

EGNYTE



SmartMarket Brief

DON Dodge
Construction
Network

Data Resilience in Design
and Construction:

How Digital Discipline Builds Stronger Firms

Introduction

ABOUT THIS SMARTMARKET BRIEF

The number of serious risks facing the construction industry has continued to grow, but so have the means for managing them effectively. To explore the ways in which data and document management can improve business resilience, Egnyte retained Dodge Construction Network to survey architects, engineers and contractors on the risks they face and the ways in which they respond to those risks. Topics explored in this *SmartMarket Brief* include:

- **Resilience and Document Access:** Benchmarks the degree to which design and construction professionals can access documents at any time, from anywhere and on any device; the issues that disrupt access to documents; and the frequency and severity of problems caused by lack of access, as well as practices that improve access.
- **Cybersecurity:** Establishes the threats already experienced; the contrast between the perception of preparedness for loss of access to documents and the reality in the face of cyberthreats; and the approaches used to manage these risks.
- **Workforce Resilience:** Determines the challenges of finding and retaining qualified staff and the means to address them.
- **Managing Other Risks:** Examines the perceived threat posed by other critical risks, including supply chain disruptions, market challenges and technology issues, and the most effective means to address them.

The findings demonstrate the critical importance of data resilience in managing these challenges. DCN thanks Egnyte for partnering on this research to help the industry rise to the challenges that face it today.

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Message From Egnyte

SmartMarket Brief

The AEC industry is no stranger to the creation and collaboration of massive quantities of data—spanning everything from handwritten forms to dense documents over hundreds of pages long to large, complex drawings and models to point cloud data from 3D laser scanners. Today’s technology enables employees to work as efficiently from a jobsite as they do from their desks, and helps companies attract and retain talent because AEC firms win when the right information is in the right hands at the right time.

The industry experienced a surge in migrating data to the cloud in the wake of the pandemic. This digital revolution empowers companies to adapt to new ways of work, but it also introduces new management challenges they have not faced before. At Egnyte, we are committed to improving the experience of users and the security of a company’s data.

Egnyte is excited to partner with Dodge Construction Network to better understand the challenges faced by the AEC industry as a whole and, more specifically, how companies in each subindustry perceive and adapt their business model as they face labor shortages, cybersecurity threats and the broader reputational opportunities and risks that come with technology today. Egnyte is proud to be at the forefront of the digital transformation movement, from cloud storage and collaboration products to AI enhancements tailored specifically to address the needs of the AEC industry.

Kevin Soohoo

Senior Director of AEC Industry Solutions
Egnyte



Key Findings

Data Resilience in Design and Construction

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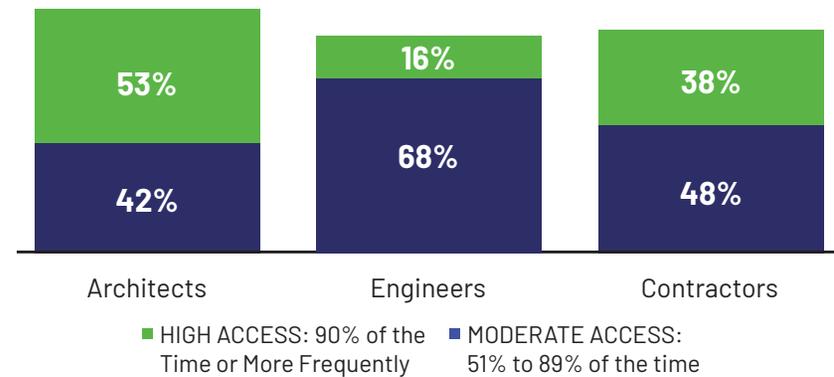
MANY IN THE DESIGN AND CONSTRUCTION INDUSTRY STILL STRUGGLE WITH DOCUMENT ACCESS, AND THEY EXPERIENCE SEVERE PROBLEMS AS A RESULT

Consistent, reliable and universal access to documents and data is at the heart of business resilience. But as the chart at right shows, nearly half of architects and nearly two thirds of contractors do not have a high level of access to documents.

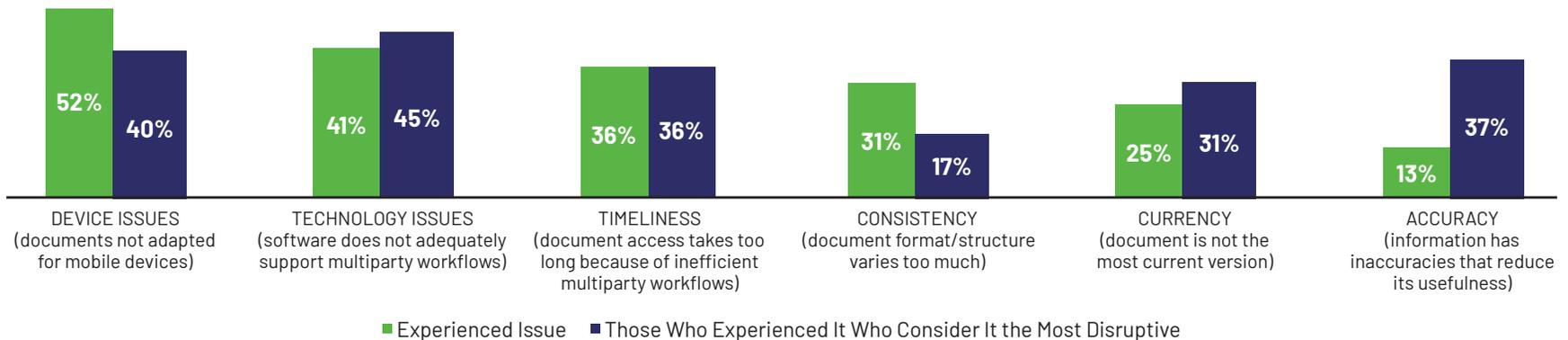
The chart below shows the key issues that interfere with access to documents.

- Inefficient multiparty workflows, especially due to technology issues, and an inability to access documents on mobile devices rank the highest for both frequency and degree of disruption.
- Challenges with the documents themselves are less common, although accuracy stands out as a troublesome issue.

Able to Access Documents Any Time, Anywhere and From Any Device More than 50% of the Time



Issues Interfering With Document Access



Key Findings

SEVERAL PROBLEMS RESULT FROM CHALLENGES IN ACCESSING DOCUMENTS

Several problems result from the issues with accessing documents:

- **Unplanned Rework:** This is the most common problem experienced by all respondents, especially the architects and contractors, both of whom also cite it as the most disruptive.
- **Schedule Delays:** This is the engineers' most frequent problem although not their most disruptive. By contrast, both architects and contractors say it is nearly as disruptive as unplanned rework.
- **Cost Overruns:** Though all respondents report moderate frequency, the engineers rate this as their most disruptive problem, notably more so than either architects or contractors.
- **Construction Errors:** While all the respondents designate this as moderately disruptive, only the contractors identify it as a frequent issue.

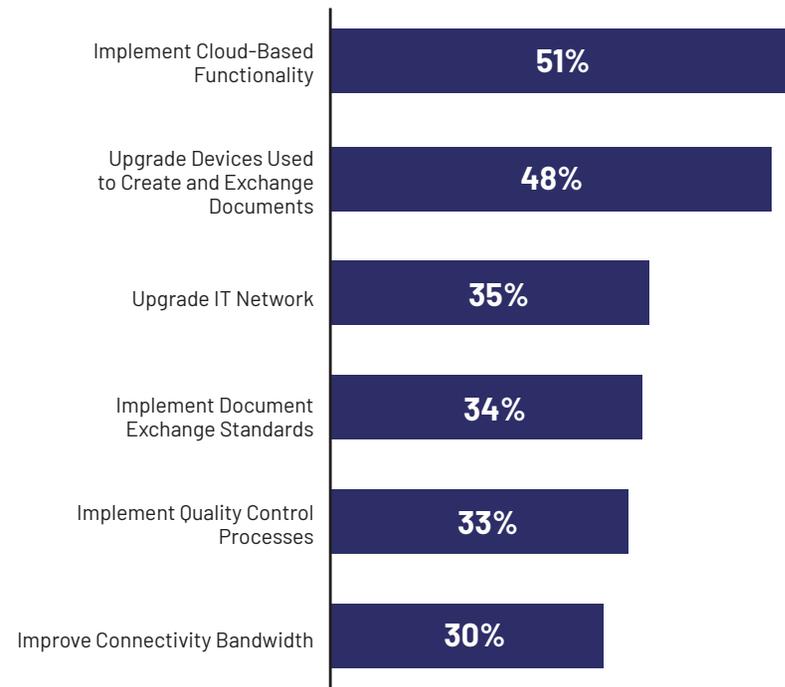
Clearly, improving document access by addressing these problems has the potential to significantly improve project delivery for everyone.

CLOUD-BASED FUNCTIONALITY IS THE MOST COMMONLY USED MEANS TO IMPROVE DOCUMENT ACCESS

The chart at right shows how architects, engineers and contractors are currently improving their document access.

While cloud-based functionality leads the way, it is still not adopted by nearly half overall, with contractors in particular lagging behind design firms in its use. Promisingly, nearly all (85%) of the respondents who report that they have no document access issues are utilizing the cloud.

Top Measures in Use to Improve Document Access



Key Findings

THE DESIGN AND CONSTRUCTION INDUSTRY NEEDS TO BE BETTER PREPARED FOR CYBERATTACKS

Robust data resilience refers not only to the day-to-day access to documents but also to the ability to withstand cybersecurity threats. This requires utilizing the tools available to prevent an attack as well as being prepared if such an event occurs.

As the findings shown at right reveal, most of the industry is not prepared for a serious cyberattack. One recent study listed the average length of a ransomware attack in the US as 20 days.* However, 77% of those surveyed cannot go more than five days without access to their documents before they experience serious schedule impacts.

Unfortunately, the findings also suggest that there may be a degree of complacency about their state of preparedness to withstand a cyberattack, since 72% believe that they have a medium or higher level of preparedness.

The study also demonstrates that design and construction are not immune to these attacks, with 59% reporting a cybersecurity incident in the last two years. General contractors seem to be a particular target, since nearly 1 in 3 has experienced a ransomware attack in that time frame.

Currently, the strategy most widely deployed by those who recognize the cyber risks that they face is to improve internal security procedures. Many also develop security protocols for data exchange with external parties, but far fewer require or use security compliance certificates.

*Ani Petrosyan "Average duration of downtime after a ransomware attack from 1st quarter 2020 to 4th quarter 2021, Statista, <https://www.statista.com/statistics/1275029/length-of-downtime-after-ransomware-attack/>



Have Experienced a Cybersecurity Threat in the Last Two Years



of General Contractors Have Experienced a Ransomware Attack in the Last Two Years



Cannot Go More Than 5 Days Without Access to Documents Before They Experience Serious Schedule Impacts



Believe That They Have a Medium to High Degree of Preparation for Losing Access to Documents

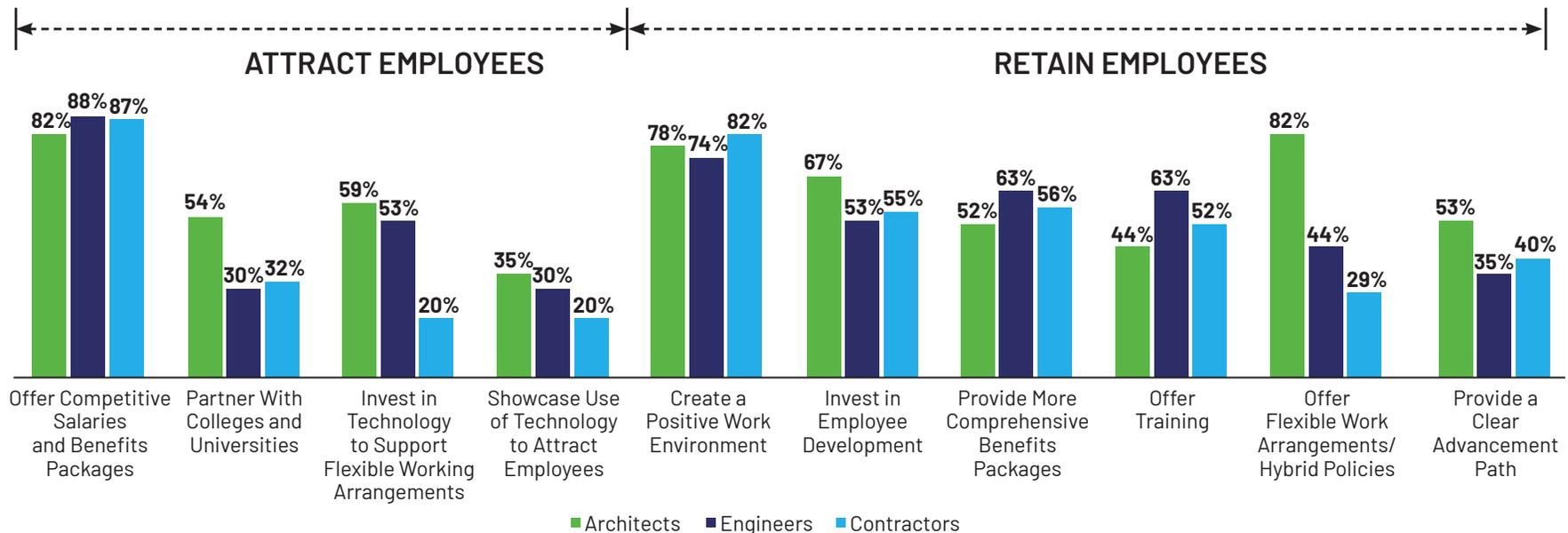
Key Findings

SALARIES AND BENEFITS ARE SEEN AS THE TOP MEANS OF ATTRACTING NEW EMPLOYEES, BUT CREATING A POSITIVE WORK ENVIRONMENT IS RECOGNIZED AS THE BEST MEANS TO RETAIN THEM

The chart below shows the top methods reported by architects, engineers and contractors to attract and retain employees. Not surprisingly, these focus on offering a competitive salary and benefits, creating a positive work environment and investing in training.

Technology may not be the top focus in bolstering workforce-related resiliency, but study findings clearly demonstrate that it plays a role.

- The chart below shows that for many, their technology use helps offer a flexible work environment or is a benefit that attracts some workers.
- Over half of contractors and over three quarters of designers believe that their technology use and digital processes have at least a moderate impact on their ability to retain employees.
- Nearly half of those who are currently trying to address the risks created by the challenge of attracting and retaining employees believe that increasing automation to reduce the time needed for tasks is a highly effective means of doing so. However, this approach is only utilized by less than one third of those who believe these workforce challenges have a major impact on their business.



