific, valuable project benefits like greater reliability, reduced cost and reduced schedule.

Disruptive Influence of Disputes and Claims

Three quarters (75%) of those who participated in the study experienced a claim or dispute in the last five years, including 83% of the GC respondents. Thus, disputes and claims are still common practice in the construction industry, leading to disruption and increased costs for all parties involved.

- Claims arising from construction defects are the most common and the most costly claims and disputes for owners.
- Subcontractor default, termination or failure claims and disputes are the most common and most costly for GCs.
- Warranty issues are the most common for trade contractors, but they are nearly evenly split between warranty issues and claims arising from construction defects when selecting the most costly.

Top Risks Faced in Construction

Owners, GCs and trade contractors face a variety of hazard, strategic, operational and financial risks. While any risk can be serious, the chart at right shows the top five specific risks considered to have the greatest impact by respondents.

This list suggests that these top risks, unlike weather, political disruption or disaster, can be anticipated from experience and managed through established risk evaluation and mitigation practices.

It is particularly striking that concerns about contractual distribution of risk are included among the top five. This is a call to the industry that good risk management starts early, as the contractual obligations are being formed.

The data in the detailed analysis in the report also demonstrate that owners, GCs and trade contractors rate risks differently. Their varying perspectives suggest that a number of mitigation strategies will be required for effective management.
Most Effective Risk Evaluation and Mitigation Strategies

The industry has multiple risk evaluation and mitigation strategies, of which 10 were included in this study. While each has value for managing risk on projects, four were selected by the highest percentage of respondents as the most effective, as shown in the chart at right.

The study also looked at the specific benefits achieved from using each risk evaluation and mitigation strategy. Information on the strategies that the highest percentage find to have achieved top benefits like increased reliability in overall project performance, reduced cost and reduced schedule are provided on page 6, with the percentage of owners and contractors who identify the top strategies to achieve each benefit.

Key Triggers and Obstacles

Contractual issues are not only among the highest risks for respondents, but they are also behind the top triggers for increased use of risk management, demonstrating the importance of getting risk attribution right before the project begins.

The top obstacles preventing the use of more risk management practices are basic and fundamental: lack of cooperation across the project team and basic lack of knowledge.

Collaboration Reduces Risk

Many of the findings throughout the study point to the same conclusion: that increased collaboration is a fundamental strategy for reducing risk.

- Nearly all (91%) agree that collaboration reduces risk.
- The most effective risk evaluation strategy (formal brainstorming with team) and most effective risk mitigation strategy (regular meetings with the full project team) are means to enhance collaboration.
- Two top obstacles involve the lack of communication and information flow across the project team.
- One of the top triggers for increasing use of risk management practices is the use of delivery systems/contracting methods that encourage project team integration.
- The current approach to apportioning risks in construction contracts to specific parties discourages collaborative behavior. Shared risk and reward contracts may be a way to address this issue.

Top Triggers and Obstacles to Increased Use of Risk Management Practices

(According to All Respondents)

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<thead>
<tr>
<th>Top Triggers Encouraging Increased Use of Risk Management Practices</th>
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<tr>
<td>Increased Tendency for Clients to Shift Project Risk to Contractors*</td>
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<th>Biggest Obstacles to Increasing Ability to Use Risk Management Practices</th>
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<td>Lack of Cooperation/Information Flow Between Design and Construction Team Partners</td>
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* Only Asked of Contractors
Top Risk Evaluation and Mitigation Strategies to Achieve Benefits

Increase Reliability In Overall Project Performance

- Owner
  - Formal Brainstorming With Team
- Contractor
  - Regular Meetings of Full Project Team Focused on Risk
  - Expert Input From Internal Resources
  - Developing a Plan to Manage Risk
  - Expert Input From Internal Resources

Reduce Cost Of Construction

- Owner
  - Expert Input From Internal Resources
  - Formal Brainstorming With Team
- Contractor
  - Expert Input From External Resources
  - Developing a Plan to Manage Risk
  - Formal Brainstorming With Team

Improve Project Schedule

- Owner
  - Checklists Forms Risk Registers
- Contractor
  - Expert Input From Internal Resources
  - Contingency Planning
  - Formal Brainstorming With Team
  - Regular Meetings of Full Project Team Focused on Risk
  - Contingency Planning
As the construction industry has emerged from the recession into a higher level of activity, the risk landscape has changed, but it has not declined. Risk still has a profound impact on all players in the construction industry. These impacts can include significant financial disruptions due to claims and disputes, concerns about safety, business impacts due to shifts in schedule and cost, and even reduction in the ability to attract and retain talented workers.

In order to capture the extent of the risks faced and the evaluation and mitigation efforts that improve risk, Dodge Data & Analytics and Alliant have partnered on this study, which encompasses a broad swath of the construction industry. Both building owners and contractors are included among the 507 total respondents, comprised from companies doing general building and industrial projects, in addition to non-building. The breadth of responses allows for several analytic variables to be used in the data analysis throughout the report. These variables are described briefly in the Note About the Data to the right and more fully in the methodology on page 60.

In addition, the type and amount of data gathered is expansive as well. The study not only looks at the most frequent and costly disputes and claims suffered by the industry in the last five years, but it also looks at the impact of 25 different risk factors in four major categories: financial, hazards, operational and strategic. In addition, it takes an intensive look at 10 risk evaluation and mitigation approaches, not only highlighting those considered most effective, but examining which ones help deliver critical project benefits like increased reliability, reduced cost and schedule, and improved safety, and critical business benefits like improved client satisfaction, increased competitive advantage and increased ability to innovate.

Understanding the risks faced by owners and contractors, and the ways in which these companies evaluate and mitigate those risks, is critical to help the industry become more effective in facing current and future challenges.

Note About the Data

The data and analysis in this report are based on an online survey conducted with responses from 507 building owners, general contractors, construction managers, design-build firms and trade contractors. For the purpose of analysis, the category of general contractors (GCs) used in the report includes design-build firms and construction managers. The online survey was conducted in July and August 2016.

The central analysis of the data pursued in the report focuses primarily on the statistically significant differences in the responses of the owners, GCs and trade contractors. However, the analysis also includes several other analytic variables where notable differences occur, including:

- Variation by Size of Contractor
- Variation by Size of Largest Project
- Variation by Industry Sector
- Variation by Location of Work (a comparison of companies working solely in the U.S. to those that do work in the U.S. and abroad)

More information on each of these variables can be found in the methodology on page 60.
Most of the owners, general contractors and trade contractors who participated in the study have experienced a claim or dispute in the last five years. This finding supports the need for improved risk evaluation and mitigation practices in the construction industry.

As the chart shows, general contractors are most likely to report experiencing a dispute or claim, although the difference between owners and GCs is within the margin of error for the study. A significantly smaller percentage of trade contractors experienced disputes or claims in the last five years than owners or general contractors.

This finding is notable because trade contractors frequently report lower levels of use of many risk evaluation and mitigation measures (see pages 22 and 32). Owners and general contractors may see a more urgent need to invest in these measures based on their previous history with claims. However, trade contractors are critical for managing risk on a project, and with well over half (60%) reporting that they have experienced a dispute or claim in the last five years, industry efforts to engage the trades in greater risk mitigation awareness and adoption may be necessary to improve the effectiveness of the industry as a whole.

**Variation by Size of Project and Company**

Not surprisingly, companies that do large projects of $20 million or more are more likely to experience a claim or dispute than companies that do smaller projects. Over three quarters (79%) of companies doing large projects have experienced disputes or claims in the past five years, compared with two thirds (67%) of companies doing smaller projects.

The difference between large and small companies is particularly notable among contractors (GCs and trade contractors combined), where 95% of those with annual revenues of $500 million or more have experienced a claim or dispute, compared with 77% of those with revenues of less than $50 million.

**Variation by Project Type**

More companies doing transportation infrastructure projects (80%) report experiencing a dispute or claim in the last five years, compared with those doing general building (74%), industrial (74%) or water infrastructure (73%) projects. This may be influenced by the size and long duration of many transportation projects.
Owners, GCs and trade contractors who have experienced a dispute or claim in the last five years were asked to rank the disputes and claims with the greatest impact in two ways: those experienced most frequently and those that were the most costly. The chart at right indicates the types of disputes and claims ranked first.

Their responses indicate that the impact of many of these types of disputes and claims varies by player.

- **Owners:** Owners most frequently experience claims arising from construction defects (31%) and warranty issues (25%). In addition, the highest percentage (36%) consider claims arising from construction defects to be the most costly. However, a much lower percentage (13%) rank warranty issues first in terms of cost, with a higher percentage (19%) selecting subcontractor defaults as the most costly instead.

- **GCs:** Subcontractor default, termination or failure is by far the most frequent and most costly type of dispute/claim experienced by GCs. Claims arising from construction defects, while only selected as most frequent by 18% of GCs, are considered most costly by 27%, suggesting that this is also a notable problem that GCs need to address.

- **Trade Contractors:** The highest percentage of trade contractors (38%) most frequently experience claims or disputes due to warranty issues. However, when it comes to the costliest types of disputes and claims, those arising from construction defects appear to have a nearly equal impact on trade contractors as warranty issues. Concerns about the cost impact of GC default, termination or failure are also notable for trade contractors, with 20% ranking this as the most costly issue.

These findings demonstrate the impact of the recession, with the high level of concern about subcontractor default, termination or failure, and the financial toll it places on the industry.

In addition, they reveal how differently the three types of players experience risk, which may influence the types of risk evaluation and mitigation strategies they are most interested in adopting.
Exposure to Risk on Past Projects
Disputes and Claims With Greatest Impact CONTINUED

Variation by Size of Project
Warranty issues appear to loom largest over the smallest projects.
- 22% of respondents from companies whose largest project is under $10 million rank warranty issues as their most frequent claim or dispute, compared with 16% that do larger projects.
- 19% of companies doing small projects consider warranty issues the most costly, compared with 8% of those doing larger projects.

Variation by Project Type
Infrastructure projects, in particular water infrastructure, tend to experience more claims/disputes associated with professional liability than general building or industrial projects, and the percentage who find them the most costly trends higher as well for those doing infrastructure projects. Approximately 13% of those doing infrastructure projects select professional liability claims/disputes as the most costly, compared with 7% of those doing general building or industrial projects.

Types of Projects Prone to Construction Defects

Public and Private Projects
All respondents were asked whether public projects, private projects or public-private partnerships have experienced the most claims from construction defects. When limiting the analysis to those who have done public projects in the last five years and who have also experienced claims arising from construction defects, there is little difference between those who think that public projects more frequently experienced claims arising from construction defects (47%) and those who think private projects did (43%), and most of the remaining 10% believe that there is no difference between the number of claims reported in public and private projects. This suggests that whether projects fall in the public or private realm has little impact on the likelihood that they will experience a claim due to construction defects.

Types of Projects
The type of project, on the other hand, does appear to influence the frequency of claims due to construction defects.
- These kinds of claims are reported most frequently by those doing multifamily projects (31%), and by a high margin. This sector has a reputation for being particularly litigious, which these findings bear out. Given the unusually high volume of multifamily projects started in the last three or four years (according to the Dodge database of project starts), this may have influenced the frequency with which those claims are reported in this study.
- Education is the next highest type of project, with 20% of those doing work in that sector reporting that they had claims due to construction defects.

Interestingly, both of these types of projects span the public and private sectors, which may account for the relatively even distribution of these claims between public and private projects.

Project types in which claims due to construction defects are least frequently reported include office, healthcare, retail, airports and tunnels, all of which have less than 10% reporting these claims.
The construction industry has rebounded from the 2008 recession to find the risk landscape transformed. The last five years have seen new risk factors spiking while perennial factors continue in force. In response to this complex new mix, the industry is making a major shift toward managing risk more systematically.

**Top Three Post-Recession Risks**

Among today’s top-ranked risks, the shortage of skilled craft labor has reached crisis level. With more than 1.5 million workers who left the industry during the recession now unlikely to return, the total number of employed construction workers currently hovers around 20% less than the 2006 peak; and among the skilled workers who remain, those in the baby boom generation are reaching retirement age. In this market, contractors pursuing a growing number of projects with fewer, less-experienced workers are finding themselves stretched.

Pressure from owners has also intensified in the last five years, not only constricting project costs and schedules, but transferring greater risk contractually. “Today, we spend a tremendous amount of time analyzing project risk for clauses that we’ve never had to worry about in the past, since they were either the owner’s or architect’s responsibility,” Dan Whiteman, vice chairman at Coastal Construction, reported in a survey conducted this year by the Associated General Contractors of America (AGC) and FMI. (See page 46 for citation information.) This finding resonates in another recent study by FMI, focused on electrical contractors, that has not been released publicly: “Incomplete designs have become the contractor’s responsibility.” Contractors who internalized a mentality of scarcity during the downturn have been slow to say no when their plates are full, making subcontractor default the third-ranked risk trend in the post-recession mix. Between 2009 and 2015, the average number of months of contractor backlogs industry-wide increased by 33 percent, according to Associated Builders and Contractors. Subcontractors especially are struggling to meet their existing commitments: failing to adjust to new margins, tighter cash flows and reduced labor pools, they may be undercapitalized, carrying too much overhead and unable to bond.

**Responding to Risk**

Post-recession impacts combining with the industry’s more consistent risks have generated a complex new risk environment, and construction companies are responding with new approaches to risk management. Among participants in the AGC/FMI survey, 90 percent are deploying new tools and strategies, providing risk management-specific training, hiring personnel for new risk management positions, making more effective use of their relationships with brokers or combining these and other tactics; and almost 70% have a formalized risk management department and dedicated risk manager. These indicators suggest the industry is moving toward a more comprehensive approach to risk management at the enterprise level.

The practice of enterprise risk management (ERM) controls for all of the risk factors an enterprise faces: strategic, operational, financial and hazard; and it does so in a systematic way. It engages all company personnel in a cyclical process consisting of five key risk management steps: identification, analysis, response, control and monitoring. Done right, ERM improves managerial decision-making around strategic risks, promotes operational efficiencies through increased reliability and accuracy of data, maintains availability of credit and manages the cost of capital, and reduces the consequences of uncontrollable losses.

Historically, it’s been primarily the largest companies that have adopted ERM, says David Druml, a construction risk management consultant, yet the process “fits smaller companies like a glove.” Large or small, he says, “any owner or senior officer who wants to improve the profitability of their firm would be well advised to take an interest in ERM.”
Managing Subcontractor Default Risk

The risk of subcontractor default is ongoing in the post-recession construction industry. Subcontractor default insurance may help address the issue, and that industry is evolving in response to industry trends. Some contractors are also devising their own strategies to deal with this issue.

Since emerging from the last recession, the construction industry has taken a hard look at subcontractor default. Both insurance carriers and contractors have adjusted their outlook on subcontractors in the hopes of better protecting against future losses.