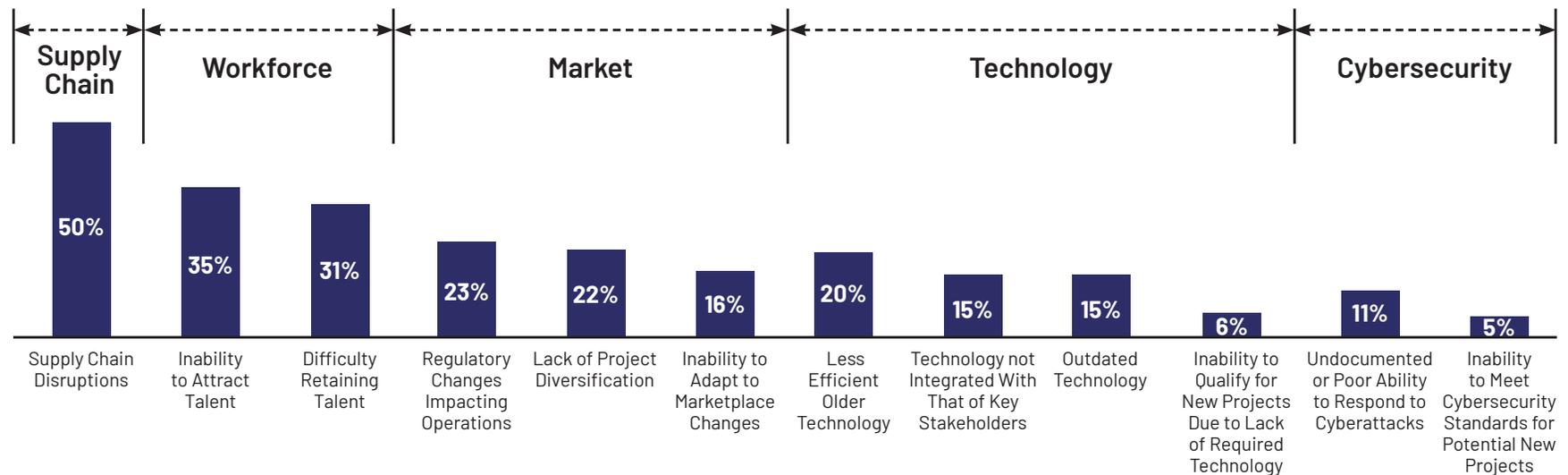
Key Findings

AEC COMPANIES FACE MANY RISKS WITH THE POTENTIAL TO HAVE A MAJOR IMPACT ON THEIR BUSINESSES, BUT THERE ARE ALSO MANY EFFECTIVE STRATEGIES TO HELP MITIGATE THOSE RISKS

The chart below shows what factors architects, engineers and contractors believe pose the risk for a major impact on their businesses. These include some risks already discussed, such as cybersecurity and workforce risks, and others like supply chain, market and technology risks. The chart provides a spectrum of how AEC firms perceive the landscape of risks that they face.

- The high degree of concern over supply chain and workforce risks correspond to other DCN studies that examine these challenges, such as the *Commercial Construction Index* and *Civil Quarterly*.
- Even though market and technology risks have fewer respondents overall who are concerned about them, it is notable that 1 in 5 contractors believe there is a potential for major business impacts from risks in these categories. Clearly, the industry as a whole would benefit from strategies that could help to address them.
- Cybersecurity has the fewest respondents who worry about a major impact, which is consistent with the findings previously discussed on page 5.

Risks With a Major Impact on AEC Businesses



Key Findings

MOST EFFECTIVE MEANS OF ADDRESSING RISKS

The data on pages 29, 34, 38, 41, 42 and 43 offer a portrait of the most frequently used mitigation strategies and an effectiveness rating for each by those using them. The chart at right provides a snapshot of the strategies rated most effective by those using them for each risk category.

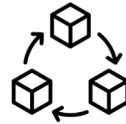
- **Cyber Risks:** As mentioned on page 5, very few of the respondents who are most concerned about cybersecurity pursue security compliance certificates. 62% of those that do, though, think this is a highly effective way to manage these risks, the largest share to give that high of a rating to any of the risk mitigation strategies. Notably, the second highest share (60%) also consider improving internal security procedures to be highly effective.
- **Supply Chain Risks:** Identifying alternative sources for materials is selected by over half as a good means of mitigating supply chain risks. It is by far the most effective of all the options offered.
- **Technology Risks:** Cloud-based collaboration solutions are not only widely used, but over half (55%) of those using them believe that they are highly effective to help minimize technology risks. Despite relatively high levels of use, though, there is still a major opportunity for more of the industry to utilize these tools.
- **Resource/Workforce Risks:** The options offered to the respondents for workforce focused on the ability of technology to help address issues. About half (46%) of those who are using automation to improve productivity believe it is highly effective for workforce attraction and retention. This suggests that companies not currently utilizing technology in this way should consider its potential benefit.
- **Market Risks:** All respondents clearly struggle with addressing market risks since the most effective option in this category is only ranked highly by 44%, placing it eighth in effectiveness in the overall list of potential mitigation factors.

Most Effective Means of Managing Risks (By Category of Risks)



Cyber Risks

Pursue Security Compliance Certificates



Supply Chain Risks

Identify Alternative Sources for Materials



Technology Risks

Use Cloud-Based Collaboration Solutions



Resource/Workforce Risks

Increase Automation to Reduce Time Needed for Tasks



Market Risks

Upskill Current Resources to Be Able to Qualify for Work in New Markets

Data Resilience and Document Access

INTRODUCTION

Universal document access is a critical element of a company's data resilience. This section provides a thorough examination of the degree to which architects, engineers and contractors have access to documents, the factors that inhibit their ability to either access or utilize the documents effectively and the top measures they are utilizing to improve their access.

The findings reveal that these companies are all in the midst of strengthening their data resilience as they grapple with improving document access.

TOPICS ADDRESSED IN THIS SECTION

- **UNIVERSAL DOCUMENT ACCESS:** The degree to which each type of company can access its documents to support work at any time, from anywhere and on any device.
- **ISSUES EXPERIENCED WITH DOCUMENT ACCESS:** The frequency, severity and negative outcomes related to six issues:
 - Device Issues (documents not adapted for mobile devices)
 - Technology Issues (software does not adequately support multiparty workflows)
 - Timeliness (document access takes too long because of inefficient multiparty workflows)
 - Consistency (document format/structure varies too much)
 - Currency (document is not the most current version)
 - Accuracy (information has inaccuracies that reduce its usefulness)
- **WAYS TO IMPROVE DOCUMENT ACCESS:** This section examines the utilization and effectiveness of eight measures to improve document access. It also features a perspective on those measures from those not using them. Lastly, all respondents provided feedback on other approaches they believe could improve document access in a meaningful way.



Frequency of Universal Access to Design/Construction Documents

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NEARLY TWO THIRDS OF AEC PROFESSIONALS DO NOT CONSISTENTLY HAVE COMPLETE ACCESS TO THEIR DOCUMENTS WHENEVER, WHEREVER OR HOWEVER THEY WORK

The survey presented respondents with an ideal scenario for document access, which is that everyone working on design and construction projects should be able to access the right documents anywhere, any time and on any device. They were then asked how frequently they can access documents based on that standard.

The pie chart at upper right shows that there is a lot of progress to be made.

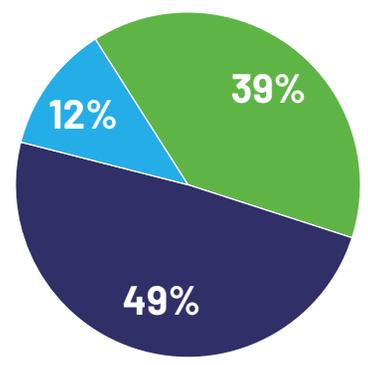
- While only 12% report limited access (half or less of the time), just 39% report high access (90% or more of the time).
- The largest share (49%) fall somewhere in between those extremes.

The bar chart at lower right reveals how access varies by type of company, with architects having the most robust level. Contractors report more moderate access and engineers have the lowest overall.

Other notable differences include:

- **BENEFIT OF WORKFLOW AUTOMATION:** 64% of architects who have high levels of internal workflow automation report the highest level of document access, compared with just 43% of the rest. Notably, this difference is not found among contractors.
- **IMPACT OF PROJECT TYPE:** 41% of contractors engaged primarily in building projects report high access to documents, compared with 27% of those primarily engaged in nonbuilding/civil projects.

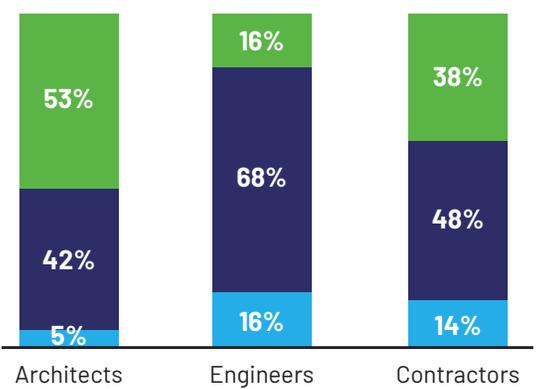
Frequency of Access to the Right Design/Construction Documents to Be Able to Work From Anywhere, at Any Time, on Any Device



- HIGH ACCESS
90% of the Time or More Frequently
- MODERATE ACCESS
51% to 89% of the time
- LIMITED ACCESS
50% of the Time or Less Frequently

Frequency of Access to the Right Design/Construction Documents

By Type of Company



- HIGH ACCESS
90% of the Time or More Frequently
- MODERATE ACCESS
51% to 89% of the time
- LIMITED ACCESS
50% of the Time or Less Frequently

Issues With Document Access

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ADDRESSING DEVICE AND TECHNOLOGY ISSUES IS CRITICAL TO IMPROVING DOCUMENT ACCESS

There are multiple reasons why documents may not be available for access at any time, from anywhere or from any device. The software supporting the exchange of documents through multiparty workflows could be at fault, but issues can also arise with the documents themselves, including whether they can be accessed by mobile devices, lack of consistency in their format or structure, not knowing whether the version accessed is the most current and inaccuracies in the data.

The chart below shows the overall issues reported with documents by those with less than 100% access to their documents, and it suggests that both the workflows supporting the exchange of documents and the documents themselves need to be improved in the industry.

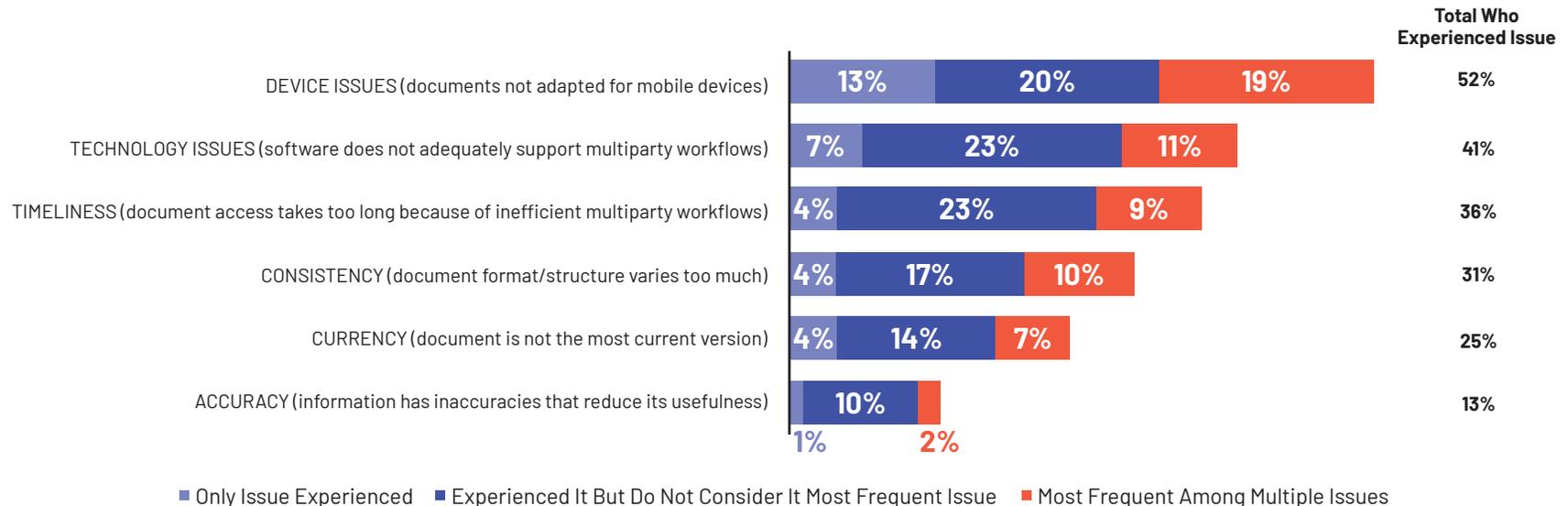
DOCUMENT CHALLENGES

Lack of suitability for access through mobile devices is the biggest challenge with the documents themselves, limiting where, when and how people can utilize them.

- This is the only challenge noted by over half of the overall respondents.
- It also is considered the most frequent of challenges by over one third of those who experience it.
- It has the highest share who report that this is the only challenge they experience.

In contrast, most of the other issues with the documents are reported far less frequently. Of these, consistency in the documents is the biggest issue, experienced by 31%. Nearly one third of those who experience it find that it is the most frequent challenge they face.

Issues Experienced That Limited Full Document Access



Issues With Document Access CONTINUED

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Currency and accuracy issues with documents are least frequently reported. This may be because these challenges would become more evident if workflows allowed greater access to documents overall.

MULTIPARTY WORKFLOW CHALLENGES

The data also reveal the importance of improving multiparty workflows.

- Nearly half (41%) of AEC respondents find that their current software does not adequately support these workflows.
- This is the only issue experienced by respondents more frequently than any of the other workflow challenges, second only to poor access on mobile devices.
- Over one third of respondents say inefficient workflows lead to timeliness issues with their documents, although the majority of those who experience this issue do not cite it as the most frequent.

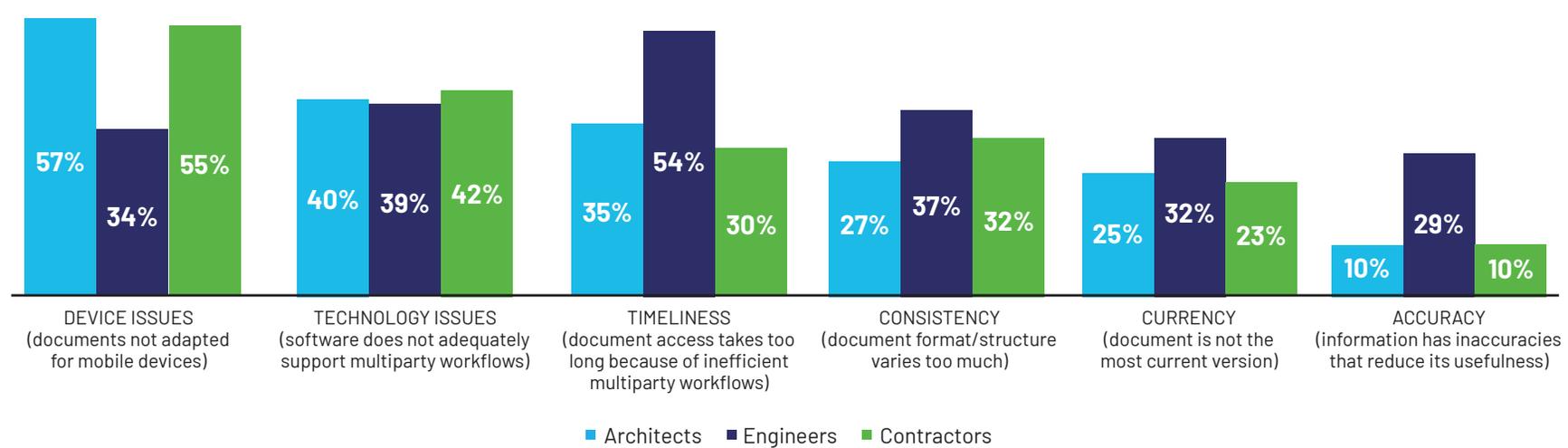
FREQUENCY OF ISSUES VARIES BY COMPANY TYPE

The chart below reveals that architects, engineers and contractors do not experience these issues with the same frequency.

- Architects and contractors are hampered most frequently by not being able to access documents on their mobile devices.
- Engineers more frequently report that inefficient multiparty workflows prevent them from accessing documents in a timely fashion.
- Engineers also struggle more frequently with the accuracy of the documents they access than do architects or contractors.
- One area of agreement is that all experience technology issues.

Experienced Issues With Document Access

By Type of Company



Issues With Document Access CONTINUED

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LOW DOCUMENT ACCESS CORRELATES WITH MORE FREQUENT ISSUES WITH SOFTWARE THAT DOES NOT SUPPORT MULTIPARTY WORKFLOWS

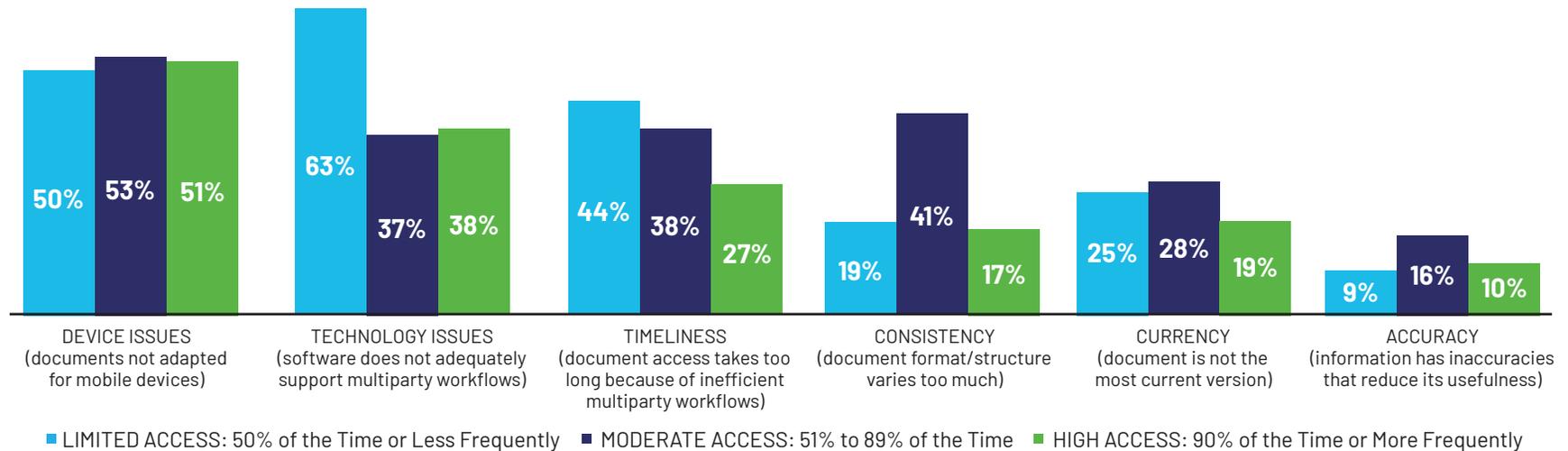
The chart below compares the findings on the frequency with which these issues are experienced with those that have low, moderate and high access to documents.

- Almost two thirds (63%) of those with low document access report technology issues with multiparty workflows and 44% cite timeliness issues due to inefficient workflows.
- Importantly, all equally suffer from documents that are not adapted for mobile devices. This is an area technology companies need to address so that document access can be significantly improved.

- Those with moderate access to documents experience more consistency issues than do those at the low or high end of the scale. It is likely that those at the low end of the scale do not have sufficient document access to yet be aware of consistency problems, and those at the high end have largely already addressed that issue.
- In fact, those with moderate access also report other document issues more frequently, such as currency and accuracy. This may suggest that greater access reveals the document deficiencies that need to be addressed by companies, a critical step in the overall process of digital transformation.

Experienced Issues With Document Access

By Level of Access to Documents



Issues Considered Most Disruptive

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NOT HAVING SOFTWARE THAT ADEQUATELY SUPPORTS MULTIPARTY WORKFLOWS IS THE MOST DISRUPTIVE ISSUE IMPACTING DOCUMENT ACCESS

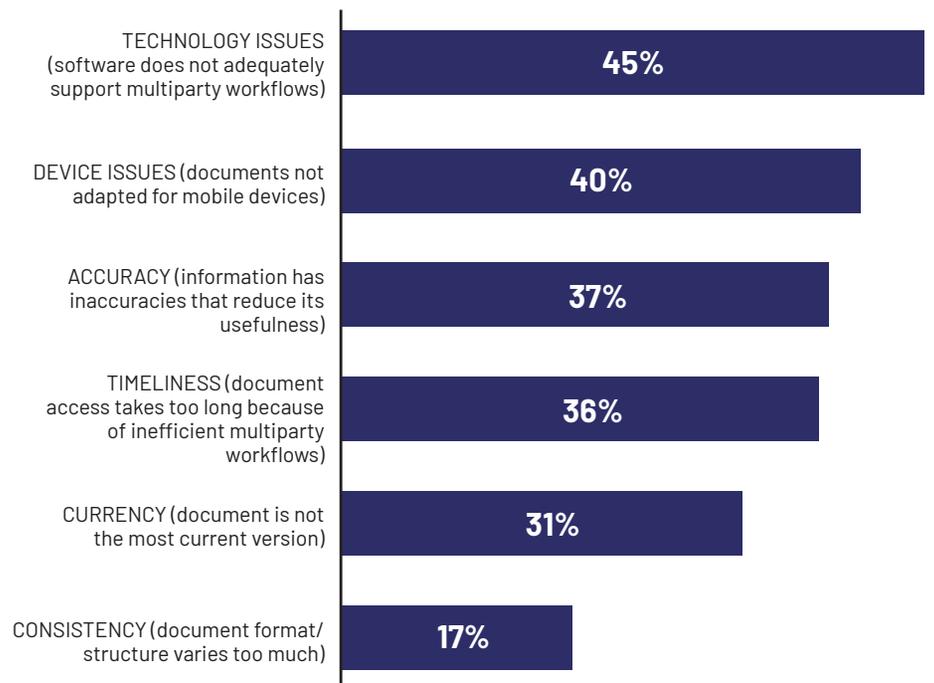
When determining what will help companies to strengthen their data resilience, the degree of negative impact an issue has can be as important as the frequency with which it is experienced.

To better understand the importance of severity, respondents who report having experienced more than one issue were asked which, among those they identified, has been the most disruptive. The chart at right shows the share citing each issue.

- Technology issues rank second in frequency, but are the most disruptive. This reconfirms the importance of having software that supports multiparty workflows.
- The findings also emphasize the importance of addressing device issues. Growing industry-wide reliance on mobile devices leads many to consider this the most disruptive issue they face.
- Document accuracy is the least frequent challenge, but over one third of those who experience it identify it as the most disruptive. Accuracy issues can lead to rework or even potentially to litigation, both costly challenges in the industry.
- Timeliness ranks fourth, but is quite close to both device and accuracy issues. Increasing the efficiency of multiparty workflows would be highly important here.
- Consistency is cited by the lowest share of respondents. However, as the design and construction industry increasingly seeks to utilize analysis tools to improve project processes, consistency will likely grow in importance.

Issues Considered Most Disruptive

By Those Who Experience This Issue and Others



Frequency and Impact of Issues

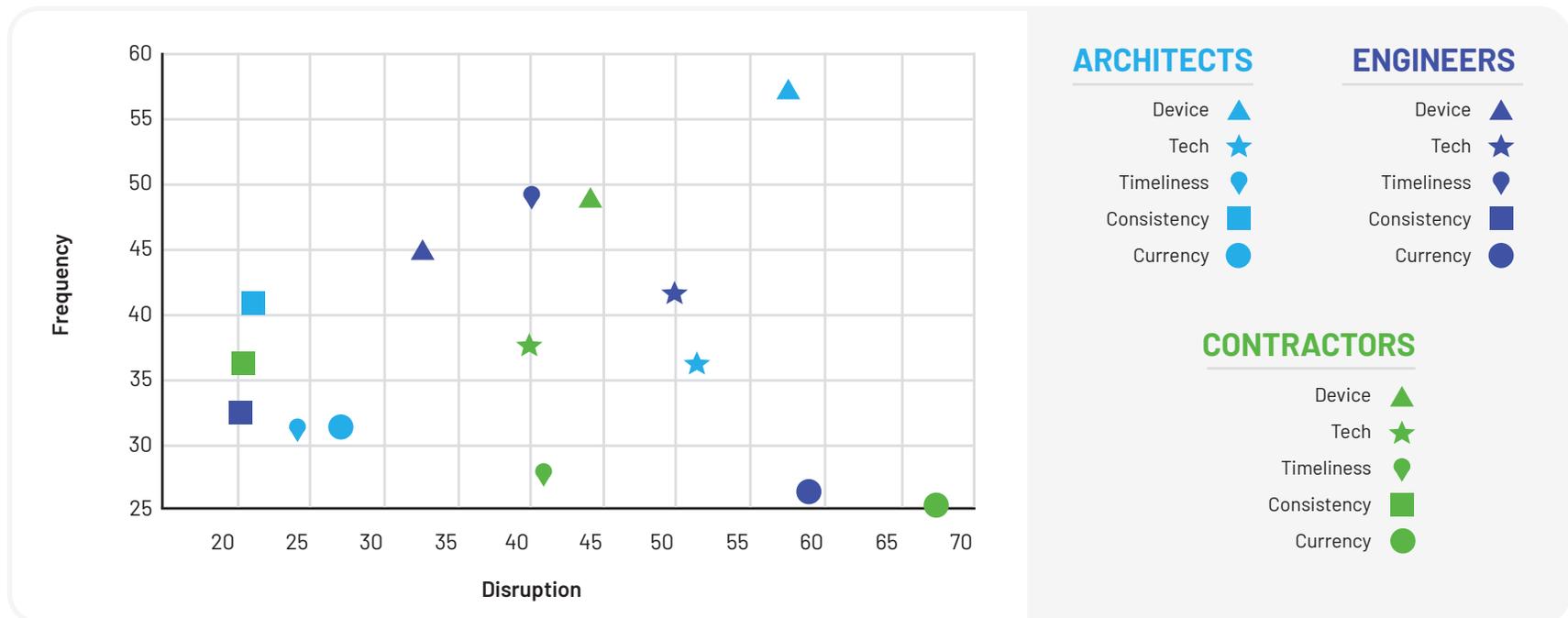
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EACH COMPANY TYPE HAS A UNIQUE SET OF ISSUES WORTHY OF HIGH PRIORITY TO ADDRESS

The matrix chart below combines the findings on both the frequency (vertical axis) and negative impact (horizontal axis) of the issues related to document access. It prioritizes the issues worthy of focus, color coded by type of company.

- ARCHITECTS: By far, the most critical issues are device- and technology-related. All others lag notably behind.
- ENGINEERS: Currency has the greatest impact, but is rarely experienced. Technology and timeliness are the key issues to address for engineers.
- CONTRACTORS: As with engineers, currency has a high impact but a low frequency. Device, technology and timeliness issues all have nearly the same impact, but vary widely by frequency.

Frequency and Impact of Issues Reported by Architects, Contractors and Engineers



Problems Resulting From Issues With Document Access

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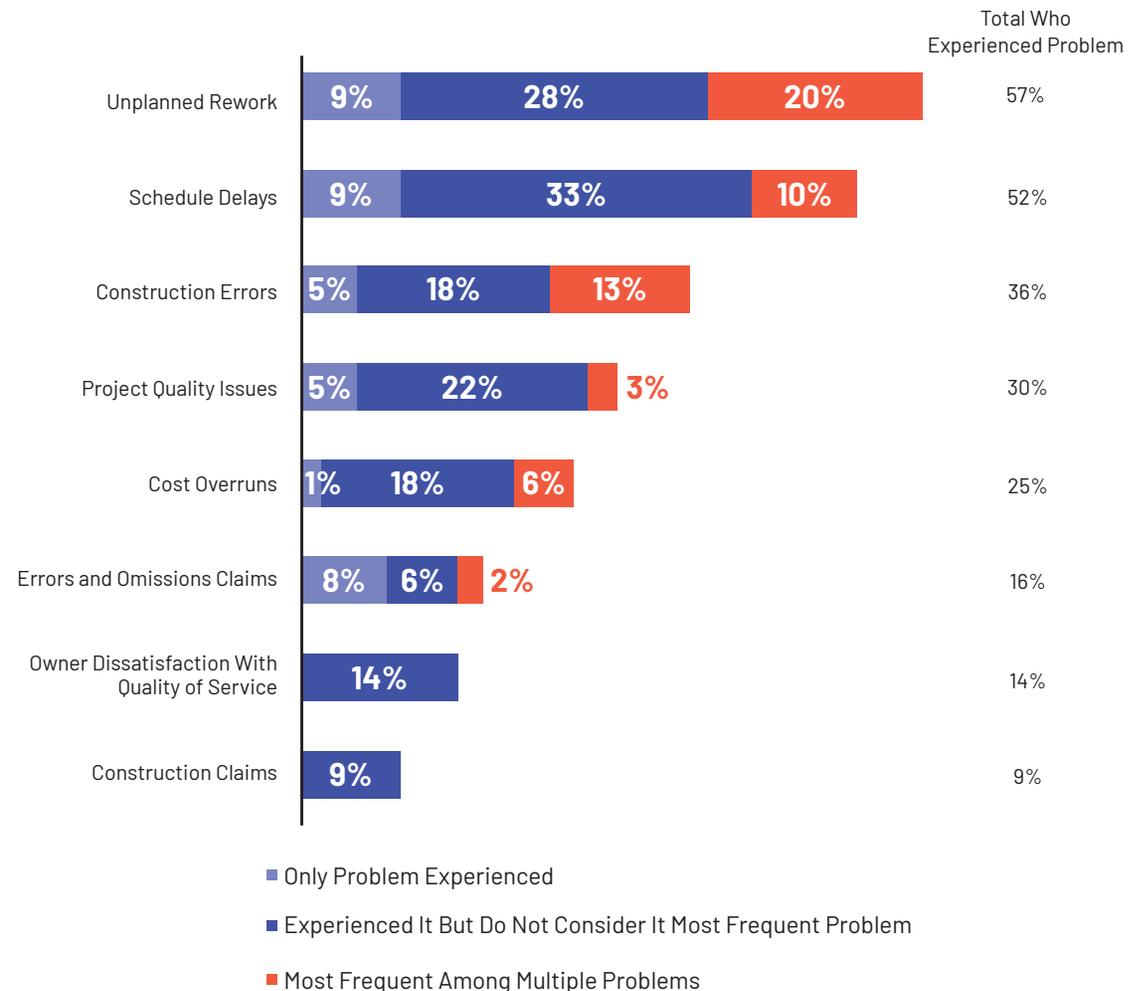
UNPLANNED REWORK IS THE MOST FREQUENT PROBLEM RESULTING FROM LIMITED DOCUMENT ACCESS

The respondents who cannot always access their documents anytime, anywhere, from any device were asked about the problems they experience due to lack of document access. Those who have experienced multiple issues were then asked which issue is the most frequent. The chart at right shows the responses to these questions.

- Unplanned rework ranks first, both in the percentage who experience it (57%) and in the share citing it as the most frequent (20%). This is a compelling reason to improve document access, since unplanned rework can negatively impact cost, schedule, productivity, profitability, quality, safety and more.
- Schedule delays are experienced by more than half of the respondents. They are reported far more frequently by those with low (53%) and moderate (59%) access to documents than by those with a high level of access (36%).

Other issues noted by one quarter to one third of respondents include construction errors, project quality issues and cost overruns. Among these, construction errors are considered the most frequent by a notably high share of those who experience them.