Factors Impacting Availability of Subcontractor Default Insurance

Jim Bly, managing director at Alliant Construction Services Group, says that although subcontractor defaults weren’t as dire as initially predicted going into the recession, carriers still tightened terms for subcontractors to reduce risk. One lesson learned was that even a default from a small subcontractor could have a big impact on a job, Bly says. “[Carriers] found that the smaller subcontractors had a much higher maximum probability loss factor,” he says. “A critical path subcontractor could be relatively small, but have a large impact on the overall schedule. The loss on that subcontractor could end up being four to six times the subcontract value.”

As a result, the industry has moved to limit coverage. “We’ve seen underwriting that goes up to three times the subcontractor value in limits, and that’s it,” he adds.

While small contractors may receive more scrutiny, so do big jobs. Bly notes that the recent trend in megaprojects has led to very large subcontracts, increasing concerns that a default could lead to significant losses. Bly says the industry is already witnessing defaults on subcontracts in the $30 million to $40 million range. “It comes about from subcontractors that shot for the moon and tried to hit a homerun on a very large project that was maybe beyond their capabilities or they didn’t have the balance sheet to finance it,” Bly says.

Although there have been losses, Bly says that hasn’t driven carriers away from subcontractor default insurance. In fact, the options have expanded. When the recession hit, only Zurich Insurance Group offered subcontractor default insurance. Since then, XL Catlin and Arch have launched programs as well.

New Post-Recession Concerns

Coming out of the recession, new concerns around subcontractor risks have emerged. Terry Gray, managing director at FMI, says that tight labor market has had a big impact on the ability of contractors to properly man jobs. “That inability to find new people or get qualified people to run and manage work is creeping into the cause for default,” he says.

Gray says that, in today’s booming construction market, many subcontractors are working at capacity, but still pursue additional opportunities. “As you’d expect in a boom or bust industry, they are very reluctant to take a pass on good job opportunities,” he adds. “Inevitably, some of them end up being overextended, and they are out in the marketplace, struggling to find people to run their jobs. And if they find people, they might not have the capabilities or experience to run their jobs properly. That’s a big driver at the moment. Ten to 15 years ago, it wasn’t even on the radar screen.”

Gray says the recession also reminded contractors to always keep a sharp eye on subcontractors, even subs who have worked for them for decades. Gray says that contractors risk “getting comfortable” with long-time partners. “A contractor may have worked with [a subcontractor] for 50 years and automatically consider them for the job,” he says. “On the front end, they don’t have the discipline around prequalifying and questioning the subcontractor before they hire them,” he says.

Gray says that when a longtime...
subcontractor starts to have difficulty during a project, contractors often give the sub too much latitude. “A lot of time goes by before the default process is really initiated, and you’ve lost critical time,” he says.

**Ways to Mitigate Risk of Subcontractor Default**

For contractors, experts say the key to mitigating the risk of subcontractor default is robust prequalification and monitoring of subs. Sundt Construction has been prequalifying subcontractors since 2001 and today has nearly 7,000 subs in its database that renew on an annual basis, says Kevin Burnett, senior vice president at Sundt Construction.

Burnett says the company’s system is constantly evolving and improving. For example, Sundt now requests more information around experience modification ratings. “We request that and get it backed up by what the brokers provide to us, rather than just the individual companies,” he says. “That way, we know the calculations are correct.”

Burnett says the company is a big proponent of subcontractor default insurance, especially in the southwestern states where it does the majority of its business. However, when the company takes on jobs in less familiar areas of the country, it prefers to use performance bonds. “Because we’re not a local general contractor, sometimes you have subcontractors that may go through your prequalification process, prove that they are financially strong, their incident rates look good, their OSHA ratings are good, but what happens is that you may not get their A team,” he says. “They bid the job and start out with the A team, but if a general contractor they do a lot of work with locally needs them to move over, suddenly we see the crews get thinner.”

Burnett says Sundt also uses performance bonds on subcontractors that hold very large contracts. Burnett says the company currently has some sub packages valued at more than $50 million.

One tried-and-true practice is monitoring its subcontractors’ activity elsewhere in the market, Burnett says. “We always ask subs to provide us with their backlog and the work they have in the pipeline—things they know are coming but not under contract yet,” he says. “We always ask for the number of employees they have and what their crews look like.”

Burnett says Sundt also wants to know who their subcontractors are working for on other jobs. “Not all contractors are created equal, and not all of them treat subs in a fair and balanced way,” he says. “We want to know what projects they are on and where they could get stretched out in terms of cash flow. Maybe we know in the market that the project is not going well and that they may get stretched out. We will take that into consideration.”

While Sundt prequalifies its subcontractors on an annual basis, he says that if the company becomes concerned about a sub, it may request updates on a quarterly basis.

“We can monitor our jobs, but the problem is when someone else causes them a problem,” he says. “We’ve been fortunate not to have any real disasters. That’s because our guys are paying attention.”
Owners, GCs and trade contractors were asked to rate whether a series of six strategic risk factors posed a low, moderate or high risk on projects their company had conducted in the past five years. The chart at right shows the percentage who indicated that each posed a high risk.

**Brand/Reputation Risk**
Owners are most concerned about this, although with only 14% considering this a high risk, it rates considerably lower than many of the operational risks for owners (see page 16). However, while this is the top strategic risk for owners, few GCs (6%) and almost no trade contractors (1%) are concerned enough to consider this a high risk. This finding may be influenced by the ongoing use of low bids as a top method of contractor selection. If the bid amount is more influential in their ability to gain work than company reputation, they may be less likely to consider brand and reputation a high risk.

Notably, large contractors with annual revenues of $500 million or more are more often concerned about risks to their brand and reputation than the average, with 17% suggesting that this is a high risk factor for them.

**Contractual Specification of Risk**
Contractual specification of risk includes issues like risk financing, risk transfer and risk mitigation.
- The highest percentage of GC (27%) and trade contractors (27%) view this as a high risk. It is also rated higher by contractors than almost all of the other risks included in the study (see pages 16, 17, and 18). Many contractors report that contracts increasingly transfer risks to them that are traditionally held by other players, and this finding reflects that concern.
- Owners are less likely to view this as a serious risk, with only 13% rating it in this category. It is notable, though, that the bigger the owner’s annual construction budget is, the more likely they are to consider this a high risk, from 9% who do less than $50 million in projects annually to 15% who do $500 million or more.

These findings support the notion that greater experience with construction contracts leads to a higher degree of concern about contractual specification of risk.

**Other Strategic Risks**
10% or fewer owners, GCs and subs report that compliance risks, delivery methods, sufficient industry/market area experience or political risks have been high risks on their recent projects.

However, large contractors are more concerned about the risks inherent in the choice of delivery methods, with 21% considering this a high risk. Their involvement on large, complex projects may raise the level of risk associated with delivery methods that do not encourage a collaborative approach, especially given the overwhelming agreement across the industry that collaboration helps to reduce risk (see page 50).
High Risk Factors

Strategic Risks CONTINUED

Variation by Location of Projects
Companies that work outside of the U.S. are more concerned about several strategic risks than those that work solely in the U.S. It is no surprise that those working outside the U.S. are more likely to consider political risks and finding sufficient industry/market area expertise to be higher risks than those who work in the U.S. only. However, the selection of delivery methods is actually the top risk for those doing work outside the U.S., with the percentage of those who rate it as a high risk even greater than those concerned about the contractual specification of risk.

This finding could be influenced by several factors. Projects outside the U.S. may involve players used to several different markets, with very different approaches, and a delivery method that clearly defines roles and obligations could be more important in this model. In addition, larger companies are more likely to work outside the U.S., and as stated above, delivery method is a particular concern for them. Finally, there could be general concern about delivery methods differing in other markets and the challenge to the legal team to make sure that the full implications of the selected delivery method are understood.

Operational Risks

Owners, GCs and trade contractors were asked to rate whether a series of seven operational risk factors posed a low, moderate or high risk on projects conducted by their company in the past five years. The chart on page 16 shows the percentage who indicated that each posed a high risk.

Comparing these findings to the strategic, financial and hazard risk factors included in the study (see pages 14, 17 and 18, respectively), it is clear that several operational risks are a major cause of concern in the industry, especially among owners.

Planning/Scope Changes
Reliability in terms of project schedule and building functionality are often critical measures of project success for owners. In addition, many owners need to please internal stakeholders, but changes in leadership or staffing at their company during a project can abruptly change project requirements. Therefore, it is not surprising that many owners find planning/scope changes to be a high risk factor for their projects.

Nearly one fifth of general and trade contractors (19%) also consider this a high risk. Depending on when they occur in the project lifecycle, planning and scope changes can be quite disruptive for contractors.

Cost Escalation
 Owners are more concerned about cost escalation than contractors are. Cost escalation is typically a serious problem for owners because they have to pay the increase, while contractors are often able to pass cost increases on to the owner.

More data about drivers and impacts of cost escalation are available in the 2014 Managing Uncertainty SmartMarket Report.
High Risk Factors

Operational Risks  CONTINUED

Schedule Changes
This is one of the few risks included of great concern to both owners and contractors. Their agreement on the degree of risk associated with schedule changes, though, does not extend to their understanding of the top causes for this problem. The Managing Uncertainty SmartMarket Report reveals that many owners do not consider an accelerated schedule or owner program/design changes to be an important factor in schedule changes, but contractors do. Likewise, contractors are less likely to blame schedule delays on contractor-caused delays or construction coordination issues than owners are.

Regardless of the differences, though, owners and contractors are both likely to be interested in risk evaluation and mitigation approaches that minimize the impact of schedule changes (see page 43).

Surprisingly, a higher percentage (35%) of midsize contractors (those with annual revenues between $50 million and $500 million) consider schedule changes to be a high risk for their projects than larger contractors, who, because they often work on larger, more complex projects, may have more time, skills and resources to mitigate the impacts of changes.

Labor Procurement Risks/Subcontract Management
The challenges of finding skilled labor in construction currently are well documented and creating concern.

- Labor procurement/subcontract management is selected by the highest percentage of GCs (33%) of any of the risks included in the study. In fact, this is by far the highest percentage for any type of company for any risks measured. Since general contractors are ultimately liable for procuring all labor on a project, through their own efforts or through hiring trade contractors, it is not surprising that this is a critical concern for them.

- While a high percentage of trade contractors (23%) also consider this a high risk, they are less concerned than GCs. This may be the result of several factors: some trades may be able to work more with unskilled labor, or labor shortages may be more acute in some trades than others.

Additional Operational Risks
Less than 10% of owners, GCs or trade contractors rate the risk level of material procurement risks, site acquisition and environmental risks or the influence of outside consultants as high.
Owners, GCs and trade contractors were asked to rate whether a series of four financial risk factors posed a low, moderate or high risk on the projects their companies have conducted in the past five years. The chart at right shows the percentage who indicated that each of these posed a high risk.

**Contractual Risks**

Contractual risks include warranties, guarantees, liquidated damages, mutual waivers and ownership of plans and specifications.

- **GCs and trade contractors agree that this is a high risk.** Many in the construction industry see the struggle over these kinds of contractual clauses to be a cause for inefficiency in the industry, and some see potential in performance-based contracting to help projects run more efficiently. However, a long-standing status quo of using contracts as a means of limiting liability exposure makes this transition slow.

- **Small contractors (those with less than $50 million in annual revenues) are less concerned about contractual risks than larger contractors.** Only 12% of small contractors rate this as a high risk, compared with around one third (32%) of larger contractors. In addition, contractors who do projects smaller than $20 million are also less likely to consider this a high risk. It is likely that larger projects more commonly contain these kinds of clauses.

- **While more owners rate contractual risks as high risk than any of the other financial risks, the percentage who do so (13%) are significantly lower than the percentage of GCs and trade contractors.** Owners may be better protected than contractors in many contracts.

**Delays in Payment, Claims**

The further down the chain of payment a respondent is, the more likely they are to consider this a serious risk. The highest percentage of those who are concerned about this issue are trade contractors (25%). GCs follow with a more moderate 19%, and almost no owners (5%) consider this a high risk to their projects.

This finding is a good example of the kind of disconnection in the industry revealed in the Managing Uncertainty SmartMarket Report in 2014. While owners are not directly impacted by payment delays, they are more concerned about many operational risks, including cost escalation, schedule changes and labor procurement/subcontract management risks. Yet if trade contractors working on a project are overextended due to payment delays, that certainly increases the potential impact of the operational risks that owners are most concerned about, so it does have an impact, albeit a less direct one, on owners.

**Other Financial Risks**

The low percentage of owners concerned about project financing and pay-terms risks (4%) is surprising. It is possible that most owners don’t even consider a project viable until the financing is secured, and few have experienced the loss of a stream of financing they have expected to receive.

Currently, only a small percentage of owners, GCs or trade contractors (4% for all) find that credit/surety concerns are a high risk to their projects.

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### Financial Risks

**Contractual Risks (Owners of Project Specs, Warranty Guarantees, etc.)**

<table>
<thead>
<tr>
<th></th>
<th>Owners</th>
<th>GCs</th>
<th>Trade Contractors</th>
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<tbody>
<tr>
<td></td>
<td>13%</td>
<td>22%</td>
<td>25%</td>
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</table>

**Delays in Payment, Claims**

<table>
<thead>
<tr>
<th></th>
<th>Owners</th>
<th>GCs</th>
<th>Trade Contractors</th>
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<tbody>
<tr>
<td></td>
<td>5%</td>
<td>19%</td>
<td>25%</td>
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**Project Financing and Pay-Terms Risks**

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<th></th>
<th>Owners</th>
<th>GCs</th>
<th>Trade Contractors</th>
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<tbody>
<tr>
<td></td>
<td>4%</td>
<td>9%</td>
<td>11%</td>
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**Credit/Surety Risks**

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<th></th>
<th>Owners</th>
<th>GCs</th>
<th>Trade Contractors</th>
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<tr>
<td></td>
<td>4%</td>
<td>4%</td>
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</tbody>
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Dodge Data & Analytics 17 www.construction.com SmartMarket Report
Owners, GCs and trade contractors were asked to rate whether a series of eight risk factors related to hazards posed a low, moderate or high risk on projects that their company conducted in the past five years. The chart at right shows the percentage who indicated that each of these has posed a high risk.

While overall risks due to hazards tend to be ranked lower than many of the strategic, operational and financial risks included in the survey—with none rated as high by even 20% of the respondents—there is wide variability by type of company in terms of the degree of risk posed by individual hazards. (For more information on how strategic, operational and financial risks were rated by respondents, see pages 14, 16 and 17.)