Frequency of Problems Resulting From Limited Document Access



Problems Resulting From Issues With Document Access CONTINUED

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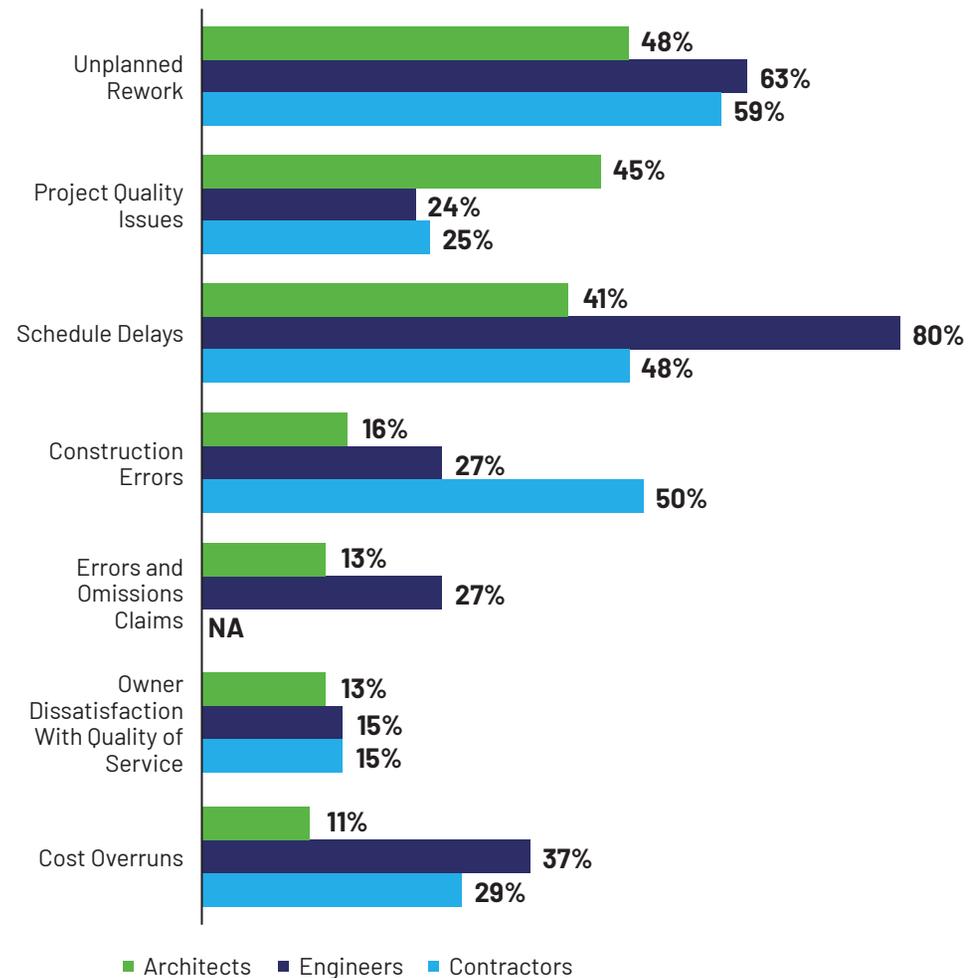
SCHEDULE DELAYS ARE THE MOST FREQUENTLY EXPERIENCED PROBLEM FOR ENGINEERS, WHILE ARCHITECTS AND CONTRACTORS BOTH EXPERIENCE MORE UNPLANNED REWORK

The chart at right shows the most frequently reported challenges by type of company.

- ARCHITECTS: Architects mainly experience three problems due to challenges with document access: unplanned rework, project quality issues and schedule delays.
- ENGINEERS: Schedule delays are by far the biggest challenge for engineers, with unplanned rework second. Importantly, though, this does not mean that engineers experience unplanned rework any less frequently than do architects and contractors.
- CONTRACTORS: The three biggest challenges for contractors are unplanned rework, schedule delays and construction errors.
 - A very high percentage of specialty trade contractors (70%) experience unplanned rework due to document access issues. The share of GCs reporting this (48%) is on a par with the architects. This may suggest that GCs and architects are not always aware of how frequently rework occurs on jobsites resulting from issues accessing documents.
 - While there is a difference between building and nonbuilding contractors in the degree to which they can access documents, their answers about the problems caused by lack of access are not significantly different. There are also no differences for contractors or architects based on their ability to access documents in general. These two findings suggest that even relatively infrequent challenges with accessing documents can lead to major issues on projects.

Problems Experienced Due to Issues With Document Access

Frequency by Type of Company



Impact of Problems Experienced

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UNPLANNED REWORK IS THE MOST DISRUPTIVE PROBLEM, BUT SEVERAL OTHERS ARE ALSO IMPACTFUL

Architects, engineers and contractors who experience more than one problem were asked to select the problem that is most disruptive to their projects. The chart at right shows the share of those who experienced these issues who have found them to be the most disruptive.

Unplanned rework is clearly the most disruptive challenge caused by lack of good document access since it is both widely experienced and frequently is also very disruptive. Notably, 50% of specialty trade contractors who experience unplanned rework select it as the most disruptive, since they bear the brunt of any rework that happens onsite.

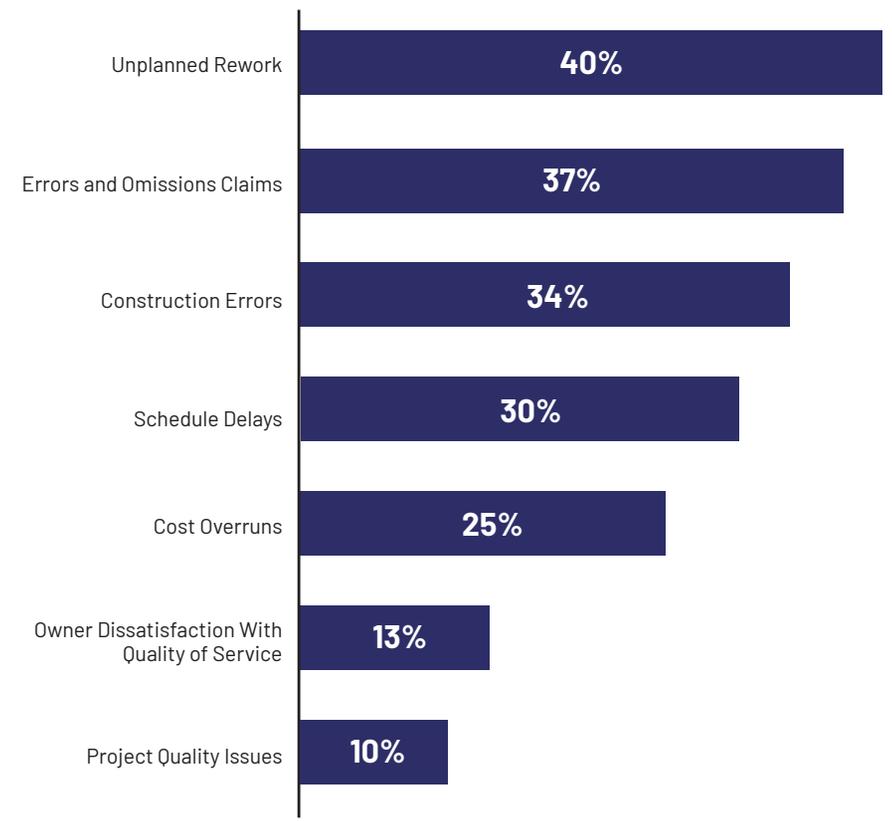
These findings, though, also make it clear that errors and omissions claims have a big impact. Although one of the least frequently experienced issues, over one third of those to whom they occur cite them as the most impactful.

Many of those who experience construction errors, schedule delays and cost overruns also find them to be the most impactful. Nearly half (43%) of contractors specializing in building construction find construction errors to be the most impactful issue, far more than those engaged primarily in nonbuilding, civil construction (11%).

Taken together, these findings clearly reveal that lack of document access has many challenging impacts on projects.

Problems Considered Most Disruptive

By Those Who Experienced This Issue and Others



Frequency and Impact of Problems

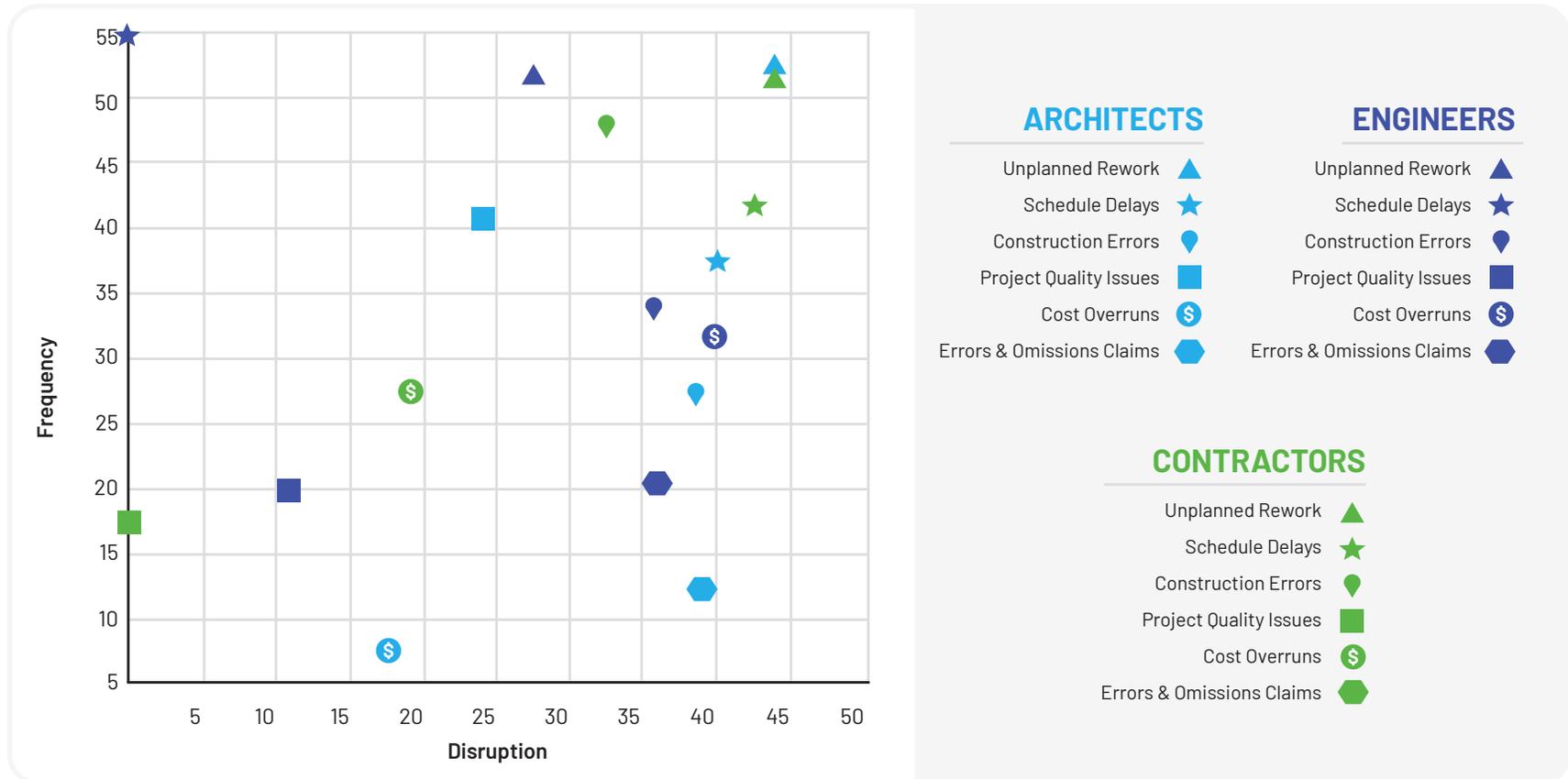
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DISRUPTIVE IMPACTS ARE GENERALLY HIGH REGARDLESS OF FREQUENCY

The matrix chart below shows that many problems are highly disruptive (horizontal axis) even though there is a wide variance in their

frequency (vertical axis). This clearly demonstrates that the design and construction industry will benefit significantly from reductions in most of these problems, even those that occur less commonly.

Frequency and Impact of Problems Reported by Architects, Contractors and Engineers



Measures Taken to Improve Access to Documents

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IMPLEMENTING CLOUD-BASED FUNCTIONALITY IS THE TOP MEASURES TAKEN TO IMPROVE DOCUMENT ACCESS

Architects, engineers and contractors who experience challenges with document access were asked what measures they take to reduce those deficiencies. Those who use more than one were asked which is the most effective. The findings are shown in the chart at right.

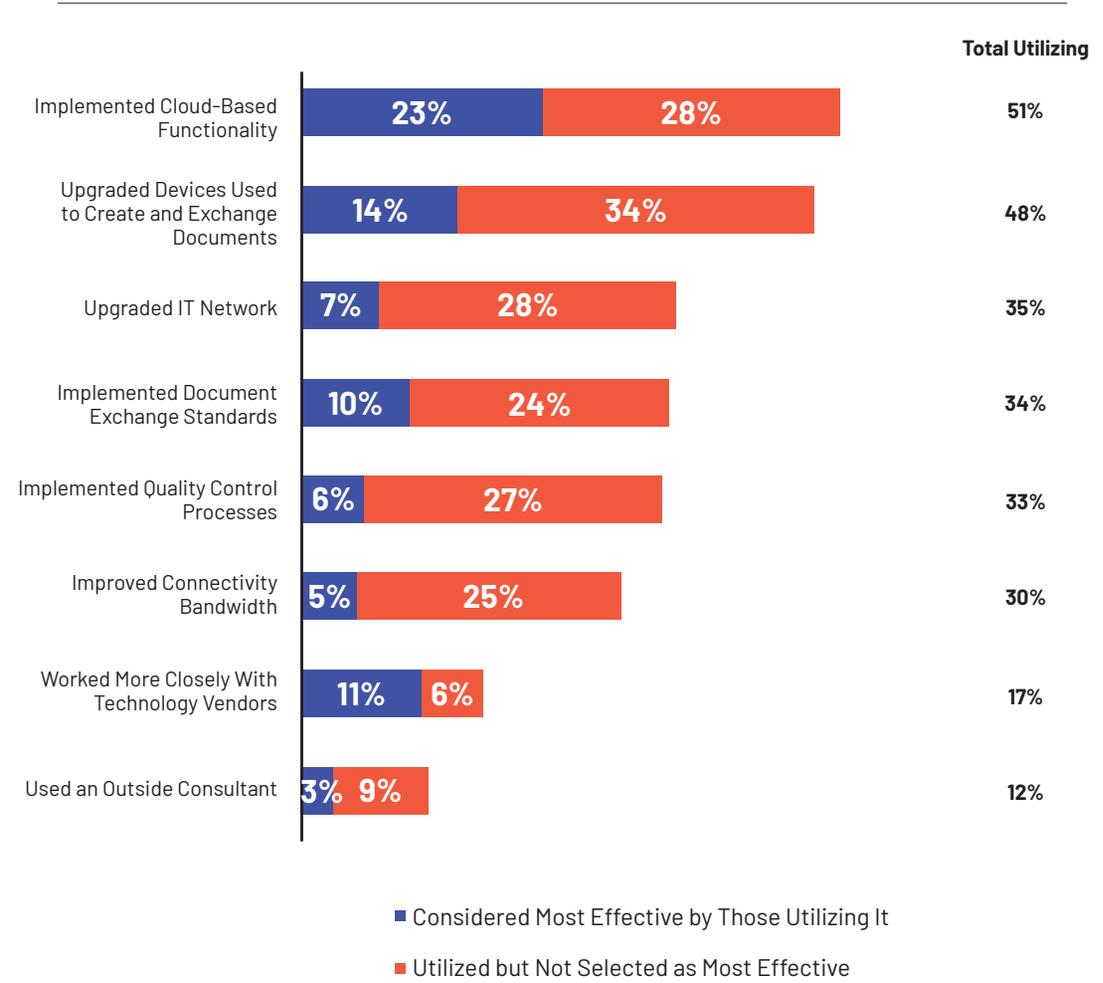
Implementing cloud-based functionality is the most widely used measure, and it is selected by the highest share of those who use it and other approaches as the most effective.