**Insufficient Quality Risks**

Owners are more concerned than other players about insufficient quality. It is the top hazard risk for them, but even so, only 10% of owners actually consider this a high risk. It is likely that other factors, such as budget and schedule, may be compromised on most projects in order to achieve the level of quality needed.

The gap between owners and contractors for this risk echoes the findings of the 2014 Managing Uncertainty SmartMarket Report, where only 20% of owners report that projects always meet expectations but 49% of architects and contractors believe that owners on their projects always find their quality expectations met.

**Unsafe Workforce Behavior**

General contractors are significantly more concerned than owners and also more concerned than trade contractors about unsafe workforce behavior. General contractors may have the greatest liability for safety on their projects.

Companies doing larger projects are also more concerned about this than those doing smaller projects, with 15% whose largest project has a cost of $20 million or more considering this a high risk, compared with just 7% of those whose largest project is less than $10 million. However, when it comes to the size of the company, midsize GCs (those with annual revenues of $50 million to less than $500 million) are the most concerned about this issue, with 17% rating this risk as high compared with about 11% of larger and smaller companies.

This finding, while surprising on the surface, is supported by the findings of the 2016 Building a Safety Culture SmartMarket Report.
The largest contractors who participated in that study (measured by number of employees rather than annual revenue) report using a wider range of safety practices; in fact, a higher percentage of large contractors report using all 16 of the practices measured than smaller contractors. This suggests that the largest companies recognize the risks of unsafe workforce behavior and have more resources put in place to manage them.

In addition, the largest companies were also much more likely to fall at the high end of the safety culture spectrum than midsize or small companies. Companies are placed on that spectrum based on the number of safety culture indicators they have embraced. Therefore, companies at the high end of the spectrum are more likely to embrace safety as a fundamental, core principle at their companies, from the level of the jobsite worker and from company leadership down. Midsize companies fall significantly behind the largest companies in that study in terms of having a strong safety culture, which may ultimately put them at risk for unsafe workforce behaviors.

Unsafe Project Planning and Negligence Risks

There is no statistically significant difference by player for either of these potential risk factors, despite slightly higher trending by contractors than by owners. However, there are notable differences between the responses of respondents doing primarily general building projects and those doing transportation infrastructure projects.

- Only 8% of those doing general building projects report unsafe project planning was a high risk factor for them on recent projects, compared with 12% of those doing transportation projects.
- Only 10% of those doing general building projects report negligence risks, compared with 14% of those doing transportation projects.

Other Hazard Risks

Since GCs are the player most responsible for site coordination issues, it is not surprising that more GCs (10%) are concerned about weather delays/force majeure than either owners (4%) or trade contractors (4%). The remainder of the hazard risks are not considered to be high risk by many, with most seeing the rating drop to 5% or less. For most of these risks—including weather delays but also risks of pollution/environmental damage and emergency response risks—it may be because, while potentially detrimental, they are also less common as a whole.

Risks Due to Hazards CONTINUED
In addition to understanding the top risks by category, it is also important to see which risks are considered highest by player across categories. The table at right shows the factors considered high risk by more than 20% of owners, GCs and trade contractors.

**Owners**

All of the top risks for owners fall into the operational category: planning/scope changes, schedule changes and cost escalation. Each has an immediate and potentially severe impact on the owners’ performance on the project, but each is also less directly influenced by the owner than many of the strategic and financial factors, which may explain why these rank so high for owners.

**Contractors**

General contractors and trade contractors are most concerned about schedule changes, contractual specification of risk and other contractual risks. Increased exposure to how risks are allotted contractually can have long-term implications when unexpected events occur. Schedule changes not only impact the project experiencing the changes but can ripple through other projects as well.

**General contractors** are most concerned, though, about labor procurement risks, far more so than even trade contractors. In general, the industry is sounding an alarm on this issue, and labor shortages could have cost and schedule implications for GCs in particular if shortages of skilled workers become more severe.

**Trade contractors** are unique in their high level of concern about delays in payment. As the last to get paid on a project, they may have to capitalize a project for weeks or even months, limiting their overall capacity to do work or causing them to risk overextending themselves.
Active Shooter Risk: More Manageable Than You Might Think

Active shooter incidents are so random, how could anyone prepare for them? And surely there are likelier risks claiming our attention. But understanding active shooter incidents as a type of workplace violence, which is all too common in America, places them on a continuum of risk that can and should be managed.

Workplace violence, according to OSHA, is any act or threat of physical violence, harassment, intimidation or other threatening, disruptive behavior that occurs at the worksite. It ranges from threats and verbal abuse to physical assaults and homicide. Nearly 2 million American workers a year report having been victims of workplace violence, and many more cases go unreported. For the construction industry, dealing with the risks of workplace violence is a logical extension of their efforts to manage issues of risk and safety.

A good beginning is to establish a zero-tolerance policy for workplace violence of all types, either as a stand-alone policy or as part of a larger safety and health program. According to OSHA, “it is critical to ensure that all workers know the policy and understand that all claims of workplace violence will be investigated and remedied promptly.”

Alertness for early warnings of violent intentions may allow construction companies to prevent an incident. Active shooters often talk about their intentions or display signs of instability or hostility that workers can be taught to recognize and report as a concern.

Managing the Risk

In the event that violence reaches emergency level, having a plan all staff have practiced implementing will reduce their exposure to risk. Studies show that employees who train for an emergency tend to act effectively, whereas those without training tend to panic. Active shooter incidents are usually over in 10 to 15 minutes, before the arrival of law enforcement. That makes site workers the first responders.

Run. Hide. Fight. Those are the three options the U.S. Department of Homeland Security recommends in an active shooter incident, and they should be attempted in that order. Escape if you can, helping others if possible. Hide if you can’t run, locking doors and turning off lights and cell phone ringers. And if you can’t run or hide, commit to disrupting the shooter with all you’ve got, coordinating with others if possible.

Workplace safety and health attorneys Linda Otaigbe and Nickole Winnett, at Jackson Lewis P.C., recommend that general contractors ask to see each subcontractor’s active shooter emergency response plan, and discuss its adequacy to the particulars of the site and the training employees have received, prior to starting work. They also recommend contractors coordinate their drills with subcontractors on multiple sites throughout the year to help make sure all workers know how to respond on each site. In addition, each site needs a Threat Response Team, consisting of both management and non-management members, to implement emergency protocols, conduct a headcount of evacuees at a predetermined assembly area, tend to the wounded and coordinate with law enforcement officers.

Stepping Up

Very few workplace emergency plans, however, currently address or train for workplace violence. “Nobody’s doing this well,” says Bo Mitchell, a former police commissioner who now heads an emergency preparedness consultancy. “I can guarantee you three things in life: death, taxes and you don’t have an OSHA-compliant emergency action plan.” (Although OSHA regulations do not specifically require employers to plan for an active shooter incident, OSHA guides include workplace violence resulting in bodily harm or trauma as an example of the definition of a workplace emergency.) “Employers need to develop an all-hazards plan for foreseeable circumstances,” says Mitchell, “whether it’s tornadoes or active shooters.”

OSHA and the Department of Homeland Security publish information to support employers in developing active shooter emergency plans. Otaigbe and Winnett’s article in Construction Executive provides a useful brief, and emergency management consultants can provide valuable guidance to construction companies in managing the rare but potentially devastating risks of workplace violence.
Data: Evaluation and Mitigation Strategies for Risk

Use of Risk Evaluation Strategies

Level of Use of Risk Evaluation Strategies
Owners, GCs and trade contractors were asked if they use any (or none) of the risk evaluation strategies shown in the chart to the right.

Their responses show that use of most of these strategies is pretty high in general, although use of specific strategies do vary by player, as well as by other factors. Only a nominal percentage of respondents report that they are not using any of these risk evaluation strategies.

CHECKLISTS/FORMS/RISK REGISTERS
Checklists, forms and risk registers—formal means of determining the level of risk on projects—are very widely adopted, with three quarters (75%) of GCs and over two thirds (69%) of owners putting them to use. Trade contractors lag behind GCs in the use of these tools, but with almost two thirds (64%) using them, their level of use is also robust.

Size of Contractor: 88% of large contractors (those with over $500 million or more in annual revenue) use checklists/forms/risk registers, compared with 69% of smaller companies. In addition, almost three quarters (74%) of companies doing projects valued at $20 million or more are using these compared with two thirds (66%) of those whose largest project is less than $10 million. Both these findings demonstrate that contractors engaged in larger, and therefore likely more complex projects, are more likely to formalize their risk evaluation process.

Type of Project: Fewer contractors (70%) doing general building projects use checklists/forms/risk registers than those doing industrial (75%) or transportation infrastructure (76%) projects. This may be due to the complexity and extended schedule length of industrial and infrastructure projects compared with general building.

Work Outside the U.S.: 84% of companies that work outside of the U.S. use these tools, compared with 70% of those that only work in the U.S. Formal processes may help a team drawn from disparate locations and different cultures to evaluate risk more effectively.

FORMAL BRAINSTORMING WITH TEAM
While a higher percentage of general contractors indicate that they are using this approach than do owners or trade contractors, the difference is not statistically significant. There are also no significant differences by size of contractor company, which underscores that most companies see value in this strategy.

In fact, the only significant difference is between those who work outside the U.S. and those who do not, with 84% of those who work outside the U.S. reporting that they take this approach, compared with 69% of those who work solely in the U.S. A formal brainstorming process could help lay the groundwork for better teamwork and collaboration, a critical element when teams are widely dispersed.

EXPERT INPUT
All types of companies rely more on expert internal resources than external resources, but the difference is particularly strong among trade contractors, where only one third (33%) use external resources at all, significantly below owners (59%) and general contractors (55%). There
are also other meaningful variations in the use of expert input by respondents.

- **Size of Contractor and of Project:** While there is no significant difference in the use of external resources among small, medium or large contractors, more than half (53%) of companies that do large projects (project budget is $20 million or more) use them.

- **Type of Project:** Companies doing general building (49%) more frequently seek external input than do those doing industrial (44%) or transportation infrastructure work (43%). Correspondingly, a higher percentage of those doing transportation infrastructure (72%) seek input from their internal experts than those doing general building (66%).

- **Doing Work Outside the U.S.:** Internal expertise is more widely drawn upon by those doing work outside the U.S. (76%) than those who solely work in the U.S. (64%). Surprisingly, though, there is no significant difference in the degree to which they rely on external resources for expert input. This may suggest that these companies rely on their partners in-country or on those in their company with knowledge of that area more than third parties to bring expertise about risks like cultural differences and regulatory requirements to bear.

### Stage at Which Risk Evaluation Strategies Are Used

Owners, GCs and trade contractors using these strategies were asked to select the stages during the project lifecycle in which they use them. The top chart at right indicates the percentage of all respondents using each of these strategies across five project stages, from predesign to post construction. The lower charts indicate the use of each strategy by stage and by player.

A few patterns emerge from the data:

- **Expert insights from internal resources and formal brainstorming are the top two strategies used early in the project lifecycle.** This may suggest that these are often used to determine project viability and scope.

- **Use of checklists/forms/risk registers peaks during construction.** These tools may be most useful when more specific information about the project is known.

- **All four strategies follow a similar pattern of use.** Owners more frequently engage in them in predesign and design, GCs are more frequently using them in design than trade contractors, and use of them during construction is nearly identical among GCs and trade contractors, while owner use tends to drop off in this phase. The drop-off in owner use may be in part due to their ability to shift the liability for many risks during this stage onto contractors.
Owners, GCs and trade contractors who use several of the risk evaluation strategies were asked to rank the ones they consider most effective. The chart at right indicates those that they ranked first. The numbers don’t total 100% by player because each strategy is only selected by the contractors who report using it, so each percentage is unique to those eligible to answer about that particular strategy.

Contractors agree about the relative effectiveness of each of these strategies, with no statistically significant differences between GCs and trade contractors. However, owners find some of the risk evaluation strategies more effective than contractors do.

**Formal Brainstorming With Team**
The most effective risk evaluation strategy for all three types of companies is formal brainstorming with team. Owners consider this even more effective than the other players, with 58% selecting it as their top choice. This is likely due to the importance of brainstorming in the early planning stages, especially given the greater likelihood that owners are engaged in risk evaluation practices in predesign and planning (see page 23) than contractors.

**Expert Input**
Relying on the expertise of internal resources comes next in effectiveness, ranked first by nearly a third of overall respondents. This high ranking indicates confidence in the general level of internal expertise for most of these companies.

Owners and contractors disagree more about the effectiveness of expert input from external resources. While owners equally value internal and external input, twice as many contractors prefer internal expertise to that secured from external parties.

Companies doing general building work are more likely to consider external expertise an effective means of risk evaluation (19%) than those working in the industrial (12%) or water (11%) sectors.

**Checklists/Forms/Risk Registers**
Checklists, forms and risk registers are widely used (see chart on page 22), but they do not garner as many top-place votes for effectiveness compared with the other three strategies, which all involve personal interaction with experts and team members.
**Top Benefits of Formal Brainstorming**

After owners, GCs and trade contractors identified the most effective methods of evaluating risk that they employ (see page 24), they were given a list of nine possible benefits from using this risk evaluation method and asked to rank the top three that they experience. The chart at right indicates the percentage who ranked each benefit as one of their top three for formal brainstorming, among those who consider formal brainstorming one of the most effective strategies for evaluating risk.

While formal brainstorming earns the highest ranking overall for benefits among the strategies studied, there are meaningful differences between the perspectives of owners, GCs and trade contractors. These differences demonstrate that even though they are using the same risk evaluation tool, each player sees quite different benefits from it.

**Owners**

By far, the greatest benefit to owners when their projects include formal team brainstorming is the increased reliability in overall project performance, with over half (57%) of owners ranking this among their top three benefits. Reliability is critical to owners, and this finding demonstrates that owners identify the collaboration implicit in formal brainstorming with achieving this goal.

The next four benefits ranked by owners are the cornerstones of project performance: cost, schedule, safety and quality. Each was selected among the top three benefits of formal brainstorming by between 20 and 30 percent of owners, reinforcing the strong relationship between this strategy and tangible results.

Also scoring well is the more subjective benefit of greater innovation, which often stems directly from interpersonal collaborative activities such as formal brainstorming.
Evaluation and Mitigation Strategies for Risk

**Top Benefits of Formal Brainstorming** CONTINUED

**GCs**
Unlike owners, there is not one clear benefit selected by GCs, although most of their top benefits align with the ones selected by the owners. **More than one third are split between four benefits: increased reliability in overall project performance (35%), improved project safety (35%), improved project schedule (34%) and increased client satisfaction (33%).** Again, clearly all of these are seen as the direct impact of improved collaboration to identify issues.