- 56% of those with a high level and 54% of those with a moderate level of access to documents have implemented cloud-based collaboration functionality, compared with just 23% of those with low access.
- Importantly, 70% of those with at the high level who have implemented cloud-based collaboration functionality along with other measures find that using the cloud is the most effective way to improve document access.

Cloud-based collaboration is currently utilized by only 51% of respondents, suggesting that many more would benefit from utilizing the cloud to improve their document access.

Upgrading devices is also a popular and effective approach, and an additional four measures are used by about one third of all respondents, suggesting the industry is still exploring many means to improve.

Measures Taken to Improve Document Access



Potential for Future Improvements

SmartMarket Brief

THOSE NOT YET USING ANY APPROACHES BELIEVE THAT CLOUD-BASED FUNCTIONALITY, UPGRADING DEVICES AND IMPROVING DIGITAL DOCUMENT MANAGEMENT CAPABILITIES ACROSS THE INDUSTRY WOULD BE MOST POSITIVELY IMPACTFUL

Respondents not yet using specific measures to improve their document access (see page 20) were asked which measures, if any, would meaningfully improve their access to documents. In addition, everyone was asked about other factors that could help them access documents. Together, these two questions provide a portrait of what the overall industry regards as the best opportunities to improve data resiliency through increased document access.

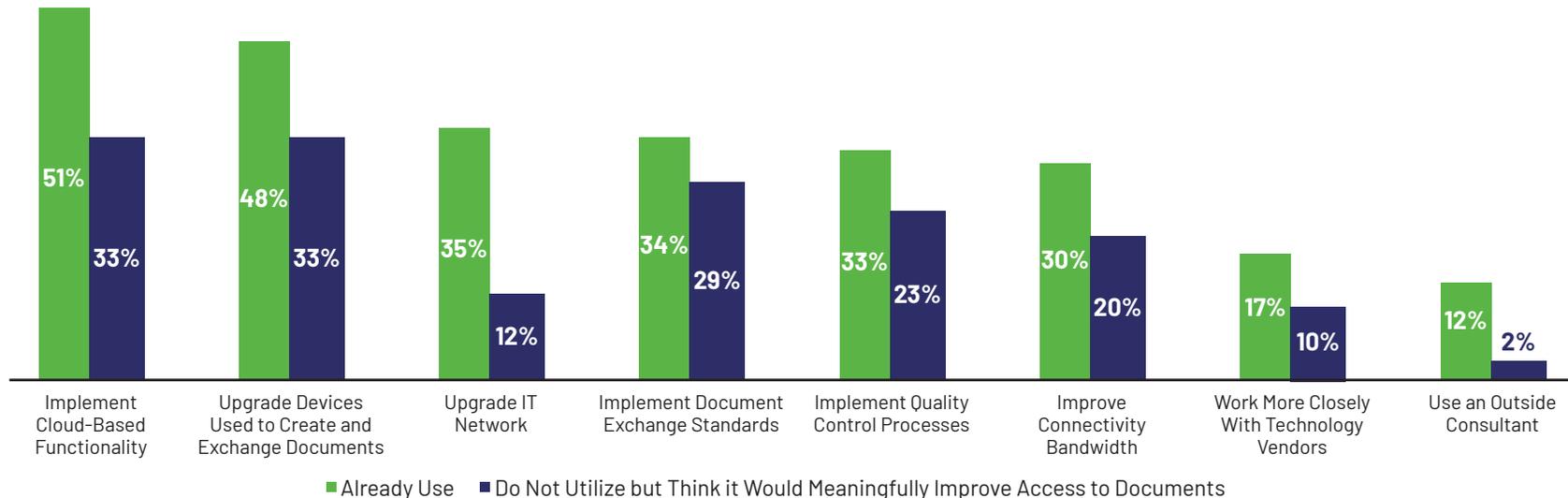
MEASURES MOST VALUED BY NON-USERS

One third of those who currently have not implemented cloud-based functionality or upgraded their devices to create and exchange documents believe each would have a meaningful impact. This suggests that for many companies, getting the basic technology infrastructure in place for better document exchange is seen as a top priority.

Notably, nearly as many believe that implementing document exchange standards would be impactful. It is likely that these are companies that are further along in their digital transformation and want to be able to make greater use of the increased data exchange they have enabled.

Measures That Could Meaningfully Improve Document Access if Adopted

According to Those Not Using Them Yet and Contrasted With Those Who Use Them



Potential for Future Improvements CONTINUED

SmartMarket Brief

ENGINEERS DIFFER FROM ARCHITECTS AND CONTRACTORS ON THE TOP FACTORS THAT WOULD MEANINGFULLY IMPROVE ACCESS TO DOCUMENTS

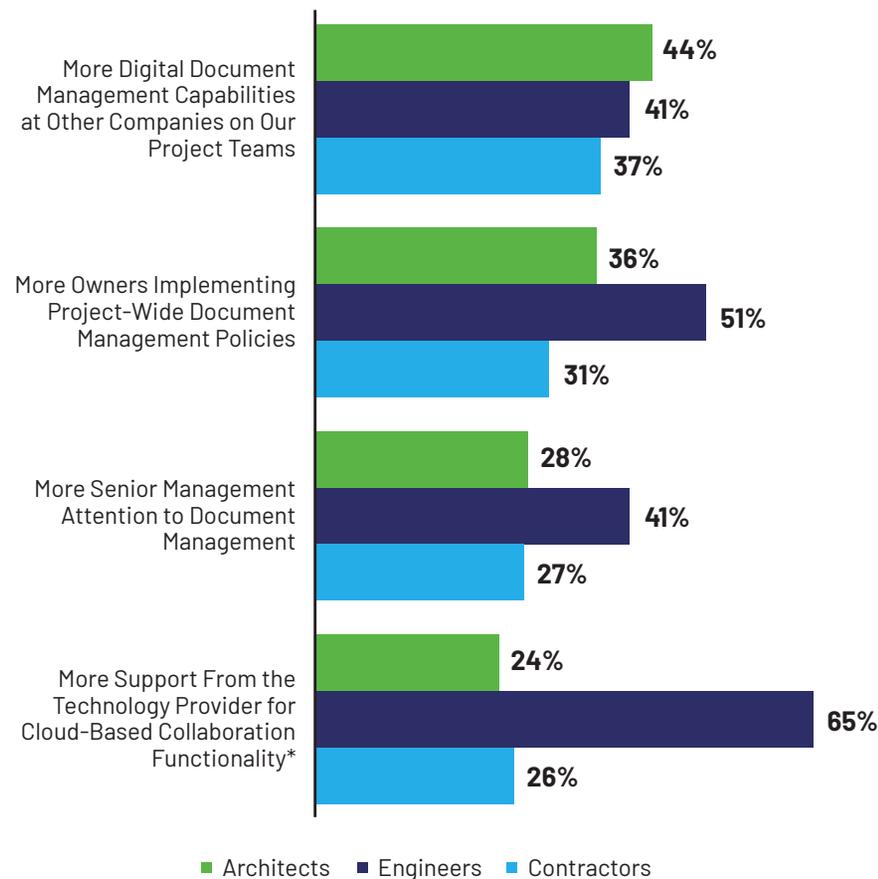
As the findings in the chart at right make clear, architects and contractors agree that, out of the options provided, the top means to improve their access to documents is to have better digital document capabilities across the project team. The current fragmentation of industry approaches to technology creates challenges as many documents need to be shared across companies.

Engineers also agree that this is a challenge, but many more of them are also seeking more support from technology providers and more project-wide document management policies from owners. In addition, many more of them believe that more engagement by senior management with this issue would also be useful.

- Since engineers often are contracted to architects rather than owners, they may have a stronger belief that owner policies would help normalize document management in the industry, while architects and contractors may be less enthusiastic about having another technology requirement.
- The engineers' relatively moderate concerns about digital document management capabilities of other project team members compared with the other factors may be influenced by the relatively high digital sophistication of the architects with whom they most frequently exchange documents (see page 10).

Additional Factors That Would Meaningfully Improve Access to Documents

By Type of Company



*Asked only of those using cloud-based collaboration.

Cybersecurity

INTRODUCTION

Cybersecurity is another pillar of data resiliency. Cyberattacks continue to grow more aggressive and sophisticated, but their prevalence is often misunderstood, especially since few companies want to publicize that they have been breached. This can lead many companies to underestimate their vulnerability and what they need in order to be prepared for a serious attack.

These findings reveal that the design and construction industry is largely unprepared for a major cyberattack, with few believing that they can go for one week or more without document access before they experience serious schedule implications. This is particularly problematic since over half have experienced a cyberattack in the last two years. General contractors are particularly at risk in this area.

TOPICS ADDRESSED IN THIS SECTION

- **READINESS:** Self-evaluation of the degree to which they are prepared if they can not access project documents and the number of days they can tolerate no access before a significant impact to project schedules.
- **TOP CONCERNS:** The most significant concerns that architects, engineers and contractors have about the loss of access to project documents.
- **THREATS EXPERIENCED:** The prevalence of various types of cyberthreats in the industry in the last two years, as reported by the respondents (most of whom are not IT professionals within their companies).
- **MITIGATION APPROACHES:** The share using three different approaches to help mitigate the possibility of loss of access to documents.
- **REQUIRED SECURITY PRACTICES:** The share who require various data security practices from their software providers.
- **MANAGING CYBER RISK:** Measuring those who believe that a poor ability to respond to cybersecurity attacks or the inability to meet cybersecurity standards for potential new projects poses a major impact to their businesses, and what they have deployed to address those risks.



Readiness for Cyberattack

SmartMarket Brief

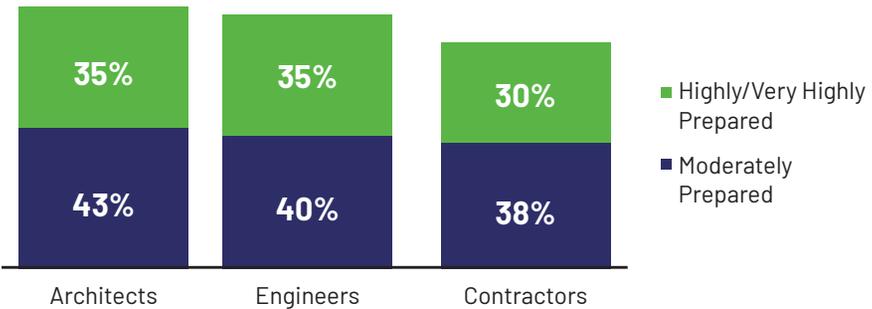
THE DESIGN AND CONSTRUCTION INDUSTRY NEEDS TO BE BETTER PREPARED FOR A CYBERATTACK

As shown at upper right, most respondents believe they are either moderately or highly prepared to manage if documents were no longer available due to a cyberattack. However, as the table at right shows, most say they can only go three to four days without significant impact to schedule. Since many cyberattacks can leave companies without data access for weeks, this disruption would have serious repercussions.

The chart below shows the differences by type of company, and by level of document access. As the latter makes clear, those with moderate or high levels of access are able to go longer without document access, suggesting that the more tech savvy are also taking steps to reduce their cyber risk.

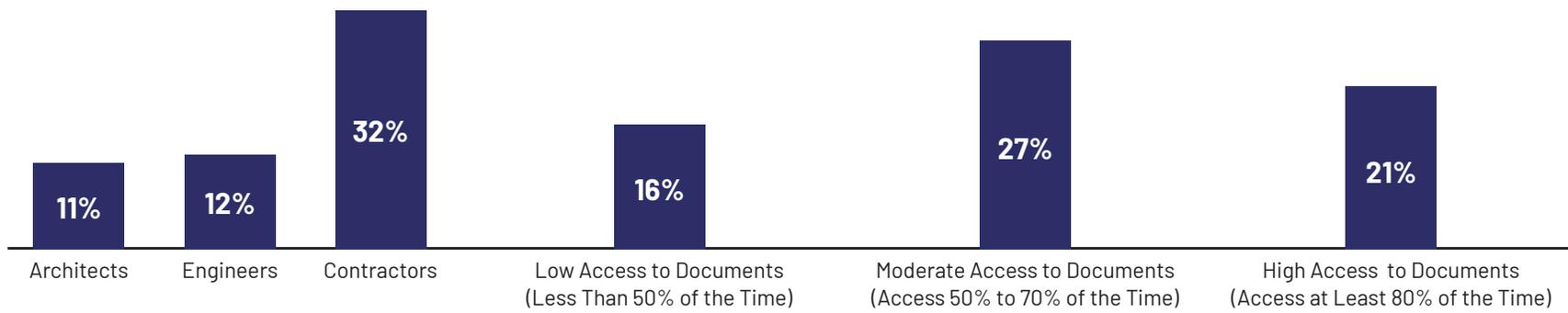
Prepared if Project Documents Were No Longer Accessible

Self-rated



Number of Days With No Access Before a Significant Impact to Schedule		
	Mean	Median
High/Very Highly Prepared	7.8 Days	3 Days
Moderately Prepared	9.1 Days	4 Days

Can Go More Than Five Days Without Access to Project Documents Without Significant Schedule Impact



Top Concerns About Loss of Access to Project Documents

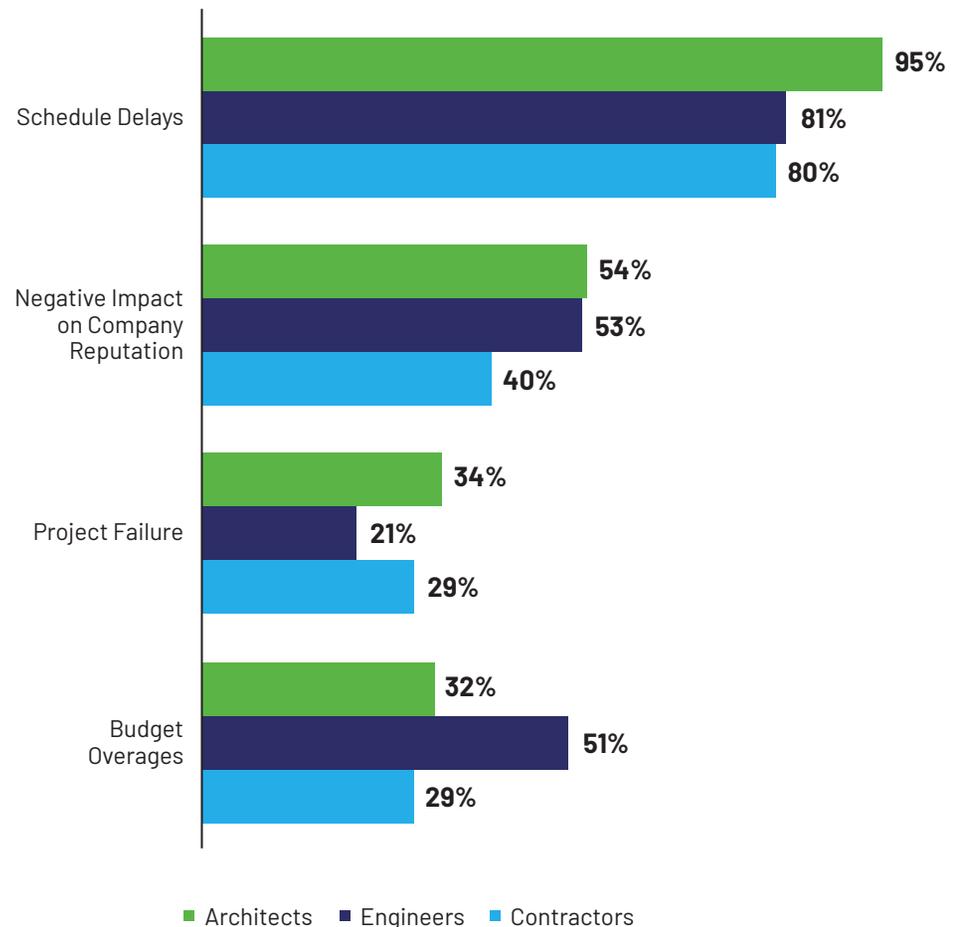
SmartMarket Brief

SCHEDULE DELAYS ARE THE TOP CONCERN ABOUT LOSING ACCESS TO PROJECT DOCUMENTS, BUT OVER ONE QUARTER ALSO ARE CONCERNED ABOUT PROJECT FAILURE

Respondents were asked to select their top concerns about losing access to project documents from the list of four options shown in the chart at right.