A relatively high percentage of contractors also see formal brainstorming resulting in reduced construction costs (31%) and increased ability to innovate (27%). In fact, owners and contractors agree that this is the top risk evaluation or mitigation activity associated with an increased ability to innovate. Early involvement in a formal brainstorming process allows GC and trade contractor expertise to inform the design process, and may help to generate constructible solutions collaboratively that the design team alone would not have developed.

**Trade Contractors**
The highest percentage (44%) of trade contractors rank reduced cost of construction as the top benefit of formal brainstorming. Often trade contractors can have insights on specific challenges related to their trade that may not be considered by the design team or the general contractors. Their participation in formal brainstorming during design can help address these issues in less costly ways than inheriting them once the design is close to final or construction is underway.

As with owners and GCs, trade contractors also see increased reliability in overall project performance as a top benefit of engaging in brainstorming.

It is notable that a relatively high percentage of trade contractors (22%) report seeing a competitive advantage. While only significantly higher than the percentage of owners, they also trend higher than the GCs for this category. Because their insights are most often missed on traditional projects, the trades who are able to participate in formal brainstorming during planning may find that their expertise offers a competitive advantage because of how it is perceived by owners and GCs.
There is wider agreement among owners, GCs and trade contractors about the benefits associated with using checklists, forms and risk registers than there are about the other risk evaluation methods. In fact, the only difference outside of the margin of error in the study among the three players is that a higher percentage of owners (30%) find that checklists, forms and risk registers allow the original intent for the level of project quality to be maintained than do general contractors (15%).

In addition, there is no single major benefit emerging from the use of these tools. Instead, between roughly one quarter and one third of respondents find that these tools help them achieve increased reliability in overall project performance (32%, averaged across all players), improved project safety (28%) and improved schedule (24%).

There is also little variability by the size of largest project conducted, by the size of firm by annual revenue, by project type or by whether they do work in the U.S. only or internationally, with a few exceptions.

- Only a small percentage (8%) of respondents from companies doing small projects (those whose largest projects are smaller than $10 million in total project cost) find that these tools increase their ability to maintain the original intent for the level of project quality, compared with 22% of firms doing larger projects.
- A much lower percentage of those doing water infrastructure projects (11%) find that these tools help reduce rework than those doing general building (21%), industrial (18%) or transportation infrastructure (17%) projects.

Overall, all these findings suggest that there are several benefits widely experienced by those using these tools, rather than a few specific firm types or project types that see a big boost in one or two areas.
The differences in frequency of use and in what is considered most effective between inputs from internal experts and external experts are also reflected in the benefits reported from getting those inputs.

**Input From Internal Experts**

The highest percentage of owners, GCs and trade contractors rank increased reliability of the overall project as one of the top three benefits from using inputs from internal experts for risk evaluation. For each player, this benefit is also several percentage points above any of the rest, revealing strong consensus that getting input from internal experts is critical to increase overall project reliability.

**Top Benefits of Input From Internal Experts**

(Ranked in the Top Three by Respondents Who Consider This Strategy Most Effective)

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<thead>
<tr>
<th>Benefit</th>
<th>Owners</th>
<th>GCs</th>
<th>Trade Contractors</th>
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<tbody>
<tr>
<td>Increased Reliability in Overall Project Performance</td>
<td>45%</td>
<td>36%</td>
<td>39%</td>
</tr>
<tr>
<td>Improved Project Schedule</td>
<td>30%</td>
<td>18%</td>
<td>13%</td>
</tr>
<tr>
<td>Reduced Cost of Construction</td>
<td>24%</td>
<td>14%</td>
<td>24%</td>
</tr>
<tr>
<td>Maintained Original Intent for Level of Project Quality</td>
<td>24%</td>
<td>15%</td>
<td>18%</td>
</tr>
<tr>
<td>Improved Project Safety</td>
<td>21%</td>
<td>23%</td>
<td>24%</td>
</tr>
<tr>
<td>Increased Ability to Innovate</td>
<td>13%</td>
<td>21%</td>
<td>21%</td>
</tr>
<tr>
<td>Competitive Advantage</td>
<td>6%</td>
<td>18%</td>
<td>17%</td>
</tr>
<tr>
<td>Increased Client Satisfaction</td>
<td>21%</td>
<td>21%</td>
<td>24%</td>
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</table>

Significantly more owners (30%) rank improved project schedule as a top three benefit resulting from internal expert advice than contractors (18%) do. It is possible that owners with experts on construction risk at their company can produce more accurate estimates of project schedules based on experience with the complexity and potential for unexpected problems common to construction. Better estimates at the start are more likely to yield better schedule performance by setting up realistic expectations.

More owners (24%) and trade contractors (24%) rank reduced cost of construction as a benefit from the input of internal experts than do GCs (14%). For owners, this could also be a reflection of a more accurate cost estimate resulting from internal expertise. For trade contractors, this finding may imply that they see cost benefits when their experts are called upon to directly participate. Combined with the findings on formal brainstorming, it is a clear call to engage trade contractors earlier in the risk evaluation process to help control costs.

In fact, other than increased reliability, less than one quarter of GCs rank any of the benefits listed among their top three for internal experts. It is possible that many already factor in their internal expertise and do not consider it as a separate risk evaluation approach.

Not surprisingly, contractors are more likely to find that their ability to use input from internal experts for risk mitigation increases their competitive advantage. Owners who use value-based contracting methods may find internal expertise an important factor when considering contractors to hire, so the importance to contractors is evident.
Input From External Experts
Owners outpace contractors in terms of their use of external experts to manage risk (see page 22) and in the percentage who consider them among the most effective means of mitigating risk (see page 24). This trend continues in the percentage of owners reporting the benefits achieved from using external experts for risk evaluation. Far more owners rank factors like increased reliability of overall project performance (31%), reduced cost of construction (31%), improved project schedule (28%) and maintained original intent for level of project quality (20%) than contractors, who range anywhere from 7 to 22 percentage points behind them for each of these factors.

However, a higher percentage of trade contractors report one benefit from working with external experts than either owners or GCs: improved project safety. While the GCs have a great deal of liability, the trades carry the direct personal and financial cost of injuries, and therefore, their sensitivity around this issue is not surprising.

VARIATION BY PROJECT TYPE
A higher percentage of respondents from companies doing general building (21%) and industrial (22%) projects rank improved project safety as one of the top benefits they experience from gaining input from experts outside their company than those working in the water infrastructure sector (14%). There are several possible reasons for this disparity. It may be more difficult to have budgets for external experts on public water infrastructure projects, or there may be greater reliance on internal expertise in the water infrastructure sector.

The percentage of respondents from the industrial sector who find that reducing the cost of construction is a top benefit of seeking external input on risk evaluation (7%) is significantly lower than those in other sectors, which range from 15% to 19%. Other factors, such as safety and reliability, may carry greater weight in this sector and thus are more likely to be the focus of external input.
When Gilbane contracted to restore Brooklyn’s historic, sumptuously ornate Kings Theatre, built in 1929, the building had been abandoned for 35 years. Superstorm Sandy had yanked the roof off, entire sections of the theatre’s mezzanine had washed away, return air tunnels were filled with water, historic finishes were woefully deteriorated, ornamental plaster lay in piles on the floor, and a massive domed ceiling was at risk of complete failure. Gilbane’s contract assigned all risk for existing conditions, known or unknown, to Gilbane, and fixed a date when funding expired and the curtain rose. “We had an undefined scope, limited funding, unknown environmental and design risks, three separate applicable building codes, and schedule risk due to more than 10 regulatory agencies having jurisdiction over the project,” says Sue Klawans, senior vice president and director of operational excellence and planning at Gilbane. “But we also had a comprehensive approach to risk management.”

Swarm and Solve
At the heart of Gilbane’s approach is a risk assessment template with which a project’s leadership analyzes and rates each of 12 risk categories, with two or three subsections in each category, and calculates a weighted score for the project. “But it’s not about the score,” says Klawans. “The real value is in the conversation.” The risk assessment template provides an agenda from which the project manager, project executive, business unit leadership and other principals can work together to generate strategies for success. “Swarm and solve” is how Klawans describes the process, crediting the concept to business authors Jim Collins and Steve Spear.

As their first step in bounding the Kings Theatre risks, several of which had earned the maximum score on the risk assessment template, the leadership team conducted a two-day planning session to identify and map onto a framework schedule all the factors in play. These included regulatory requirements and processes, funding requirements and processes, investigations and assessments, design, construction, theatrical outfitting and decision forecasting. The team then used this interactive plan as a meeting agenda and risk log with which the project team could track progress, measure milestones and inform critical decisions.

Investigating Existing Conditions
The team next set about reducing uncertainty by conducting a thorough, yearlong analysis of existing conditions at the theatre. This investigation included environmental and hazardous materials, structural conditions, code compliance, historic restoration, building envelope, and heating and ventilating systems. In a step that alone saved millions, investigators ran cameras on robots through existing ductwork to check for integrity and hazardous materials, in the process identifying opportunities to reuse existing ductwork rather than cutting and repairing historic plaster.

With the information from the investigation, the team was able to generate realistic options for project scope and corresponding cost. The team developed seven different program and cost options concurrently, with pros and cons to inform the owner’s decision-making. Now with clear goals for what could be achieved with the time and funds available, the project team implemented a stabilization phase in which the theatre was dried and cleaned, and hazards removed, so that the balance of the restoration work could proceed in a safe and organized manner.
Enhancing Knowledge and Communication

A particular risk identified in the project analysis was the location of the architect and a number of the design team’s engineering consultants outside the region. To ensure this posed no disadvantage, Gilbane implemented a design assist strategy, retaining a structural and historical consultant in New York to enable all members of the design team to function as effectively as if they themselves worked in the city. Extensive use of BIM facilitated the team’s communication.

To further reduce the risks of uncertainty for all members of the project team, Gilbane required prospective bidders on the project to spend weeks in the theatre before assembling their bid so that they thoroughly understood the existing conditions and the requirements governing the restoration of a building listed on the National Register of Historic Places.

Achieving Success Across Projects

“Everything went from uncertainty and risk to bounded and defined,” says Klawans. As a result, the Kings Theatre restoration met all its funding deadlines, and the curtain rose on the first concert as scheduled. The project was completed within budget, and without a single contractor-initiated change order. The team even managed to find room for an additional 100 seats, adding an extra $250,000–$300,000 in annual revenue to the theatre. In testament to its success, the restoration won awards from the New York Landmarks Conservancy and from the Office of Parks, Recreation and Historic Preservation.

With regard to Gilbane’s risk management process, however, says Klawans, “it wasn’t one and done.” The company piloted the risk assessment template in each of its business units for six months, and then reviewed the pilot’s lessons for opportunities to improve, an iterative process Klawans calls dynamic discovery. Gilbane has since upgraded its risk assessment template to a proprietary software application housed in its business intelligence platform.

No longer simply a scoring system that prompts a conversation, the system now documents agreed strategies into a road map for each project, and actively supports project teams in identifying those strategies. Using an interactive dashboard of all projects, project teams can search by multiple factors, such as specific risks, risks in categories, or other variables as they consider where to prioritize executive resources to swarm and solve. In addition to its internal risk assessment process, Gilbane has guided integrated project teams to develop project-specific risk and opportunity logs. Several options, customized to each project team’s specific needs, are now available through the company’s software, so that a new project manager can benefit from the knowledge of previous teams.

“It’s real time prevention and solving,” says Klawans, “rather than reacting to issues after they happen.” For example, recognizing that scheduling constitutes by far the most frequently occurring risk, Gilbane initiated an Advanced Planning and Scheduling (AP&S) Leadership Group to develop a manual of guiding principles and best practices, which in turn has led to an AP&S coaching program providing onsite support to integrated project leadership.

“Traditionally, risk management seems to be about not failing, putting in place rules and procedures to avoid loss,” says Klawans, “but ‘not failing’ isn’t the right goal. The goal is success on every project and as a company—and a comprehensive approach to risk management is an integral part of that.”
Use of Risk Mitigation Strategies

Level of Use of Risk Mitigation Strategies

Owners, GCs and trade contractors were asked if they use any (or none) of the six risk mitigation strategies shown in the chart to the right.

Two out of the six strategies are used by over 60% of the total respondents: regular meetings with full project team focused on risk (66%) and the development of a plan to manage risk (62%). Meanwhile, special teams to monitor and mitigate risk, risk prioritization and tracking metrics on risk across projects are used by less than one third of respondents (24%, 32% and 32%, respectively), suggesting that the industry still has many underutilized strategies that could be productive to help reduce risk.

There is also a high degree of variation in the use of mitigation strategies by type of company, by size of contractor, by where they do work and, to a lesser degree, by project type. This degree of variation reveals that there is no universal approach to risk mitigation currently in the construction industry.

Variation by Type of Company

Owners are the most prevalent users of most of the risk mitigation strategies included in the study. While most of the differences between owners and GCs are not larger than the margin of error for the study (with the exception of the use of contingency planning), the data demonstrate a clear trend toward higher usage by owners. The one exception is the use of special teams to monitor and mitigate risk, with a slightly higher percentage of GCs (26%) using this strategy than owners. Most of the GCs using this strategy (86%) report doing so in the construction phase, which means that, in many cases, GCs are likely to be deploying these special teams onsite.

On the other hand, trade contractors are consistently lower than GCs and owners in their use of all of these strategies, and in most cases the difference in use between either the owner or the GC is statistically significant. This may be in part because trade contractors tend to be smaller companies than owners or GCs, and the use of these practices is more common among large companies than smaller ones, possibly due to more available resources for implementation (see below).
Evaluation and Mitigation Strategies for Risk

Use of Risk Mitigation Strategies (According to Contractors by Size)
Dodge Data & Analytics, 2017

<table>
<thead>
<tr>
<th>Use of Risk Mitigation Strategies</th>
<th>Large Contractors (Annual Revenue $500 Million or More)</th>
<th>Small Contractors (Annual Revenue Less Than $50 Million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of a Plan to Manage Risk</td>
<td>91%</td>
<td>46%</td>
</tr>
<tr>
<td>Regular Meetings With Full Project Teams Focused on Risk</td>
<td>81%</td>
<td>56%</td>
</tr>
<tr>
<td>Contingency Planning</td>
<td>69%</td>
<td>47%</td>
</tr>
<tr>
<td>Tracking Metrics on Risk Across Projects</td>
<td>64%</td>
<td>24%</td>
</tr>
<tr>
<td>Risk Prioritization</td>
<td>52%</td>
<td>22%</td>
</tr>
<tr>
<td>Special Teams to Monitor and Mitigate Risk</td>
<td>41%</td>
<td>15%</td>
</tr>
</tbody>
</table>

VARIATION BY SIZE OF COMPANY AND OF PROJECTS

The largest contractors, those with annual revenues of $500 million or more, report using many of the risk mitigation strategies more than smaller companies, those with revenues of less than $50 million (see the chart at right). Development of a plan to manage risk and regular meetings with full project teams focused on risk are common practices among companies with annual revenues of $500 million or more, but they are only used by around half of respondents from companies with revenues of less than $50 million.

One of the biggest differences in the use of risk mitigation strategies between large and small contractors is the use of metrics. Nearly two thirds (64%) of respondents from large contractors track metrics on risk across projects, but only 22% of those from small contractors do so. Tracking data across projects can require considerable resources, but it also yields valuable information for risk mitigation that can influence the planning stages of other projects and help reduce potential risks.

The notable differences in use by size of contractor are also evident across all respondents in relation to the size of their largest project. Respondents from companies whose largest projects are less than $10 million in total project cost report lower use of most of these strategies than those whose largest projects are $20 million or more.

Large projects can be associated with greater risk, which may contribute to why large companies are more engaged in risk mitigation practices to a degree. However, the large degree of difference on so many practices suggests that the issue may also relate to a lack of resources. The industry needs to address how smaller contractors and contractors that work on smaller projects can enhance their ability to mitigate risk.
**Evaluation and Mitigation Strategies for Risk**

**Use of Risk Mitigation Strategies** CONTINUED

**VARIATION BY LOCATION WHERE WORK IS CONDUCTED**
Companies that work outside of the U.S. also consistently use several of the risk mitigation strategies more than companies that only work in the U.S. (see chart at right). Working internationally may also create the need for a more formal risk mitigation process, given the additional challenges faced by firms working abroad. Thus, developing a plan to manage risk, conducting regular meetings, doing formal risk prioritization and creating special teams to monitor risk are all done more frequently by companies that work outside the U.S., compared with companies that work solely in the U.S.

As with the size of company, the biggest difference is evident in those that **track metrics on risk across projects**, with 60% of those that work abroad reporting tracking metrics compared with 28% of those whose companies do work only in the U.S. This finding is not surprising since larger companies are more likely to work abroad than smaller ones.

**VARIATION BY PROJECT TYPE**
Development of a plan to manage risk and tracking metrics on risk across projects are used less frequently by those in doing work in general building than by those doing industrial, transportation or water projects. Several factors could contribute to this finding, including the possibility for greater public attention and oversight on large infrastructure projects, the complexity of large industrial projects and the likelihood of smaller companies working in the general building sector.

It is also notable that **special teams to monitor and mitigate risk** are more widely used by those in the transportation infrastructure sector (32%) than in the general building (23%), industrial (25%) or water (24%) sectors. Again, this could relate to the likelihood of having large, multiyear contracts and a high degree of public oversight in this sector. Transportation projects can also involve dangerous job sites, with active traffic lanes next to work being conducted. Therefore, paying close attention to hazards would be particularly important.

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**Use of Risk Mitigation Strategies**  
(According to Respondents From Companies That Work Abroad and Those That Work Only in the U.S.)

Dodge Data & Analytics, 2017

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Works in and Outside the U.S.</th>
<th>Works in the U.S. Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of a Plan to Manage Risk</td>
<td>76%</td>
<td>60%</td>
</tr>
<tr>
<td>Regular Meetings With Full Project Teams Focused on Risk</td>
<td>74%</td>
<td>28%</td>
</tr>
<tr>
<td>Tracking Metrics on Risk Across Projects</td>
<td>60%</td>
<td>31%</td>
</tr>
<tr>
<td>Risk Prioritization</td>
<td>42%</td>
<td>31%</td>
</tr>
<tr>
<td>Special Teams to Monitor and Mitigate Risk</td>
<td>36%</td>
<td>22%</td>
</tr>
</tbody>
</table>
Evaluation and Mitigation Strategies for Risk

Use of Risk Mitigation Strategies

Stages at Which Risk Mitigation Strategies Are Used

As with risk evaluation strategies, respondents using each risk mitigation strategy were asked to identify all of the project stages, from predesign to post construction, when they use these strategies. The chart below represents their responses.

Overall, most of the risk mitigation strategies follow the same pattern for use in the different stages of the project lifecycle.

- A higher percentage of owners than GCs or trade contractors use each strategy during predesign and design, where contractors are often not yet engaged.
- Use among all three players is the same during construction and post construction.
- Even among owners, use tends to peak during the construction phase, with one exception: more owners use risk prioritization during the planning stages than during construction.
- Contingency planning is used by more than three quarters of GCs (77%) during bidding/negotiating.

- Development of a plan to manage risk is the least typical in terms of use. Owners use it primarily before construction begins. GCs tend to use it most in the bidding and construction phases. Trade contractors follow the same pattern as the other mitigation strategies, with use peaking during construction.

These findings suggest that owners consider risk mitigation approaches throughout the project lifecycle, but that contractors are more likely to consider mitigating risk after construction has started. It is possible that earlier adoption of mitigation strategies could help reduce risk once construction is underway. However, GCs and especially trade contractors may be limited in how early they are included in the project. It would be interesting to see if the pattern for risk mitigation practice use is different for contractors when they are involved in more collaborative delivery methods, or if they still consider risk mitigation most frequently during construction, the part of the project lifecycle for which they are most directly responsible.

Project Stage at Which Risk Mitigation Strategies Are Used

(According to Owners, GCs and Trade Contractors)

Dodge Data & Analytics, 2017
Owners, GCs and trade contractors who use several risk mitigation strategies were asked to rank the ones they consider the most effective. The chart at right indicates those that they ranked first. There were no statistically significant differences in the percentages of owners, GCs and trade contractors who ranked each strategy first, so only totals are shown. The numbers don’t total 100% because only those who use each strategy were asked to rank them, and, therefore, each percentage is based off of a different total.

Two strategies clearly emerge as the most effective:

- **Regular meetings with full project teams focused on risk** is selected as most effective by more than half of the respondents (57%) who conduct these meetings. This finding demonstrates that risk mitigation is a critical benefit of increased, regular collaboration across the entire project team. This finding is supported by numerous other findings in other Dodge Data & Analytics studies that repeatedly reveal that collaborative approaches yield strong benefits, including reduced risk. It is also one of the most widely used strategies by owners, GCs and trade contractors (see page 32).

- **Development of a plan to manage risk** is also considered most effective by nearly half (42%) of the respondents who use this strategy. While this strategy is widely used by GCs, it is less frequently used by owners and trade contractors. It is also one of the few strategies where use by owners and GCs doesn’t peak in construction, but is more evenly spread out throughout the project lifecycle. Acknowledging and planning for major risks on the project clearly has strong benefits later in the project lifecycle.

The remaining strategies are all ranked first by less than 20%. There are also no statistically significant differences in the percentage who rank any of the strategies first by project type, location of work or even size of contractor, suggesting strong industry agreement across the board about the value of the regular full project team meetings and developing a plan to manage risk.
Owners, GCs and trade contractors were asked to rank the top benefits they have experienced from each of the mitigation strategies from the same list of nine benefits they ranked for the evaluation strategies (see pages 25 to 29). They could select up to three responses, and the chart at right shows the benefits ranked in the top three for regular meetings with the full project team focused on risk.

The highest percentage of owners, GCs and trade contractors all rank increased reliability in overall project performance as one of their top three benefits. Knowing that projects will be on time, on budget, achieve the expected quality and do so safely can be even more valuable to owners and contractors than achieving cost savings or shortening schedules on a few projects. Getting the whole project team evaluating risk throughout the project lifecycle clearly contributes toward this goal.

Other top benefits vary by the type of company.

**Top Owner Benefits**
The other benefit ranked in the top three by a high percentage of owners (42%) is maintaining the original intent for level of project quality. In addition to revealing potential problems, regular meetings on risk by the full project team can ensure that the solutions do not compromise the goals the project is trying to achieve, whether those are performance-related, aesthetic or deal with the functionality of spaces within the building. Active owner engagement in these meetings is critical to deliver a project that best meets the owner’s desired goals. It is also notable that more than one quarter of owners rank improved project schedule (28%) and reduced rework (27%) as top three benefits, suggesting that they see projects running more efficiently due to these meetings.

**Top GC Benefits**
Over one third of GCs rank improved project safety (38%) and improved project schedule (35%) among the top three benefits they experience from full project team meetings on risk.

- **Safety:** Full project team meetings draw upon all the expertise across the team to identify and mitigate possible risks, which can clearly impact safety. In addition, the Building a Safety Culture SmartMarket Report revealed that larger companies often have more resources for implementing safety practices than
Evaluation and Mitigation Strategies for Risk

Top Benefits of Regular Meetings With Full Project Team Focused on Risk (Ranked in the Top Three by Respondents Who Consider This Strategy Most Effective)

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Large Contractors (Annual Revenue $500 Million or More)</th>
<th>Small Contractors (Annual Revenue Less Than $50 Million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased Reliability in Overall Project Performance</td>
<td>53%</td>
<td>34%</td>
</tr>
<tr>
<td>Improved Project Safety</td>
<td>27%</td>
<td>43%</td>
</tr>
<tr>
<td>Reduced Rework</td>
<td>12%</td>
<td>27%</td>
</tr>
<tr>
<td>Increased Ability to Innovate</td>
<td>3%</td>
<td>16%</td>
</tr>
</tbody>
</table>

smaller companies. Full project team meetings on risk may allow smaller companies to benefit from the more formalized and extensive safety resources of larger companies on the project.

- **Schedule**: In addition, shared expertise in regular project meetings may reveal potential issues that can impact schedule and tap that expertise to help address them more effectively than a GC could just on their own, allowing for better project coordination.

A relatively high percentage of GCs (28%) also select increased client satisfaction as a top benefit of full project team meetings on risk. Given the owner responses that these meetings improve reliability and help deliver the desired project quality, it is likely that they would lead to more satisfied clients.

**Top Trade Contractor Benefits**

A high percentage of trade contractors (37%) also rank improved project safety as a top benefit of full project team meetings on risk. For the trades, getting to participate in that process, not just with the GCs but with the other trades they must coordinate with on the project, can impact safety.

A significantly higher percentage of trade contractors (35%) also rank reduced cost of construction as one of the top benefits they see from participating in full team meetings. This may be in part due to the savings they directly experience from increased safety and better project coordination.

It is notable that trade contractors are more likely to consider increased ability to innovate to be a top benefit of team meetings than do owners or GCs, even though the percentage of trade contractors ranking this as a top benefit is still relatively low. It is not surprising that the trades would find increased opportunities for innovation on their part of the project if they are included in full project team meetings on risk, especially before construction begins.

**Variation by Contractor Size**

More than half of large contractors (53%) find increased reliability in overall project performance one of the top benefits of conducting regular project team meetings on risk, compared with about one third of small contractors (34%). However, the reasons for the increased reliability experienced by larger contractors may be evident in the responses of smaller contractors, who are much more likely to rank improved project safety (43%), reduced rework (27%) and increased ability to innovate (16%) among their top benefits than are large companies (27%, 12% and 3%, respectively). Assuming that in many cases, larger companies are contracting smaller ones on projects, the larger ones would see more reliable results if the smaller ones are experiencing safer projects with less rework and more opportunities to improve the way they approach the project.

**Variation by Project Type**

There are two notable variations by project type in the benefits resulting from full project team meetings on risk.

- **Reduced Rework**: More respondents working in the general building sector (24%) find reduced rework to be a top benefit than those in the transportation (17%) or water (16%) infrastructure sectors.
- **Increased Client Satisfaction**: More contractors working in the industrial sector (23%) consider this a top benefit than those in transportation or water infrastructure (16% and 17%, respectively).
Top Benefits of Developing a Plan to Manage Risk

The chart at right shows the top benefits that owners, GCs and trade contractors experience from developing a plan to manage risk. The chart shows all of the benefits ranked in the top three by more than 20% of respondents.

Owners and contractors experience the benefits of developing a plan to manage risk very differently.

- **Owners:** The top benefit reported by owners (44%) is increased reliability in overall project performance, followed by maintained original intent for level of project quality (30%). It is likely that owners are less aware of specific benefits like safety or even reduced cost of construction, but that they are aware of how well the project progresses overall and whether the final project fulfills their needs, which may be why these two benefits so frequently top the list for them.

- **Contractors:** The top benefit reported by over half of GCs (52%) and trade contractors (51%) is improved project safety, followed by increased reliability in overall project performance (44% and 46%, respectively). The high performance in reliability is not surprising since having a plan to manage risk can touch on many benefits. However, the strong ranking for safety by both GCs and trade contractors demonstrates that having a plan to manage risk is a critical part of any safety program.

- **Additional benefits reported by all respondents include improved schedule and reducing the cost of construction.** Schedule and cost are fundamental measures of project performance. The relatively strong ranking and experience of these benefits by all players who use a plan to manage risk demonstrates that investing in this strategy has a strong potential impact on a company’s bottom line.

There are no variations by size of contractor in these findings, and only a few variations by project type and by the location where they work.

- **Project Type:** A higher percentage of those doing industrial (14%) or water infrastructure (17%) projects consider having a competitive advantage a top benefit of developing a plan to manage risk than those doing general building (9%).

- **Location Where They Work:** 27% of respondents from companies that work solely in the U.S. report that improved project schedule is a top benefit of developing a plan to manage risk, compared with 15% of those that work outside the U.S. as well.
The chart at right represents the benefits that more
than 20% of owners, GCs and trade contractors ranked
among the top three that they receive from their use of
contingency plans.

Although contingency planning ranked fourth out
of the six mitigation strategies for overall effectiveness
(see page 36), a high number of respondents included it
among their top three related to these important benefits.

Owners in particular experience benefits from
contingency plans. Consistent with many of the other
benefits, many owners rank increased reliability in
overall performance (32%) and maintained original intent
for project quality (25%) among their top three benefits.
(See page 39 for a discussion of these two benefits
related to owners.)

However, 31% of owners also rank improved
project schedule in the top three, and similar
percentages of GCs and trade contractors agree.
This supports the assumption that having contingency
plans in place prevents delays on the projects that might
otherwise occur.

A high percentage of trade contractors also rank
reduced cost of construction (25%) and increased
client satisfaction (26%) in their top three. Since trade
contractors are judged by GCs and owners alike on their
ability to deliver projects on time and on budget, it makes
sense that, since they are seeing contingency plans
benefit both of those areas, they would also see improved
client satisfaction.

GCs are slightly less enthusiastic about the benefits of
contingency planning than owners or trade contractors,
but more than 20% do rank improved project schedule
(25%) and increased reliability in overall project
performance (24%) as top benefits of this strategy.