- Nearly all respondents, regardless of company type, regard schedule delays as a major concern.
 - A higher share of GCs(87%)select schedule delays than do specialty trade contractors(71%).
 - Contractors with higher levels of automation for their project and internal workflows(89%)select schedule delays more frequently than those with fewer automated workflows (76%).
- Negative impact on company reputation ranks third. This is not only due to project performance issues, but also, in the case of a ransomware attack, documents not meant for public knowledge can be released deliberately to harm a company’s reputation.
- While project failure may have the lowest share overall who pick it as a top concern, it is the most catastrophic option, so the fact that over one quarter select it suggests that many in the industry can imagine a high potential for serious consequences from a successful cyberattack. Among contractors, it is more frequently cited by individuals with direct project involvement (39%).
- Engineers are notably the most concerned group about budget overages.

Concerns About Losing Access to Project Documents



Cyberthreats and Attacks Recently Experienced

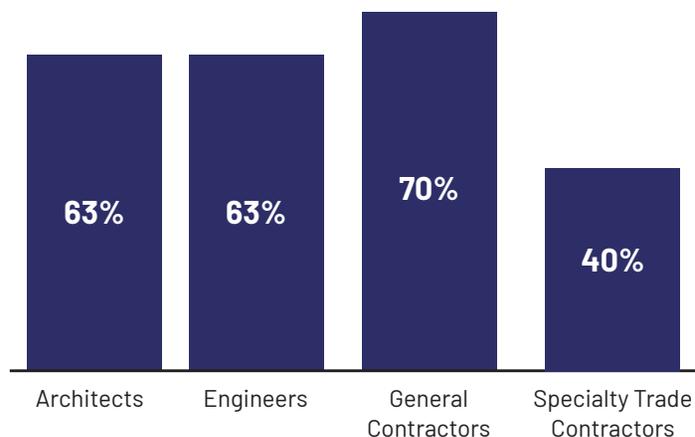
SmartMarket Brief

59% OF RESPONDENTS EXPERIENCED A SECURITY THREAT IN THE LAST TWO YEARS

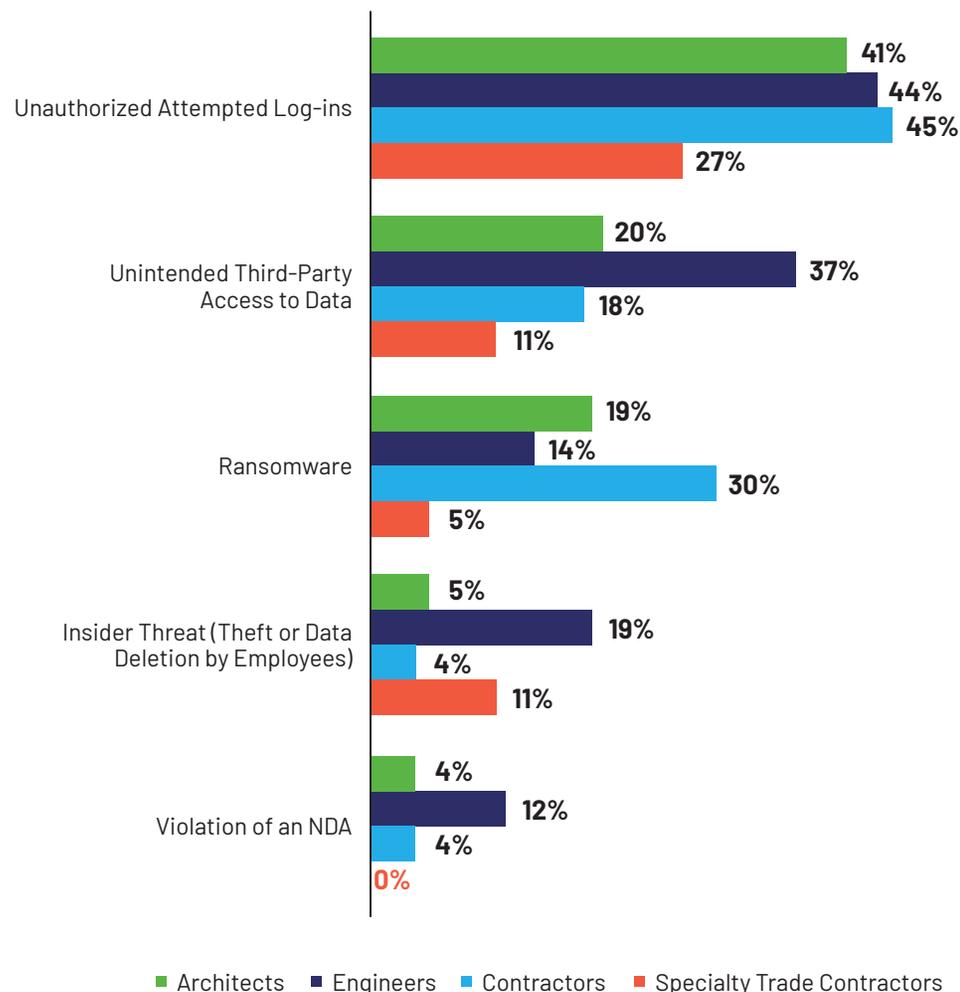
Respondents were asked whether they experienced any of the five security threats shown in the chart at right in the last two years, and 59% said that they experienced at least one threat.

- 30% of general contractors have experienced a ransomware attack, suggesting that they are prime targets for them.
- Unauthorized attempted log-ins are commonly reported.
- A high share of engineers also experience unintended third-party access to data.
- This data may underreport most of these threats, since they are just the ones respondents know about and many may not be aware of all the issues their company has experienced.

Experienced an Information Security Issue in the Last Two Years



Threats Experienced in the Last Two Years



Approaches to Mitigate Loss of Document Access

SmartMarket Brief

NEARLY ALL RESPONDENTS ARE TAKING SPECIFIC ACTIONS TO MITIGATE THE RISK OF LOSING ACCESS TO THEIR DOCUMENTS

Architects, engineers and contractors were asked to select what approaches they take to mitigate the risk of losing access to their documents. The chart at right shows their responses.

- Only 1% of respondents did not select at least one of these approaches. This may explain why so many rate their readiness for loss of access to their documents so highly.
- Backing up documents is by far the most common strategy.
 - It is nearly universal among architects and engineers, but somewhat less frequently used by contractors.
 - 89% of those with a high level of access to their documents back them up compared with 78% of those with moderate access and 72% of those with low access.

VARIATIONS BY COMPANY TYPE

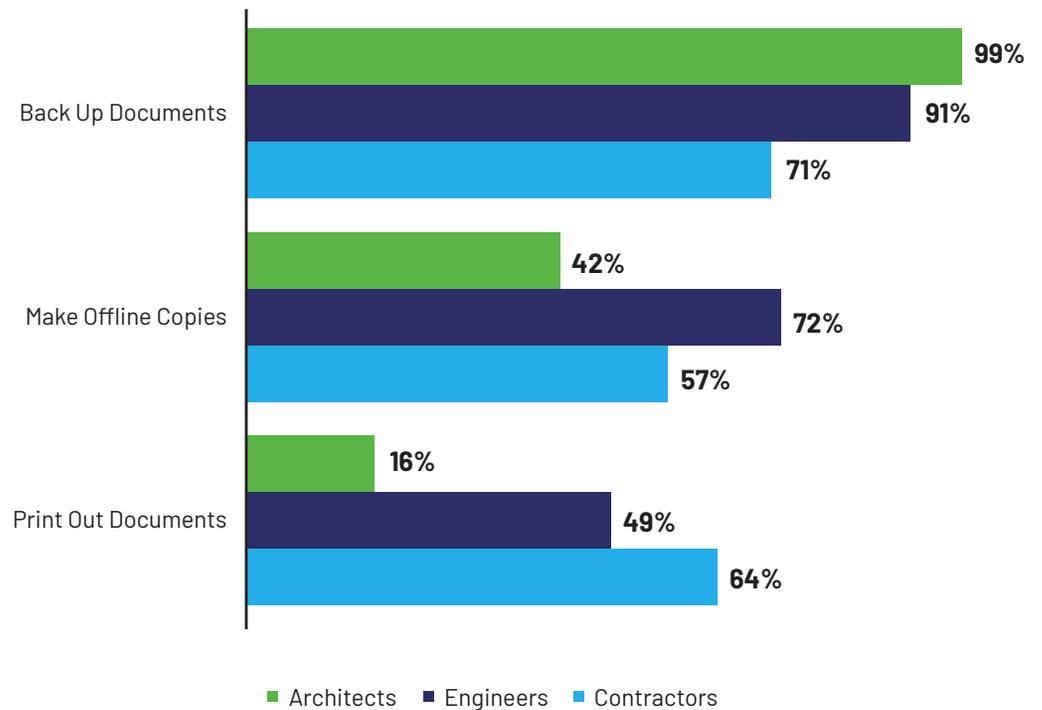
Engineers rely more frequently on making offline copies of their documents than do architects or contractors.

Contractors frequently rely on printed documents, but architects rarely do.

- Small contractors (86%) more frequently print out documents than do larger companies.
- Nonbuilding/civil contractors (79%) also print out documents more frequently than their peers.
- Those with a high access to documents less frequently rely on printing out documents (36%) than do those with low (53%) or moderate (56%) access.

Mitigation Approaches Currently Utilized for Loss of Document Access

By Type of Company



Required Security Practices From Software Companies

SmartMarket Brief

RELATIVELY FEW AEC COMPANIES REQUIRE DATA SECURITY MEASURES WHEN SELECTING SOFTWARE COMPANIES

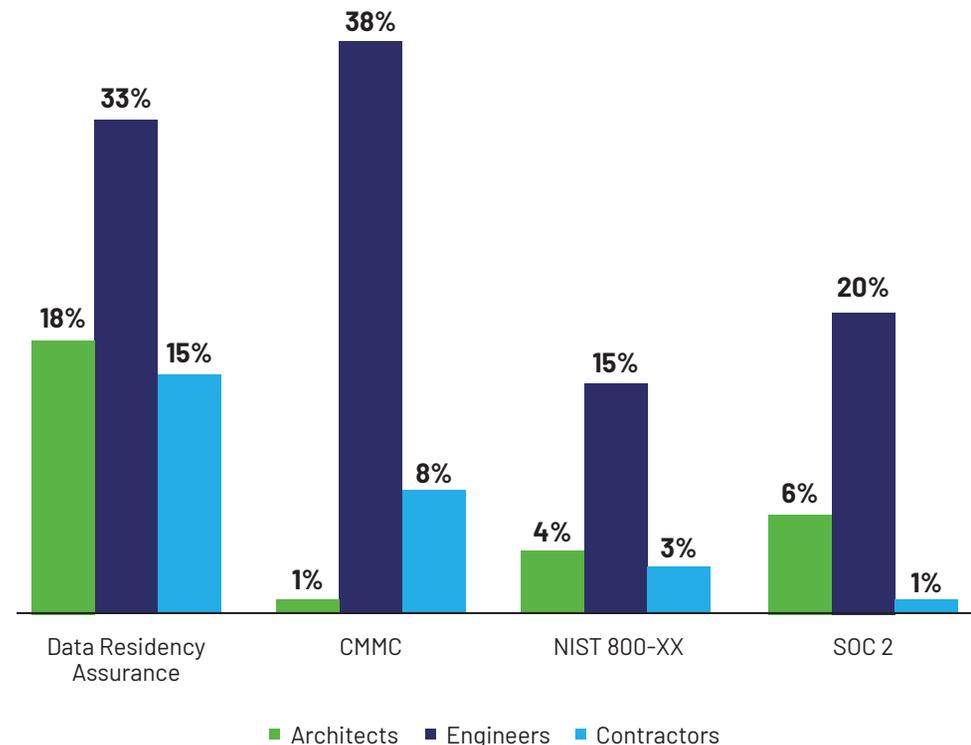
Architects, engineers and contractors were asked to select which, if any, of the four security practices shown in the chart at right they require of their software providers to be qualified for use when bidding on projects.

Notably, the majority (69%) require none of these options. Engineers are the exception: 33% of them have no requirements, compared with 78% of architects and 75% of contractors. Thus, it is not surprising to see that engineers require each measure more than do architects or contractors.

- **DATA RESIDENCY ASSURANCE:** Once data is in the cloud, it can be stored anywhere. However, countries have varying rules regarding data security, and knowing where a company's specific data actually resides will provide more insight into the type of security that can be expected of the vendor. While this is the most common requirement of architects and contractors, only a small share of each require it.
- **NIST 800:** The NIST 800 series of special reports includes guidelines for cybersecurity that are generally referred to simply as NIST 800. Even among engineers, these are rarely required, and only a tiny share of architects and contractors do so.
- **CMMC:** CMMC is a certification program that measures compliance to the NIST 800 guidelines. This is more widely required by engineers than NIST 800.
- **SOC 2** is a report that provides information about data security, availability, processing integrity, confidentiality and privacy created by the AICPA, and is also still emerging in use in the design and construction industry.

Security Practices Required for Software Companies to Be Qualified to Use When Bidding on Projects

By Type of Company



Managing Cyber Risks

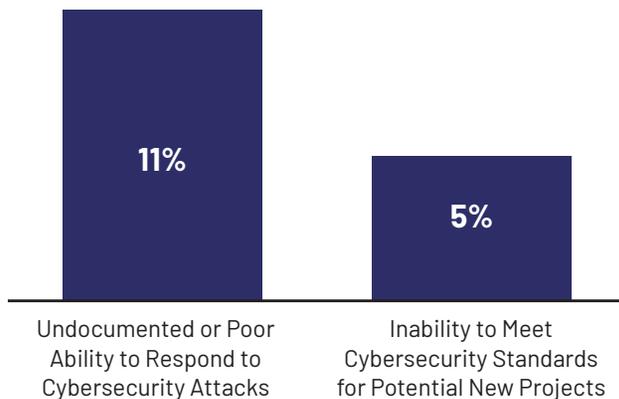
SmartMarket Brief

MOST DO NOT EXPECT CYBER RISKS TO HAVE A MAJOR IMPACT ON THEIR BUSINESS

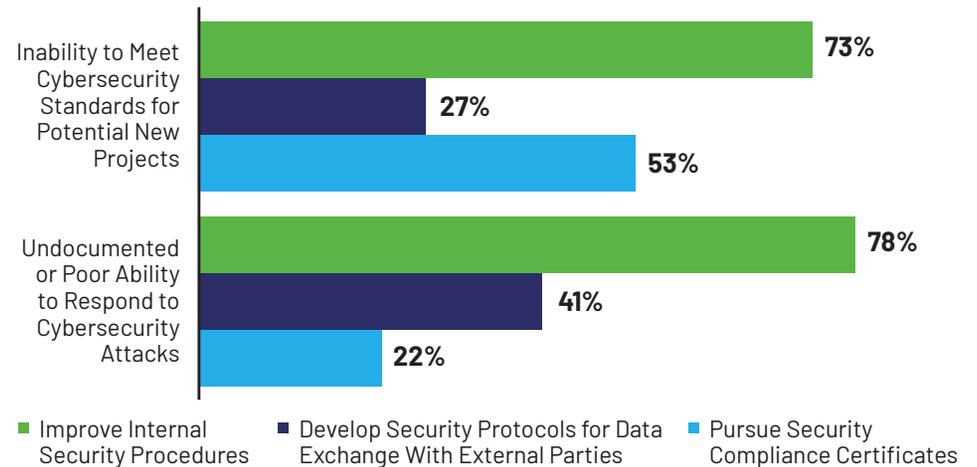
The two cyber risks shown in the chart below and at upper right were part of a larger question about risks that may have a major business impact (see page 7). As the chart below makes clear, few architects, engineers or contractors consider them a serious risk.

The charts at right show the approaches used to mitigate these risks by type of company, along with the overall rating of the effectiveness of each approach. Promisingly, most of those who pursue security compliance certificates and improve their internal security procedures find these measures highly effective, suggesting that there are good options for the industry to effectively address these challenges.

Respondents Who Believe Cyber Risks Have a Major Impact on Their Business



Mitigation Strategies Used by Those Who Believe These Risks Have a Major Impact on Their Business



Share of Those Using These Approaches Who Consider Them Highly Effective*



*Since none of these methods are widely used, only 13, 30 and 15 respondents, respectively, were asked to rate the effectiveness of each approach.

Workforce Resilience

INTRODUCTION

Architects, engineers and contractors face many risks, but currently, including in this study, challenges attracting and retaining talent are typically among the most prominent. Contractors have struggled with skilled worker shortages for over a decade, but architects and engineers have recently begun to find it difficult to staff their projects consistently as well. For architects, in particular, staffing issues are the top risks they cite with a major impact on their business.

Individual companies cannot solve this problem, but they can utilize other approaches to lessen its impact. As the findings in this section reveal, application of technology can be one means of dealing with this challenge.

TOPICS ADDRESSED IN THIS SECTION

- **DIFFICULTY FINDING EMPLOYEES:** The degree to which they struggle to find qualified employees and the share who believe that the inability to attract talent has a major impact on their business.
- **MEANS TO ATTRACT STAFF:** The utilization and effectiveness of five approaches to attracting new employees to their companies.
- **DIFFICULTY RETAINING EMPLOYEES:** The degree to which they struggle to retain employees and the share who believe that the challenge of retaining talent has a major impact on their business.
- **MEANS TO RETAIN STAFF:** The utilization and effectiveness of eight ways that they seek to retain employees.
- **TECHNOLOGY STRATEGIES TO ATTRACT AND RETAIN EMPLOYEES:** The degree of utilization and effectiveness of three ways in which technology can help minimize the risks created by difficulty in attracting and retaining employees, and the degree to which they believe that their use of technology and digital workflows helps them to retain staff.



Finding Skilled Employees

SmartMarket Brief

THE CHALLENGE OF FINDING QUALIFIED EMPLOYEES IS WIDESPREAD IN THE DESIGN AND CONSTRUCTION INDUSTRY

Architects, engineers and contractors were asked to rate the difficulty of finding qualified employees on a five-point scale that ranged from no difficulty to very high difficulty. As the chart at right reveals, most of them find it moderately to highly difficult to find workers.

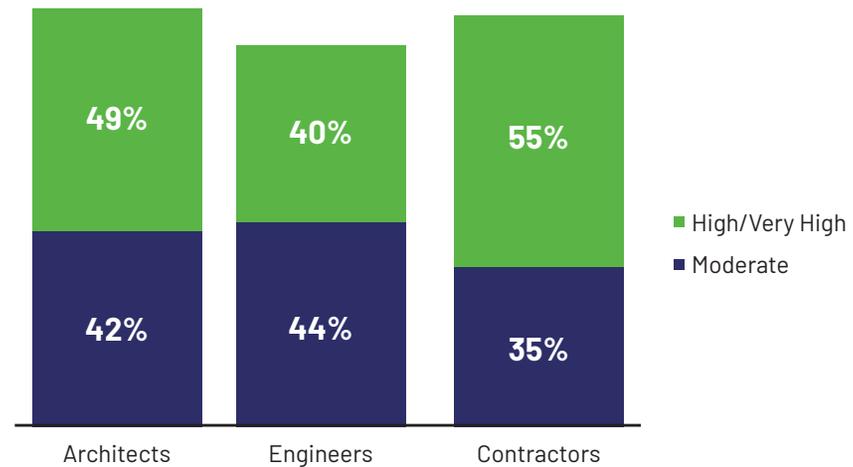
- Contractors most frequently report high or very high difficulty, at 55%.
- 49% of architects agree. Senior management at architectural firms are particularly concerned about this, with 65% selecting high or very high.
- Engineers are slightly lower, but with 84% reporting this challenge at a moderate or higher level, it is still clearly a concern for many.

ARCHITECTS ARE MOST CONCERNED ABOUT THE BUSINESS RISKS POSED BY THEIR INABILITY TO ATTRACT TALENT

The challenge of attracting talent was included in the list of potential business risks that the respondents were asked about (see page 7). Architects are far more concerned about this risk than are contractors or engineers. While the data above suggests that engineers struggle slightly less to find workers, the lower level of concern reported by contractors is surprising. One factor that may influence this is that contractors have been facing this challenge for over a decade and may have more strategies in place to manage it.

Difficulty Finding Qualified Employees When Needed

By Type of Company



Inability to Attract Talent Has a Major Impact on Their Business



Approaches to Attract Skilled Employees

SmartMarket Brief

OFFERING COMPETITIVE SALARIES AND BENEFITS IS THE TOP APPROACH CURRENTLY USED TO ATTRACT SKILLED EMPLOYEES

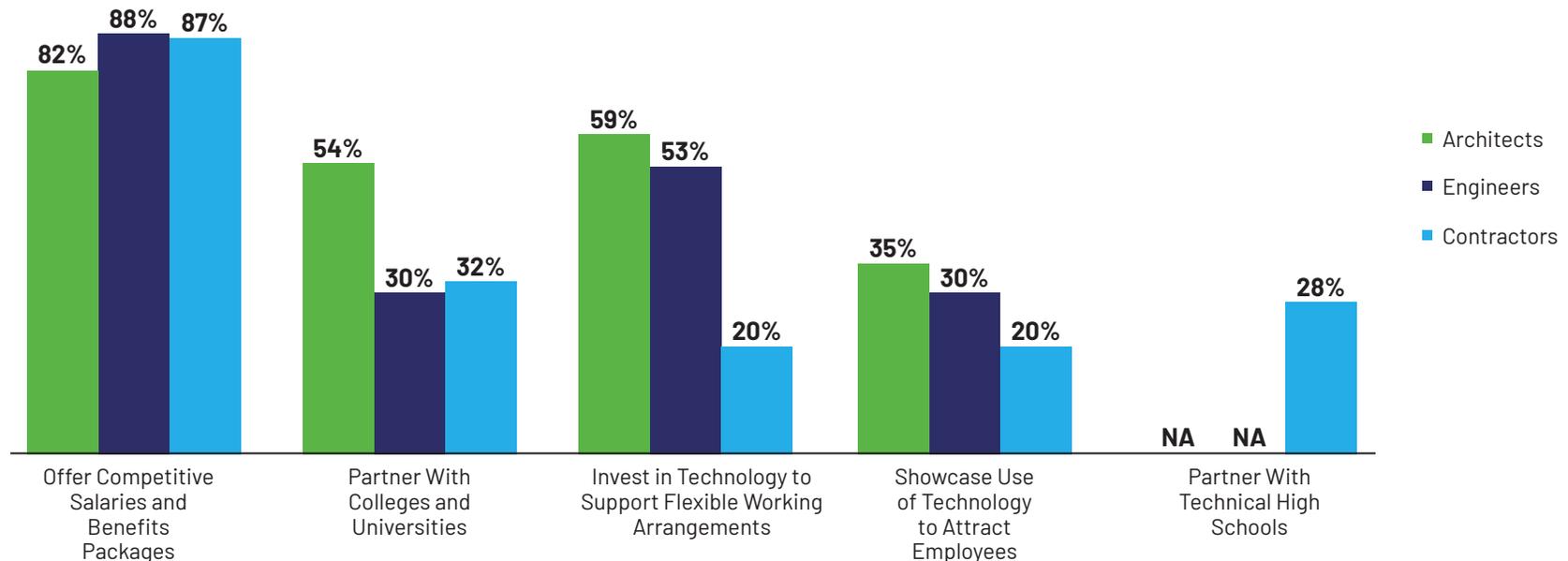
All respondents were asked how many of the four options shown in the chart they are using to attract skilled employees. Contractors were also asked about partnering with technical high schools.

- Offering competitive salaries and benefits packages tops the findings.
- Architects are far more likely to partner with colleges and universities than are engineers or contractors. However, this is a very common approach at large contractor firms, selected by 61%, and it is more frequently used by general contractors (46%) than by specialty trade contractors (16%). 37% of large

contractors also partner with technical high schools, far more than smaller companies, although this is a less common strategy overall than partnering with colleges and universities.

- More than half of the architects and engineers are making investments in technology to support flexible working arrangements, but far fewer contractors select this. Even among large contractors, it is only utilized by 32%.
- While contractors in general are less likely to showcase their use of technology than are architects or engineers, 41% of large contractors report that they do so. This makes sense since most DCN research on technology use among contractors shows that large contractors are more invested in technology.

Approaches Currently Used to Attract Skilled Employees



Approaches to Attract Skilled Employees CONTINUED

SmartMarket Brief

OTHER APPROACHES

Respondents could also write in other means they use beyond the list of options included in the survey. A few architects and contractors both cite using recruiters, and some architects also said that they promote their workplace culture.

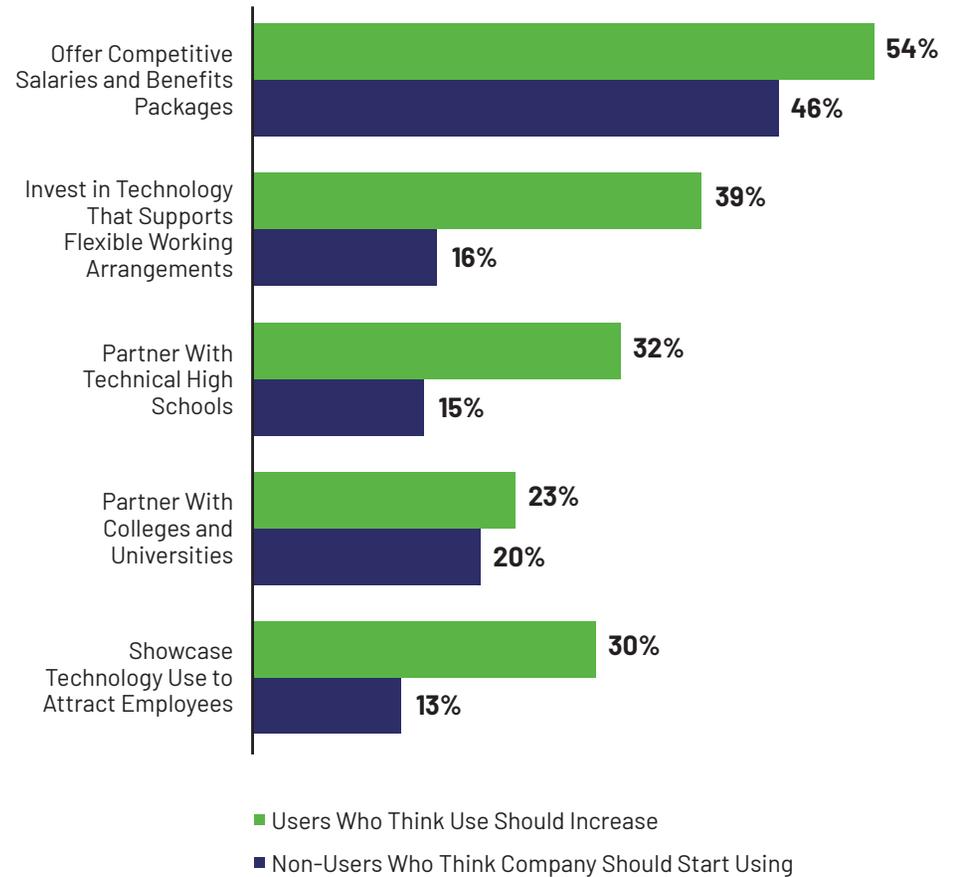
MANY WHO USE THESE STRATEGIES BELIEVE THAT MORE ENGAGEMENT WITH THEM WILL HELP ATTRACT SKILLED EMPLOYEES

Those who use any of the approaches to attract workers were asked if they think the use of these approaches at their company should increase, and those who do not currently use them were asked if they believe their company should start doing so.

A much higher percentage of those using these strategies believe that they should be used more than non-users who think they should be adopted. That suggests that non-users may be underestimating the value of these approaches. This is particularly true for investments in technology that support flexible working arrangements, partnering with technical high schools (for contractors only) and showcasing technology use to attract employees.

Approaches That Should Be More Widely Used to Help Attract Skilled Employees

According to Those Currently Using Them and Non-Users



Using Technology to Minimize the Risks Created by Issues With Finding Skilled Employees

SmartMarket Brief

INCREASING AUTOMATION IS LEAST FREQUENT BUT MOST EFFECTIVE TECHNOLOGY-BASED APPROACH

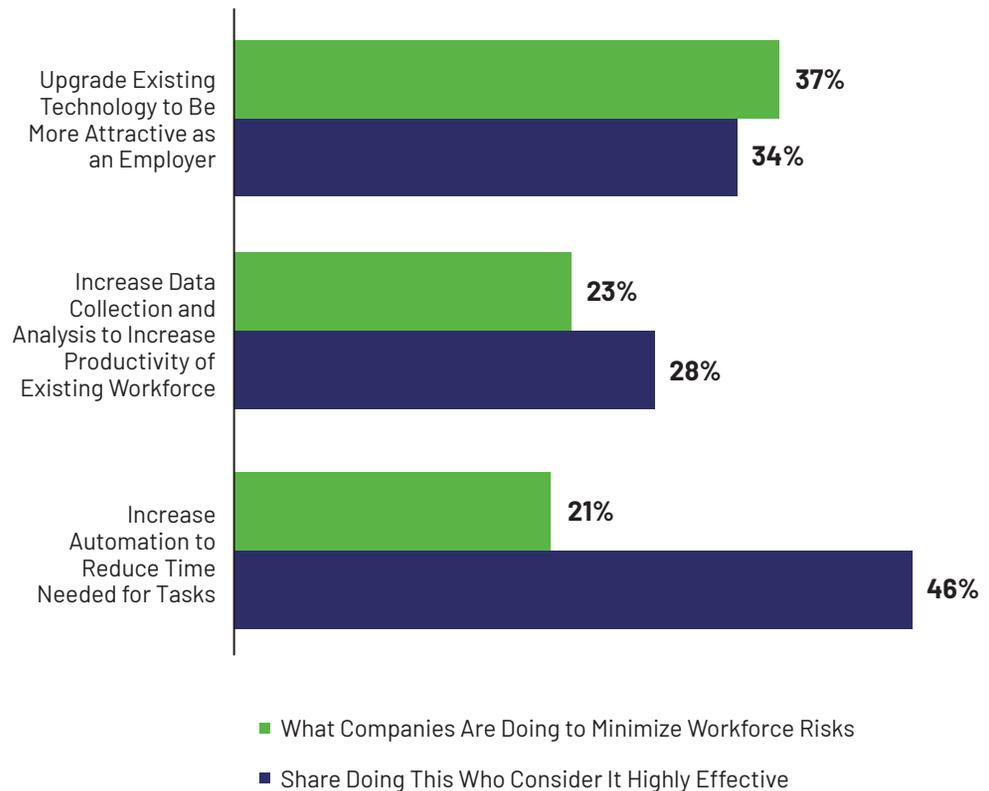
Architects, engineers and contractors who consider the inability to attract talent to their organization to have a major impact on their business (see page 31) were asked whether they use three technology-based approaches to help them minimize that risk. Those using each approach were asked to rate its effectiveness on a five-point scale from none to very high. The chart at right shows the findings from these two questions.