**Variation by Size of Contractor**

A significantly higher percentage of small contractors,
those with annual revenues of less than $50 million, see
benefits from using contingency planning than large
contractors with annual revenues of $500 million or
more. In addition to the benefits that rank toward the top
generally, such as improved project schedule, reduced
cost of construction and increased client satisfaction,
small contractors also rank improved safety and reduced
rework among the top benefits they experience from
contingency planning far more frequently than large
contractors do.
**Variation by Type of Project**

For the most part, respondents across project types tend to rank the benefits of contingency planning similarly. However, 17% of those who do general building work ranked maintain original intent for level of project quality in their top three, compared with those doing industrial (10%), transportation (11%) or water projects (10%).

**Variation by Location of Work**

A higher percentage of respondents from companies doing work solely in the U.S. rate nearly every benefit higher than those who also do work outside of the U.S. It is likely that this is due, at least in part, to the fact that larger companies tend to work internationally and is therefore a reflection of the different response by size already noted.

In addition, contingency planning may be less effective when it is used on projects with dispersed and diverse teams, since it may be harder for other aspects of the project to adapt when one team member puts a contingency plan into place. This may also explain why smaller contractors generally see more benefits from contingency planning than larger contractors, who are also more likely to be coordinating disparate teams on complex projects.

**Top Benefits of Contingency Planning**

(According to Large and Small Contractors)

Dodge Data & Analytics, 2017

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Large Contractors (Annual Revenue $500 Million or More)</th>
<th>Small Contractors (Annual Revenue Less Than $50 Million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased Client Satisfaction</td>
<td>30%</td>
<td>7%</td>
</tr>
<tr>
<td>Reduced Cost of Construction</td>
<td>24%</td>
<td>7%</td>
</tr>
<tr>
<td>Improved Project Schedule</td>
<td>33%</td>
<td>10%</td>
</tr>
<tr>
<td>Improved Project Safety</td>
<td>33%</td>
<td>19%</td>
</tr>
<tr>
<td>Reduced Rework</td>
<td>20%</td>
<td>3%</td>
</tr>
</tbody>
</table>
The level of use of three other mitigation strategies—special teams to monitor and mitigate risk, tracking metrics on risk across projects and risk prioritization—is relatively low, and each of these are also selected as the most effective strategy by a relatively low percentage of respondents. Thus, it is not surprising that the percentages that are experiencing benefits due to these strategies are also relatively low.

The chart at right represents all the benefits ranked among the top three by more than 20% of owners, GCs or trade contractors for each strategy. A few conclusions can be drawn from this data:

- **Increased reliability in overall project performance** is a top benefit of all the mitigation strategies included in the study. For many of the other strategies (see pages 39 and 40), owners tend to rank this as a top benefit more than contractors do, and this is also true for tracking metrics on risk across projects and risk prioritization. However, for the use of special teams, nearly the same percentage of owners (19%), GCs (17%) and trade contractors (20%) report this benefit, suggesting overall agreement about the value of using special teams to achieve this benefit.

- **Improved project safety** is the greatest benefit for all players from the use of special teams and the top benefit for contractors from risk prioritization. Many owners (44%), GCs (29%) and trade contractors (32%) rank improved safety as one of the top benefits of special teams. Several factors may contribute to this finding, including heightened awareness of safety on projects with teams that are specifically devoted to mitigating risk. Contractors also see their safety improve when they use risk prioritization.

- **Owners more frequently experienced improved schedule as a top benefit of tracking metrics on risk across projects and risk prioritization than contractors do.** If owners are tracking risk metrics across projects themselves, the improvement in schedule may actually be the result of better initial estimates on schedule by owners before the project begins, due to a greater understanding of the factors that yield delays. On the other hand, contractors may find that risk prioritization can lead to schedule delays, in order to help other factors like fulfilling the owners expectations for the project and keeping on budget, leading to their relatively low ranking of schedule for this strategy.
Owners, GCs and trade contractors were asked to rank the top three benefits they achieve from the risk evaluation and mitigation strategies that they consider most effective. Pages 25 to 29 and pages 37 to 42 provide a detailed evaluation of the top benefits associated with each strategy. The tables below and on the following page reorganize that data according to which strategy the highest percentage found yielded each benefit.

Previous charts and tables showed the split by owner, GC and trade contractors. However, for the benefits included in the table, GC and trade contractors tended to find the same three benefits effective, and, therefore, the table shows the general results for contractors instead of providing separate data for GCs and trade contractors.

Agreement between owners and contractors is far less consistent. Contractors consistently find regular meetings of the full project team on risk to be a critical strategy, and frequently select formal brainstorming, which suggests that they see the ability to collaborate across the team as critical to help achieve these benefits.

- **Increase Reliability in Overall Project Performance**: There is consensus among owners and contractors that regular meetings of the full project team on risk and expert input from internal resources help to achieve this benefit. However, owners also credit formal brainstorming with the project team, while contractors credit developing a plan to manage risk to achieve this benefit.

- **Reduce Cost of Construction**: Owners and contractors agree that formal brainstorming with the project team is an important strategy to reduce the cost of construction. Owners also find expert input, whether external or internal, important, while contractors see this benefit also emerge from developing a plan to manage risk and conducting regular meetings of the full project team on risk.

- **Improve Project Safety**: Owners and contractors agree that formal brainstorming and developing a plan to

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**Top Evaluation and Mitigation Strategies to Achieve Benefits**

(According to Owners and Contractors Who Rank Them in the Top Three)

<table>
<thead>
<tr>
<th>Increase Reliability in Overall Project Performance</th>
<th></th>
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<tr>
<td>Owners</td>
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<tr>
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<tr>
<td>Owners</td>
<td>Contractors</td>
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</tr>
<tr>
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</tr>
<tr>
<td>Developing a Plan to Manage Risk</td>
<td>26%</td>
<td>38%</td>
</tr>
<tr>
<td>Checklists/Forms/Risk Registers</td>
<td>26%</td>
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<table>
<thead>
<tr>
<th>Improve Project Schedule</th>
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<tr>
<td>Owners</td>
<td>Contractors</td>
<td></td>
</tr>
<tr>
<td>Checklists/Forms/Risk Registers</td>
<td>32%</td>
<td>32%</td>
</tr>
<tr>
<td>Contingency Planning</td>
<td>31%</td>
<td>33%</td>
</tr>
<tr>
<td>Expert Input From Internal Resources</td>
<td>30%</td>
<td>26%</td>
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**Evaluation and Mitigation Strategies for Risk**

**Top Evaluation and Mitigation Strategies to Achieve Benefits**

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Manage risk are critical strategies to improve project safety. Owners also see value in using checklists/forms/risk registers to achieve this goal, while contractors again consider conducting regular meetings of the full project team on risk important.

- **Improve Project Schedule**: This is one of the top benefits associated with contingency planning by owners and contractors. Owners also select checklists/forms/risk registers and expert input from internal resources as a top way to achieve this benefit. However, contractors favor the same methods they think yields many of the other benefits, formal brainstorming and regular meetings of the full project team on risk.

- **Maintain Original Intent for Project Quality**: Regular meetings of full project teams on risk and developing a plan to manage risk are widely recognized by all respondents as a good approach to achieve this benefit. Owners also see value in checklists/forms/risk registers, while contractors favor formal brainstorming, an approach that is generally more collaborative.

- **Reduce Rework**: Owners and contractors agree that regular meetings of the full project team on risk is the top strategy for reducing rework. They also both consider checklists/forms/risk registers to be helpful in reducing rework. Owners also select formal brainstorming as a top strategy to achieve this goal, while contractors consider developing a plan to manage risk important.

- **Increased Ability to Innovate**: There is general agreement that formal brainstorming and expert input (from both internal and external resources) help to increase the ability to innovate. Owners also note that contingency planning is important as well.

- **Competitive Advantage**: This benefit is not noted on the table because so few owners select it as the result of any of these strategies. However, contractors agree that formal brainstorming with the team, expert input from internal resources and developing a plan to manage risk help them to achieve a competitive advantage.

- **Improved Client Satisfaction**: This benefit is not noted on the table because it was only asked of contractors. GC and trade contractors agree that formal brainstorming, regular meetings of the full project team on risk and expert input from internal resources all help improve client satisfaction. However, the highest percentage of trade contractors rate contingency planning as one of the top three strategies for improving client satisfaction, while this strategy is far less important to GCs.

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**Top Evaluation and Mitigation Strategies to Achieve Benefits**

(According to Owners and Contractors Who Rank Them in the Top Three)

<table>
<thead>
<tr>
<th>Maintain Original Intent for Level of Project Quality</th>
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<th>Contractors</th>
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</tr>
<tr>
<td>Developing a Plan to Manage Risk</td>
<td>30%</td>
<td>19%</td>
</tr>
<tr>
<td>Checklists/Forms/Risk Registers</td>
<td>30%</td>
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<table>
<thead>
<tr>
<th>Reduce Rework</th>
<th>Owners</th>
<th>Contractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular Meetings of Full Project Team Focused on Risk</td>
<td>27%</td>
<td>21%</td>
</tr>
<tr>
<td>Formal Brainstorming With Team</td>
<td>22%</td>
<td>20%</td>
</tr>
<tr>
<td>Checklists/Forms/Risk Registers</td>
<td>20%</td>
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<table>
<thead>
<tr>
<th>Increase Ability to Innovate</th>
<th>Owners</th>
<th>Contractors</th>
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<tbody>
<tr>
<td>Formal Brainstorming With Team</td>
<td>26%</td>
<td>25%</td>
</tr>
<tr>
<td>Expert Input From Internal Resources</td>
<td>13%</td>
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<tr>
<td>Contingency Planning</td>
<td>11%</td>
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<tr>
<td>Expert Input From External Resources</td>
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**SmartMarket Report**

Dodge Data & Analytics 44  www.construction.com
Owners, GCs and trade contractors were asked to rank the top three triggers that would encourage them to increase their use of risk management practices. The chart at right reveals the triggers ranked in the top three by at least 20% of owners, GCs or trade contractors.

A few triggers emerge as particularly important:

- **Increased Tendency for Clients to Shift Project Risk to Contractors:** This trigger was ranked in the top three by more than half of the GCs (54%) and about two thirds of the trade contractors (67%), far more than for any other trigger. Contractors are interested in risk mitigation practices because they believe that they are shouldering more risks on their projects.

- **Use of Delivery Systems That Encourage Team Integration:** This is ranked in the top three by the highest percentage of owners (58%) and the second highest percentage of GCs (36%) and trade contractors (30%). When done properly, agreements for team integration are set up to make sure that risk is shared among all partners to allow partners to make decisions for the good of the project rather than just the good of their company. A recent study by the Lean Construction Institute (see page 54) revealed that this type of agreement is critical for successful project integration. However, fully integrated contractors are still unusual in the industry. This may be due to concerns that risks are unevenly apportioned or to the challenges inherent in the shift away from a mind-set of limiting risk exposure that has been prominent in the construction industry for decades. This finding suggests that there is an expectation of wider use of these collaborative delivery systems in the future, and it may, in fact, be a way for the industry to address the concern that too much risk is currently borne by contractors.

- **Demand for Greater Transparency on High Value Projects:** The demand for transparency is a top driver for owners, but not a particularly important driver for contractors. It is more influential among companies that do no public projects (29%) than among those that do public work (14%), so this is not a reflection of greater scrutiny on public projects. There is also no significant difference in the influence of the demand for transparency between respondents doing general building, industrial, transportation or water infrastructure projects. All these findings suggest that increasing scrutiny, whether by the general public or by regulatory agencies, is common across the industry.
Triggers and Obstacles for Increased Use of Risk Management Practices

Top Triggers Encouraging Greater Future Use of Risk Management Practices

- More Widely Available Information on Successful Risk Strategies: This is also ranked in the top three triggers by a higher percentage of owners than contractors. For contractors, the wide range of projects they work on and the other firms they work with can all be sources of strategies. However, many owners may be more isolated from resources about successful risk strategies than contractors are.

- Concerns About Trade Contractor Default: This is ranked as a top trigger by nearly one third (30%) of GCs, but is less influential for owners or trade contractors. A recent study released by AGC on risk suggests that the risk of subcontractor default has not receded with the recession but is still an ongoing concern, and this finding supports that conclusion.

Around a quarter of owners, GCs or trade contractors ranked each of the remaining options in the chart as one of their top three triggers. Such a broad series of triggers suggests that many factors have at least a moderate influence and should be considered in efforts to drive greater adoption of risk management practices in the construction industry.

- Owners are seeking more basic knowledge on risk. In addition to ranking more widely available information on successful risk mitigation strategies quite highly, they are also influenced by increased perception of different types of risks.

- Owners, GCs and trade contractors would all be influenced by access to better risk management tools. This may suggest an opportunity for technology companies to help address this issue.

- Owners and GCs in particular also believe that internal champions for risk management are important, suggesting an important role for the leadership at their companies to promote risk evaluation and mitigation strategies.

- The increased cost of litigation is a concern for GCs and especially trade contractors that will influence their future adoption of more risk mitigation practices.

- The cost of available insurance coverage is a particular concern among trade contractors. There is no statistically significant difference between small, midsize and large companies about the influence of this trigger, which suggests that the cost of insurance matters to trade contractors, not just because insurance may be a heavier burden for smaller companies, but because of specific aspects of insurance related to the trades.

Variation by Type of Project

59% of respondents doing industrial projects rank the increased tendency to shift risk to contractors as a top trigger for their future increased use of risk mitigation practices, more than those doing general building (45%), transportation infrastructure (50%) and water infrastructure (54%). Clearly, contractors in the industrial sector see themselves as bearing the burden of project risk to a greater extent than those in other sectors.

A high percentage of those in water infrastructure (31%) report that the increased cost of litigation is a trigger for their investment in risk mitigation. The high-profile issues with water quality in Flint, Mich., and other areas have led to a general concern about liabilities related to water infrastructure that may be influencing this finding.

However, those in water infrastructure are influenced by concerns about trade contractor default far less than those doing general building, industrial or transportation infrastructure projects.

Triggers and Obstacles for Increased Use of Risk Management Practices

Top Obstacles to Greater Use of Risk Management Practices

Owners, GCs and trade contractors were asked to rank the top three obstacles discouraging them from increasing their use of risk management practices. The chart at right reveals the obstacles ranked in the top three by at least 20% of owners, GCs or trade contractors.

The top obstacles vary widely by player:

- **Owners** need to overcome a lack of knowledge and need more guidance about good risk mitigation practices. The top three owner obstacles all involve knowledge or support: lack of knowledge about risk mitigation strategies, lack of awareness about the cost of risk and lack of industry standards for evaluating and managing risk.

- **Trade contractors** need for change to occur that supports their ability to collaborate with other project team members. Their top obstacles are lack of cooperation/information flow between the design and construction teams, lack of cooperation/information flow between their organizations and client firms to address risk and greater competition among bidders.

- **GCs** do not have one group of obstacles that take precedence over the rest. Instead, several obstacles are selected by roughly one third as among their top three. The same obstacles of concern to trade contractors, including lack of cooperation/information flow between the design and construction teams, lack of cooperation/information flow between their organizations and clients to address risk, and greater competition among bidders are the top issues. However, the gap is much smaller for GCs than for trade contractors between those collaborative issues and the next series of issues that they consider obstacles. The next group includes several of the obstacles reported by owners, including lack of awareness about the cost of risk and lack of knowledge about risk mitigation strategies. Rather than having one set of dominant concerns, GCs seem to consider all these serious obstacles to their wider use of risk management strategies.

There is little meaningful variation by type of project or location of work in the influence of the obstacles, suggesting that tackling the top obstacles would benefit the industry as a whole.
Surety Expert Perspectives

In-depth interviews with three surety experts reveal a positive outlook, albeit with ongoing concerns about workforce availability, contractor margin and the trend toward large projects. Trends toward more collaborative agreements and improving technology are seen as helping to mitigate risk.

Haney says he is monitoring merger and acquisition (M&A) activity to gauge market health. “[M&A activity] tends to come at the end of a cycle,” he says. “That usually means that corporate earnings are running out and they are looking for opportunities to grow.”

Lack of Workforce
Surety experts agree that availability of skilled labor is the biggest challenge facing the industry today. Haney notes that, after the recession, many workers retired or left the construction industry. “There wasn’t enough preparation done for how the pipeline of [new] people would come into the industry,” he says.

In addition to field labor, Mikolajewski says he is also concerned about availability of project management. “We’ve seen contractors unwilling to pursue opportunities because they don’t have an A or a B team available to take advantage of them,” he says. “It impacts contractors’ ability to maximize their backlogs.”

All agree that shortages are a problem across the United States, but some major metro areas could face greater challenges, such as New York, Seattle and San Francisco. They also agree that shortages are not likely to get worse in the coming years, but improvements could be limited. “Optimistically, shortages probably stay the same in the next three years,” Haney says. “[After] three years, if there is still a shortage and [construction] activity picks up, it will be even worse.”

To help mitigate risk, Haney warns that contractors should be more selective about the projects they pursue. “It can’t be all about growth—it has to focus on profitability,” he adds. McVicker says contractors need to be proactive and institute training programs “instead of waiting on the traditional associations to help them address these problems.” Mikolajewski suggests that companies could look to leverage technology and lean techniques like prefabrication to help reduce labor demand.

Contractor Margins
Surety experts have seen limited improvement in contractor margins since the recession, presenting a potential risk. They estimate margins on vertical building projects generally range from 2.5% to 5%, while infrastructure and specialty work can range from 8% to 12%.

“Margins have gone up, but not what you’d expect from our standpoint,” Mikolajewski says. He adds that current margins could be healthy for contractors, “assuming they are sustainable over a five- to seven-year cycle, but if it’s a two-year cycle and then [the market] drops, that poses a big challenge to the industry.”

McVicker has seen “very incremental” improvement in margins since the recession, but notes that clients are “being more disciplined on price.”

Mikolajewski does not see any indicators of an approaching downturn, although he expects that private investment will begin to wane while public spending increases. “There was five years of pent-up demand in the private sector,” he says. “That will have to start going down a little bit, even though it will still be robust.”
that more frequently this year, which is a good sign for the industry.”

Haney says he sees fewer bidders on jobs, which could help reduce downward pressure on margins, but he still has not seen much improvement.

Faced with tight margins, Mikolajewski suggests that contractors try to “control as much of the project as you can. Identify what the highest risk area of a project is and make sure you control the schedule and the budget for that.”

Haney says that contractors looking for better margins should move away from “hard bid” contracting and focus on more collaborative alternative delivery methods to differentiate themselves from the competition.

Shifting Risk in Contractual Agreements

Surety experts have seen increased efforts by owners to shift more risk to contractors. This trend can present both challenges and opportunities. Haney says owners are shifting more risk on contractors “from design through warranty. The contractors are in a position where, if they are hungry, they will accept the risk because they want the work.”

Mikolajewski sees more owners favoring “sole-source responsibilities” in contracts. “Owners don’t want five different sources of responsibility for five different segments of the construction, the design or other aspects,” he says, noting that more owners are looking for contractors to take on those risks.

In light of this trend, a contractor’s ability to take on more risk creates competitive advantage, experts say. “When you push that type of risk, it favors the more sophisticated contractors,” Haney says. “They will ultimately prevail in the cycle because they... are better managers of risk.”

Mikolajewski agrees that contractors who can better understand and control additional risks have improved opportunities in the current market, adding that the surety industry is “not afraid of risk as long as we get compensated.”

Risk on Large Projects

McVicker notes that he has seen an increase in the size and number of “megaprojects” in the industry. “From a surety standpoint, 10 years ago a $500 million bond in the industry was a big deal,” he says. “Now $500 million is almost an afterthought in terms of project size.”

When coupled with the trend toward shifting risk away from owners, McVicker says this raises the level of concern among sureties. “It’s hard to be right all the time,” he says. “If you take that increased risk, it just takes one or two [bad projects] for a portfolio to have a misstep and hurt your operation,” he says.

McVicker notes that dividing risk within a joint venture is a good mitigation strategy on large projects. Owners can also split up large projects into multiple jobs. “Does it need to be a $1.5 billion project, instead of three $500 million projects?” he adds.

Subcontractor Default

Although sureties experienced some losses related to subcontractor default during the recession, experts see limited cause for concern in the current environment.

“We don’t see it changing dramatically in the next three years, Mikolajewski says. “It does appear there’s a decent pipeline of construction dollars.”

However, Mikolajewski notes that, given the thin margins on many projects, “even a small downturn in revenue could have an impact on subcontractors.”

Zurich was the first to provide subcontractor default insurance and did experience some losses during the recession. McVicker says the company has since adjusted the terms and pricing of the product and remains committed to providing subcontractor default coverage.

Risk Mitigation Trends

Many surety experts see increased availability of in-house risk experts and in-house attorneys, even among medium and small contractors. “That’s one component to truly understand contractually what risks you’re taking on,” Mikolajewski says.

Surety experts agree that use of technology, such as building information modeling, can help mitigate risk on projects by helping contractors better identify and avoid potential problems. Drones and use of robotics for automated tasks were also noted as potential opportunities to reduce risks.

Prefabrication can also improve quality, safety, speed, cost and predictability on projects, although experts had mixed outlooks on its adoption in the industry. McVicker says it was a “hot trend several years ago,” but he has seen less emphasis on it recently. Haney says he sees steady adoption of prefabrication and expects to see increased use of the technique in the coming years.
Multiple findings throughout this study have demonstrated industry consensus that increased collaboration reduces risk, including the impact of collaborative risk evaluation and mitigation factors (see pages 25 and 37). In addition, owners, GCs and trade contractors were explicitly asked whether they agree with the statement that increased collaboration with other members of the project team reduces the risk they experience on their projects.

**Contractors and owners overwhelmingly agree with this statement.** In fact, 91% of owners, GCs and trade contractors alike state that they agree, and, even more tellingly, nearly half say that they strongly agree. There is strong industry consensus on this point.

Comparisons with findings from the 2011 *Mitigation of Risk in Construction SmartMarket Report* suggest that industry recognition of the value of collaboration may be growing. In 2011, owners and contractors in the infrastructure sector were asked about the impact of using integrated teams on risk. The results were quite positive, with 77% who affirmed that using integrated teams reduces risk, and only 17% reported that using integrated teams had no impact on risk.

It is important to note that the question asked in the current study and the one asked in 2011 are not directly comparable, since creating an integrated team is more formal than simply increasing collaboration. However, the truly nominal percentage (4% across all players) in the current study who neither agree nor disagree that increased collaboration reduces risk certainly suggests that the industry is increasingly crediting collaboration with actively decreasing the risks they face on their projects.

### Impact of Increased Collaboration on Risk

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<th>Owners</th>
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<th>Trade Contractors</th>
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<tbody>
<tr>
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<td>2%</td>
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<tr>
<td><strong>Agree</strong></td>
<td>36%</td>
<td>44%</td>
</tr>
<tr>
<td><strong>Neither Agree nor Disagree</strong></td>
<td>55%</td>
<td>47%</td>
</tr>
<tr>
<td><strong>Disagree/Strongly Disagree</strong></td>
<td>6%</td>
<td>7%</td>
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*Dodge Data & Analytics, 2017*
Impact of Using BIM on Risk

Research by Dodge Data & Analytics has repeatedly demonstrated that use of BIM reduces rework, reduces RFIs and has a positive impact on project cost and schedule, especially when it facilitates the transfer of reliable project information between team members.

Owners, GCs and trade contractors who use BIM or see BIM used on their projects were asked if they agree that the use of BIM decreases risk on projects. In general, over half of respondents agree that BIM reduces risk on their projects. However, approximately one quarter of owners and one third of contractors also remain neutral on the impact of BIM on risk.

Owners currently are most likely to report that using BIM reduces risk. Two thirds of owners (67%) agree that BIM decreases risk on their projects, compared with 57% of GCs and 54% of trade contractors. While this finding may seem surprising, it is in line with findings of other SmartMarket Reports that demonstrate owner confidence in the impact of BIM on their projects, including the 2015 Measuring the Impact of BIM on Complex Buildings SmartMarket Report, in which 93% of owners report that use of BIM improves the quality and function of final design on their projects. It is possible that owner involvement across the project lifecycle contributes to the increased perception that BIM reduces project risk compared with contractors who may only see the benefits that emerge during construction.

Variation by Size of Contractor

Over two thirds (68%) of large contractors (those with annual revenues of $500 million or more) agree that using BIM reduces risk on their projects, compared with slightly under half (49%) of small contractors (those with annual revenues of less than $50 million). This finding is also consistent with the findings in all the BIM-focused SmartMarket Reports, which consistently shows that larger contractors use BIM more intensively and see more benefits from its use. Many of these benefits create increased reliability on project outcomes, which would lead to overall reduced risk.
Owners, GCs and trade contractors were asked if they agree that the use of lean design and construction approaches reduces risk on their projects. All responses are shown together in the chart at right since there were no significant differences by type of company.

More than twice as many respondents agree that lean design and construction reduces risk (39%) than those who think it increases risk (16%). However, nearly half (45%) take a neutral position, perhaps because of lack of familiarity with lean. In the 2013 Lean Construction SmartMarket Report, 37% of a construction-industry representative panel of respondents were not familiar with any lean practices, and a much higher percentage were not engaged in lean on their projects. It is still a relatively small niche of contractors who truly practice lean construction, and that may contribute to the lack of a clear conception of the impact that lean practices can have on project risk.

Large contractors (those with annual revenues of $500 million or more) are more likely to find that lean construction reduces risk, with 59% in agreement with that stance, compared with 25% of small contractors (those with annual revenues of less than $50 million).

For the experience of a project supervisor with how specific lean practices like pull planning helped him to reduce the risk of negative impacts on project cost and schedule, see pages 58 and 59.
Impact of Labor Scarcity on Risk

Owners, GCs and trade contractors were asked if they agree that labor scarcity will increase risk on their projects, and most (81%) agree that they expect their project risk to increase due to labor scarcity.

Unlike their responses about the impact of the use of BIM or of lean design and construction practices, only 10% are neutral about the impact. Even fewer (9%) actively disagreed with the impact of labor scarcity on their projects.

With such a strong consensus, it is not surprising to find that there are no significant variations of interest based on contractor size, type of work or location of work.

As the construction industry continues to gain strength, skilled labor is likely to be increasingly difficult to find, and this could impact critical project success factors like cost, schedule and safety.
Collaboration and Project Risk

The most intensive form of collaboration, Integrated Project Delivery (IPD), regularly achieves cost savings in millions, and time savings in weeks, even months. But do the benefits of collaboration come risk-free?

Writing Your Own Rules

The risks of IPD are no greater than any other delivery method, according to an owner’s representative with experience running large projects as both IPD and design-bid-build. But they do exist, and, if they’re unfamiliar to a project team, they may be more likely to materialize. “People need to be careful when they’re creating a contractual environment where the parties are collectively at risk,” says this owner’s representative. How IPD partners track costs, for example, affects one and all, and it behooves each partner to understand their colleagues’ practices at least as well as they understand their own.

The radical transparency and shared liability of contractual IPD can deter some project teams from committing to the full process. Instead they look for the advantages of enhanced collaboration through an IPD-like charter or informal agreement. That middle ground can get murky: “If they haven’t worked through what they’re supposed to do instead. Cheng recommends lean tools, such as pull planning and reliable promising, to help make commitments to collaborate more specific.

Choosing Your Partners

For teams that do commit to a full IPD environment, one of the first questions is, who’s in? The larger and more diverse the group of signatories, the more people the financial stake motivates to improve the project. On the other hand, the further removed a party is from the usual core team of architects, contractors, and main consultants and trade partners, the more difficult it can be to align that party with the business plan, and to figure out the terms of the shared risk reward.

It may not be necessary, however, to include a party in the signatory pool to leverage the benefits of their collaboration. Cheng has observed that there seems to be a tipping point (and this is a subject she intends to investigate further) when the proportion of the project team in the signatory pool reaches a critical mass, its collaborative culture prevails, and “the spirit of motivation and planning alignment seems to overflow to the rest of the team.”

In addition to a well-calibrated signatory pool, IPD needs an engaged owner with a clear understanding of their reasons for committing to the process: many of a project’s participants will be used to more traditional ways of running a project, and will need regular reminders.

Committing to Change

Despite the documented successes of IPD, many in the industry hesitate to adopt it, perhaps perceiving too much risk in change itself. “Can you prove to me that it’s better?” they ask Digby Christian, director of Integrated Lean Project Delivery at Sutter Health, when he speaks at conferences. “Why would we change?”

In response, Christian points to data showing the industry’s reliability on capital project delivery (defined as completion within 3 percent of initial budget and schedule) is languishing between 5 and 20 percent. Industry efforts to improve commonly focus on increasing productivity and reducing waste, and therefore on driving costs down, but, says Christian, low productivity and waste are only symptoms of the root cause. “The primary problem in design and delivery of capital projects is

Sidebar: Collaboration

“...The collaborative culture actually grows from some of the discussions you need to have to set up the stakes, accountability and consequences in an IPD agreement.”

Collaboration without knowing what they’re supposed to do instead. Cheng recommends lean tools, such as pull planning and reliable promising, to help make commitments to collaborate more specific.
not productivity,” says Christian. “It’s reliability. We are massively unreliable in our ability to deliver projects on time and on budget.” Sutter’s reliability for its IPD-contracted projects is 100 percent.

**The Technology of Collaboration**

Digitization has made it possible to visualize, measure, and monitor communication and collaboration in new ways. This in turn is facilitating more—and more effective—collaboration and integration. “The power of this is when every stakeholder involved in delivering the project is using a single platform,” says Karthik Venkatasubramanian, director of business operations at Aconex. At that point, tactical risks such as bouncing an email, working off an old revision, getting left out of a communication loop, or compounding a mistaken assumption through multiple design iterations are all but eliminated. It’s clear who received what when, when they responded and what they’re working on.

Once a project is fully integrated into a single platform, from feasibility study to, potentially, facilities management, the next step becomes repeatability and improvement. With repeatability comes standardization, increased predictability, improved visibility of processes and the opportunity to incorporate lessons learned. “Even outside the purely analytical side of things,” says Venkatasubramanian, “there is the opportunity to have better relationships with the ecosystem.” For example, from working with the same people over a number of projects, benchmarks start to emerge from the data: teams know who’s responding and who’s not, and that creates an opportunity to figure out why. Is it something to do with the contract? Is it procedural? Are there human factors in play? The flow of information and quality of engagement start to improve.

As technological support for collaboration reaches enterprise-wide adoption across all business units and project partners, the potential arises to deliver insights from big data. Not only can firms mine their own data from multiple projects, but—leaping scale—platform providers can provide insights from data patterns across the many thousands of projects they host, patterns that can represent best practices with regard to a wide range of risks. These may include sector-specific aspects of project management, such as contract structure, design review process or volume of RFIs. Big data patterns may also suggest early warnings for inchoate risks by, for example, flagging terminology or behaviors identified as precursors to trouble across the data set, and signalling project leaders to intervene in time to prevent a risk materializing.

“We’re starting to ask if we can contribute to preventing some of the biggest sources of risk,” says Venkatasubramanian, “things like design risk and scope management, poor information flow and project management risks. The answer is progressively, ‘yes.’” The risks of not managing for the evolving technology of collaboration are real, both in terms of project functionality and competitive advantage. On the upside, that evolving technology is now pushing the frontiers of team integration and risk management.
Cyber Resilience in the Construction Industry

In today’s web-connected world, cyber attacks are a daily occurrence, with potential consequences ranging from expense and inconvenience to disaster.

The AEC industry on the whole has been slower than some of its clients to prioritize cybersecurity. For cyber criminals, this makes poorly protected AEC firms a back door into infrastructure or other client sectors. A cyber attack on a contractor working on the Australian Security Intelligence Organisation’s new headquarters, for example, allegedly gave hackers in China access to the building’s construction drawings, including the locations of communications cabling, servers and security systems. A password lifted from an employee of a major U.S. retailer’s HVAC subcontractor, using emailed malware, enabled hackers to steal credit- and debit-card information from point-of-sale devices nationwide.

AEC firms have an important role to play in reducing the risks of cyber attacks—to critical infrastructure, across the full spectrum of client sectors, and, not least, to themselves. In addition to cyber attacks that cause damage in the physical world, ransomware denying access to data can disrupt business; data theft can expose employees’ health or financial information, compromise their security and facilitate fraud; and interference with construction data can disrupt operations, damage data, servers and equipment, and impair jobsite safety.

Becoming Part of the Solution

Preventing, detecting and responding to cyber threats requires AEC companies to address both the technical and human aspects of risk. Technical aspects of cyber resilience include protection for software and hardware (such as firewalls, encryption and intrusion protection systems), protection for physical structures (such as limiting access to data centers) and clear instructions for using external hard drives.

The number of organizations involved in construction projects, and the sheer volume of information exchanged on large projects, creates a cybersecurity risk specific to the AEC industry. “No matter how many walls and moats a firm builds,” says David Chatterton, chief information officer at Aconex, “the drawbridge is down to collaborators,” putting each firm’s system at the mercy of their collaborators’ security practices. On collaboration platforms, by contrast, “the wall protects the project itself,” says Chatterton. Tracking who has access to what, and when, becomes simplified, and regular upgrades, testing and third-party audits make for higher security than the participating firms are generally able to provide for themselves.

The technical aspects of security are only part of the solution, however. Maintaining a system’s security requires building a culture of cyber awareness that encompasses the entire organization: “Your biggest risk is your people,” says Chatterton.

Human risk factors primarily revolve around the ways employees use passwords and email. For example, reusing passwords—something nearly everyone does—enables hackers to travel from a single compromised system as far as the password will take them. Emailing critical project information builds a culture of reliance on a fundamentally unsecure format, so that, when a phishing email purportedly from an employer or a colleague asks for confidential information, it doesn’t necessarily seem suspicious.

As a basic best practice, firms should plan for a cyber attack before it happens: create an incident response plan; designate leadership, procedures and communication protocols; and provide training that includes all employees. For firms wanting to assess the security of their systems, Chatterton suggests a few questions to start with:

- Who can access my information?
- And who is accessing my information?
- Who owns this system?
- Where is it located?
- How is it protected?
- Who retains the information (when it’s deleted, is it really deleted)?
- Are those people who they claim to be?

“The AEC industry does a fantastic job of making sure that safety is everyone’s responsibility,” he adds. “Security is exactly the same.”
Cyber Attacks and Critical Infrastructure

The critical infrastructure sector is particularly important to protect from cyber attack, and contractor security can be a crucial element of defense. For critical infrastructure, such as water and energy utilities, the consequences of a cyber attack can be especially acute, threatening the economy, public safety and national defense. Incidents such as the 2006 Pennsylvania Water Company hack, Florida’s 2012 Key Largo Wastewater Treatment District hack and the Tijuana River sewage spill, also in 2012, are evidence of the water sector’s vulnerability. In the energy sector, the U.S. Department of Homeland Security’s Cybersecurity Emergency Response Team responded to 295 energy sector cyber incidents in 2015, a 20% increase over 2014; and globally, 80 percent of oil and gas companies saw an increase in the number of successful cyber attacks.

“Energy leaders are increasingly recognizing the importance of viewing cyber attacks as a core threat to business continuity,” says a recent report on cybersecurity from the World Energy Council, “and the need to create an organization-wide cyber awareness culture that extends beyond traditional IT departments.”

Digitization of critical utilities through smart grids, smart devices and the growing Internet of things may create opportunities for more efficient operations and maintenance, but digitization is also expanding utilities’ surface for attack. Historically, industrial control systems (ICS) for water treatment facilities, nuclear power stations, electricity grids and transportation networks were purpose-built, and isolated for security. Increasingly, however, ICS are built using off-the-shelf components (essentially full-powered computing elements) which, when connected to the Internet, become vulnerable to the same types of threats affecting any other connected device.

Attacks can come from many quarters, but contractors who are not appropriately shielded from cyber attacks contribute to the risk. U.S. power utility’s ICS was infected with a virus when a third-party technician used an infected USB drive to upload software to the system. In the Ukraine, the world’s first publicly acknowledged hacker-caused power outage began when hackers gained access through a spear-phishing campaign to company employees. (Spear-phishing uses legitimate-looking emails to dupe recipients into disclosing confidential information.) An attack on a company operating more than 50 power plants in Canada and the U.S. began when hackers were able to steal critical power plant designs and system passwords from a contractor.
What are the primary risks lean practices are helping you to mitigate on large projects?

We’re doing jobs 10, 12, 15 months faster than we would have done the same project eight or 10 years ago. That doesn’t come without inherent risk. You have less time to coordinate the subcontract work, and there’s more of an overlap with the design phase—because the pressure on the designers in our industry is just as intense as it is on the contractor. So we’re trying to reduce the risks around delivering projects faster, and I think the only way to get there is through some truly effective lean planning practices.

Where do you start?

We’re construction managers, and we’re good at what we do, but we succeed on the capability of our trade partners who actually perform the work in the field. You have to develop a basis of trust—from the highest levels within the organization all the way down to the field level—so that the trade contractors and our staff are very quickly and easily aligned around the driving factors of the project, and what we need to do together to achieve those goals.

Developing a basis of trust is a key idea. How do you achieve it?

You don’t do it sitting across the table at a meeting when you’re reviewing a bid with a subcontractor, [although] you can form a basis then. We’ve been successful in these markets for decades. That’s the foundation. We have developed both company and individual relationships.

Another way is that we recognize that our subcontractors are in this business for profit, just like we are. We’re just filling a different role on the project, ultimately to bring to fruition the dream that our client has for it. So we don’t make it a transactional relationship where we’re just taking the lowest number and putting that guy on the job. We want to make sure that the contractor who has the best strategy, who engages with us early in a pre-construction effort, and who puts their best people on the project has an opportunity to have a successful project where they can help control the outcome.

And then, at the project level, we meet a lot. The focus of every meeting is action-oriented, where we’re asking subcontractors for their suggestions and advice to get where we need to go together. We don’t know everything, and we’re very open about the fact that they’re a critical part of the solution.

To summarize: It’s long-term development of the relationship. It’s treating contractors as partners and not a commodity. And the third thing is inviting them to be a part of the solution, not just dictating.

Can you illustrate that with an example of a problem solved?

On a recent hospitality project, we identified the biggest risk on the project was [the length of time needed for] completing the concrete. So we engaged early with all the major concrete frame subcontractors in the market, and said, “Look, we need to know what you think it’ll take.” Ultimately we partnered with a contractor who was able to take two and a half months out of our proposal schedule for the project without any additional cost. We could not have done that if we had just been looking for the low ball because they would have been looking to protect themselves and their schedule.

But these guys knew us, we had been successful together on other projects, and so they trusted us enough to come in and have an open conversation about it.

We’ve identified a relationship of trust and communication with the subcontractors. What’s next?

Now we really need to make sure the appropriate plan for building the job is in place. We begin with
Balfour Beatty is able to employ lean methods like pull planning to reduce risk on projects.

an early game schedule that creates a framework. We validate the overall sequencing with all the subcontractors, and the milestones come out of it. That’s when we start using what we call pull planning. Together we decide what week-by-week major activities have to happen to fill in a five- to six-month phase of the project.

[For the pull planning process,] we’re talking big boards with columns on them. The subcontractors have their Post-it notes, and they’re up there working with each other, low tech on a wall, but all of a sudden a guy looks up and he says, “Okay, I have 17 red stickers over those three weeks,” and he understands what his manpower looks like on this project.

If you put the decision-makers for the contractors together in a room, and the glass guy is talking to the framing subcontractor, and framing subcontractor is talking to the steel subcontractor, they not only have some accountability to each other, they also have an appreciation of how what they do affects the bigger picture.

The other thing that comes out of this collaborative discussion is identifying risks with the plan. The subcontractors are able to say, “Look, this works—as long as ...” So when you leave the room you’ve identified the things that can keep the project from being successful.

A bullet point list gets typed up and sent out, and says these are the action items, here’s who’s responsible, and here’s the date we’ve got to have resolution. The task of our guy at Balfour Beatty is to make sure that list becomes what we absolutely attack every day until we wipe it out.

Is there an achievement you can point to from using this process?

Recently we were on a project where we suffered several months of push on permitting because the city was backed up. When that happened, we had to decide as a group. (If we’re going to be managing risk, let’s not make any unilateral decisions!) We brought every contractor in, and we did a major phase plan for the entire project. It took us about a day and a half, and at the end of it, to a person, every subcontractor in that room said, “We can do this. We can support this schedule.” We were able to take what was about a 20 percent time impact on the schedule, and eliminate it.

How does this experience compare to traditional command and control?

I remember working in that command and control-type environment, dictating schedule on a job we did about 10 years ago, and I ended up spending all of my days in a reactionary mode trying to solve problems ... because we were trying to control too much.

Now we’re not just empowering our subcontractors, we [are also] empowering our [own] people better. I have assistant superintendents who are two years out of college, or recently promoted from a carpenter level, and they’re able to lead effective scheduling meetings and become good planners. They’re doing that because they don’t have to know everything. They just have to be willing to communicate openly with their subcontractors.

So the shift is to trust people. We hire good people to work for us. We talk about partnering with our trade partners. If we truly believe that, we have to trust that they’re going to do the right thing for the project as a whole. And that means now my time is spent looking ahead, helping to solve things before they happen.
This study was conducted by Dodge Data & Analytics (DD&A) to explore trends and strategies of construction risk management. The research was administered online between July 13 and August 18, 2016. Survey sample was drawn from the DD&A Contractor Panel, the Dodge Database, contact lists from funding partners Alliant, e-Builder and Procore, and association memberships. Partnering associations or groups included:
- Associated Builders and Contractors (ABC)
- Construction Financial Management Association (CFMA)
- Construction Owners Association of America (COAA)
- Construction Users Roundtable (CURT)
- International Risk Management Institute (IRMI)
- JB Knowledge
- Large Owners Group
- National Electrical Contractors Association (NECA)
- Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

Survey Respondents
507 construction professionals participated in the study.
- 111 owners (includes building/project owners, building managers, building agents and developers)
- 253 general contractors (GCs) (includes general contractor/general construction companies, construction managers, design/builders and non-building contractors)
- 143 trade contractors

To be eligible to participate in the study, all respondents had to work for companies located in the U.S. and had to be involved in evaluating or managing risk for their firm’s construction projects. They also were required to have worked on a project with a minimum valuation of $5 million or higher in the last five years. Their firms could work in a wide range of project sectors, including commercial, institutional, industrial, multifamily, single family or non-building (horizontal infrastructure), although firms with more than 50% single-family residential work were excluded.

Additional Analytical Categories
Nearly all the analysis in the report looks at significant differences by firm type. However, there are other analytic variables referenced throughout.

SIZE OF CONTRACTOR
Significant differences between small, medium and large contractors are also reported.
- 173 Small Contractors: Those with annual revenues less than $50 million
- 162 Medium Contractors: Those with annual revenues between $50 million and less than $500 million
- 42 Large Contractors: Those with annual revenues of $500 million or more

SIZE OF LARGEST PROJECT
Where meaningful, significant differences are occasionally reported based on the size of the largest project they were involved with in the past five years.
- 83 with largest project totalling less than $10 million
- 94 with largest project totalling between $10 million and less than $20 million
- 330 with largest project totalling $20 million or more

PROJECT TYPE
While these categories include significant overlap, with firms engaged in multiple categories, notable differences still emerge when comparing the responses of those who reported doing work in the following sectors:
- General Building: 455
- Industrial: 270
- Transportation Infrastructure: 174
- Water Infrastructure: 140

LOCATION OF WORK
Significant differences are reported between respondents whose companies work solely in the U.S. compared with those who work in the U.S. and abroad.
- Work in the U.S. only: 445
- Work Outside the U.S.: 62

CONDUCT PUBLIC PROJECTS
There are a few instances where significant differences are cited between those who state they do no public projects (101) and those who have done public work in the past five years (395).
Resources
Organizations, websites and publications to help you get smarter about managing risk in construction projects.

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Finally, we would like to thank all the experts who participated in our articles and case studies for sharing their experience, expertise and images with us to help the industry.
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