- None of these approaches are widely utilized, ranging from 21% to 37% of respondents using them. This suggests that the use of technology to address these risks is still emerging in the design and construction industry.
- Notably, nearly half of those who increase automation to reduce the time needed for tasks find this to be a highly effective strategy, which does suggest the potential for this approach to be far more widely utilized than it currently is.
- Most of those who are upgrading existing technology or increasing their data collection and analysis to improve productivity regard these as moderately useful strategies. In fact, far more rate them as highly effective (34% and 28%, respectively) than consider them to have little to no effect (16% and 20%, respectively).

These findings suggest that the design and construction industry is just beginning to tap the potential of technology to help mitigate the challenges of employee recruitment.

Utilization and Effectiveness of Technology to Address the Risk of Finding Skilled Employees When Needed

According to Those Who Consider That Challenge a Risk to Their Business



Retaining Skilled Employees

SmartMarket Brief

RETAINING EMPLOYEES IS LESS OF A CHALLENGE THAN RECRUITMENT, BUT A MAJORITY STILL CONSIDER IT AT LEAST MODERATELY DIFFICULT

Architects, engineers and contractors were asked the same questions about retaining skilled employees as they were about recruiting new ones. The first question was about the difficulty they are experiencing in retaining workers. As the chart at right reveals, this is a notable challenge for all, even though it is less difficult than finding new people to recruit.

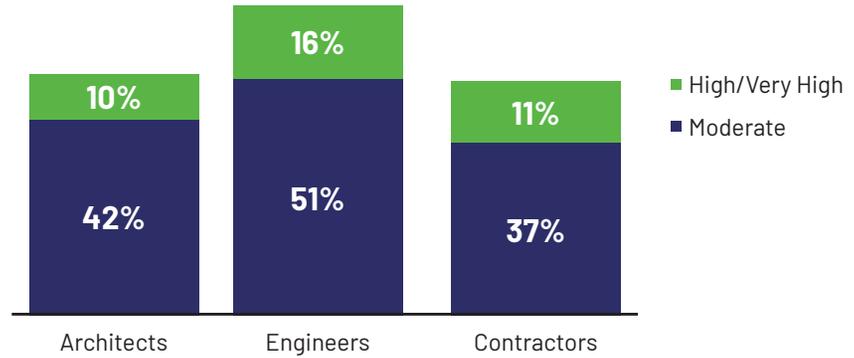
- Engineers reported the lowest level of difficulty in finding new staff compared with architects and contractors (see page 31), but they experience the biggest challenges with retention.
- Contractors have the lowest share experiencing at least a moderate difficulty retaining workers, which again is the reverse of the findings on recruitment.

MORE ARCHITECTS FIND THAT DIFFICULTY IN RETAINING TALENT HAS A MAJOR IMPACT ON THEIR BUSINESS THAN DO ENGINEERS OR CONTRACTORS

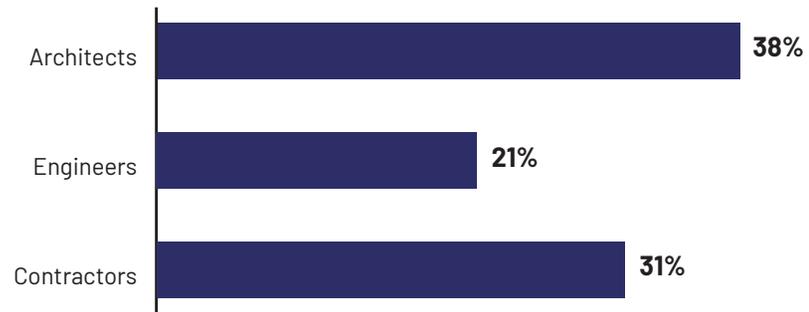
This finding is particularly surprising, given the larger share of engineers whose companies struggle with retention. It is likely due to the lower concerns engineers have about recruiting new workers. Notably, there are no significant differences by size or company or type of contractor in the responses to this question.

Degree of Difficulty Retaining Skilled Employees

By Type of Company



Difficulty Retaining Talent Has a Major Impact on Their Business



Approaches to Retain Skilled Employees

SmartMarket Brief

CREATING A POSITIVE WORK ENVIRONMENT IS WIDELY RECOGNIZED AS A TOP MEANS OF RETAINING EMPLOYEES

Respondents were asked to select all the methods they use to retain employees from the list of eight options shown in the chart at right. As that chart reveals, some approaches appeal equally to all three groups, while others vary between them.

CURRENT USE OF APPROACHES TO RETAIN EMPLOYEES WIDELY USED BY ALL RESPONDENTS

Over three quarters of the respondents agree that their company is creating a positive work environment to help with employee retention. Notably, contractors in particular regard this as important, perhaps due to the challenges they face attracting skilled workers.

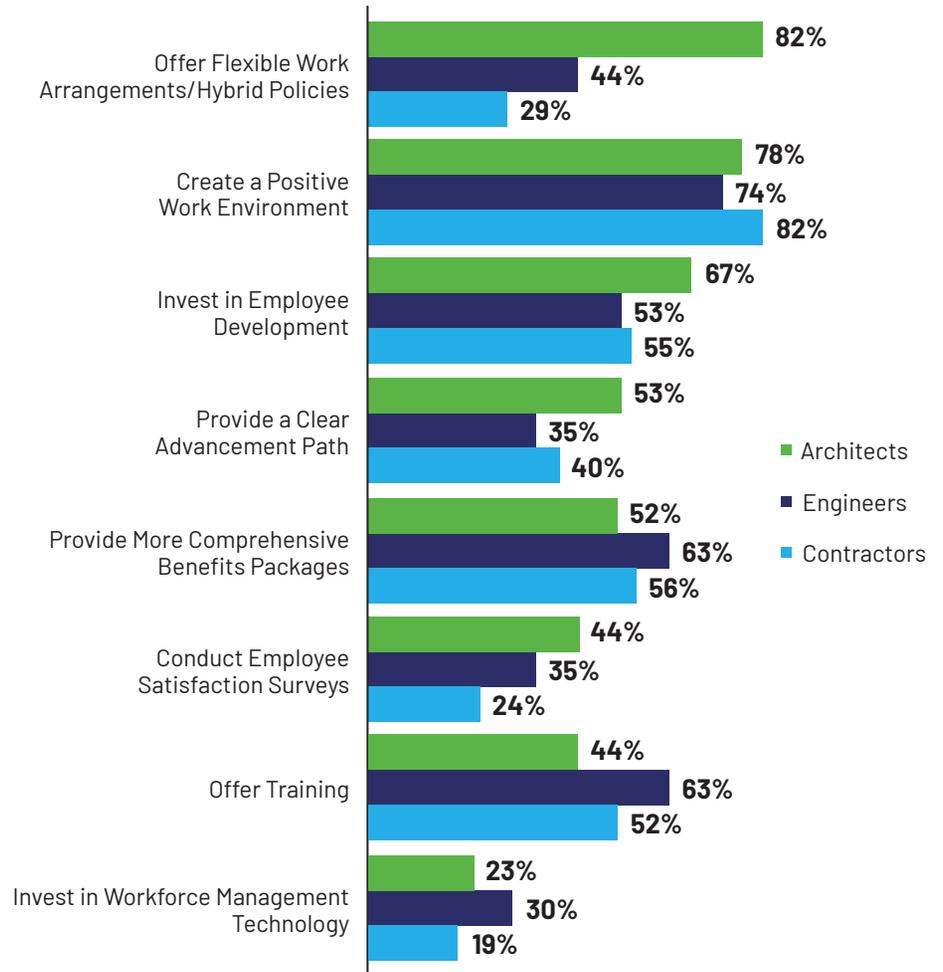
The other factor that is recognized widely by all three is providing a more comprehensive benefits package, to make sure their company is competitive.

VARIATIONS BY COMPANY TYPE

- **ARCHITECTS:** Architects are using more approaches to retain employees overall than are engineers and contractors. They more frequently offer flexible work arrangement/hybrid policies, invest in employee development, provide a clear path for advancement and conduct employee satisfaction surveys than do contractors or engineers. This correlates directly to the degree to which they are concerned that difficulty retaining talent has a major impact on their business (see page 35).
- **ENGINEERS:** Engineers offer comprehensive benefits packages and training more frequently than do architects or contractors.
- **CONTRACTORS:** Contractors generally lag behind architects and engineers in terms of the approaches taken to retain employees, other than creating a positive work environment. Three other approaches

Approaches Employed to Retain Employees

By Type of Company



Approaches to Retain Skilled Employees CONTINUED

SmartMarket Brief

are used by more than half—providing more comprehensive benefits, investing in employee development and offering training—but even for these, the contractors are not leading the industry.

- Large contractors, though, are more engaged than smaller ones in three areas: 76% invest in employee development, 56% provide a clear path for advancement and 29% invest in workforce management technologies.

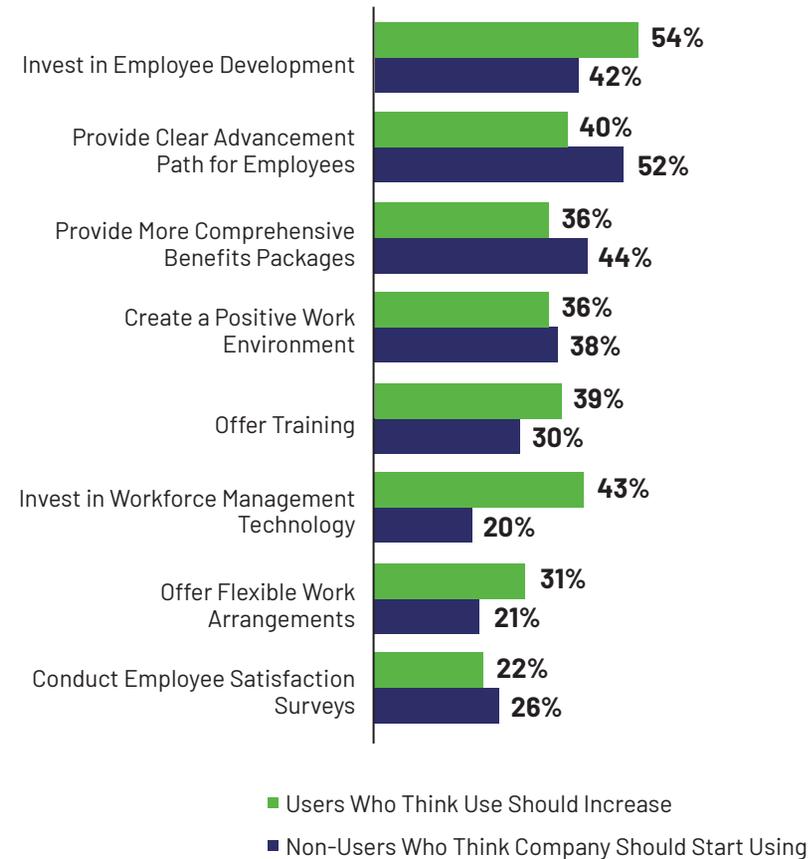
APPROACHES TO RETAINING EMPLOYEES THAT SHOULD BE MORE WIDELY UTILIZED

Those using various approaches were asked to select the ones they think should be increased in use, and those who do not use them were asked what they think their company should start using. The chart at right represents both groups.

- Generally, users and non-users both agree that investing in employee development is a top priority that should be more widely adopted in the design and construction industry.
- Those whose companies lack a clear advancement path for employees or have not recently provided a more comprehensive benefits package regard those as top priorities for investment.
- The only item that users prioritize more than non-users is investment in workforce management technology. That suggests that users are already seeing value and expect that greater investment would yield even more. This makes it likely that this approach in particular is underutilized currently.
- Generally, many of the responses are selected by about one third. This suggests that the industry is still determining which approach is likely to offer the most help in retaining employees.

Approaches to Retain Employees That Need to Be More Widely Utilized

According to Current Users and Non-users



Technology Strategies to Minimize Risks Created by Challenges in Retaining Skilled Employees

SmartMarket Brief

INCREASED AUTOMATION IS CITED AS A HIGHLY EFFECTIVE TECHNOLOGY STRATEGY FOR REDUCING THE RISK CREATED BY DIFFICULTIES IN RETAINING SKILLED EMPLOYEES

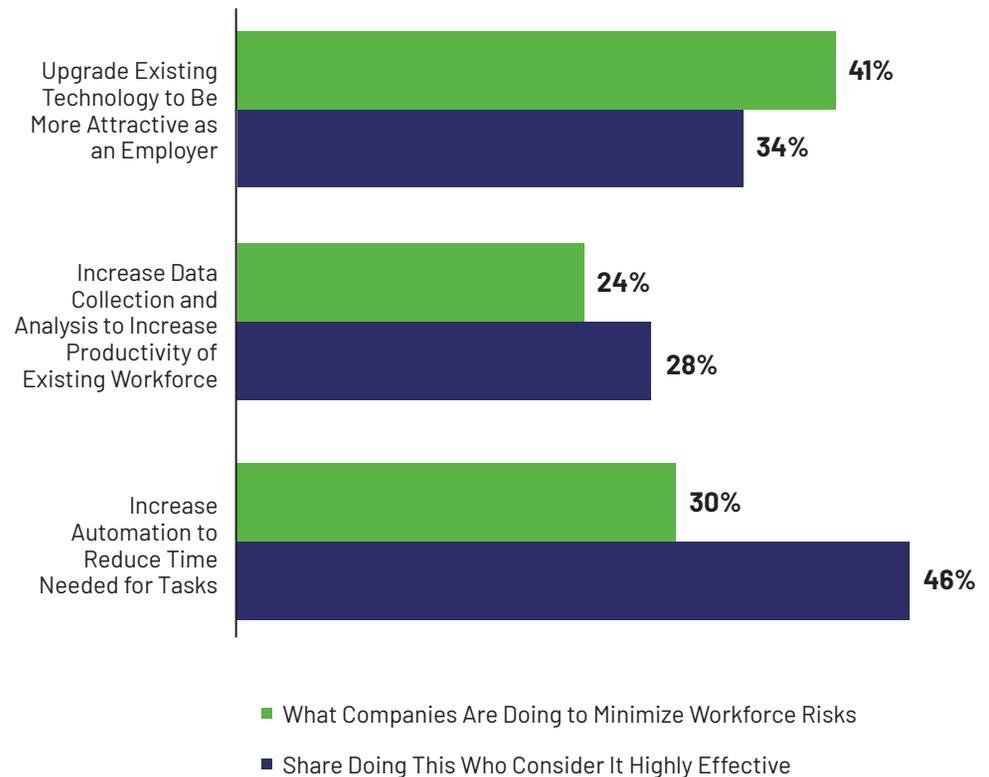
Architects, engineers and contractors who consider the challenge of not retaining enough skilled employees to be a major risk to their business (see page 35) were asked about three ways to utilize technology to help mitigate this risk. Those using them were also asked to rate their effectiveness, from ineffective to very highly effective.

These three approaches, shown in the chart at right, are the same ones that were shown to those who are concerned about the risk of finding new employees. Their responses are quite similar, both in the share using each and the degree to which users consider them highly effective approaches.

- The most widely used is upgrading existing technology to be more attractive as an employer, and about one third of those whose company makes those upgrades consider this highly effective in helping them retain employees.
- Nearly half of those whose company has increased automation to reduce time needed for tasks consider this an effective way to mitigate the challenges they face retaining employees. However, it is used by less than 30% of the respondents concerned about this challenge, which suggests that there is an opportunity for more to benefit from this approach.

Utilization and Effectiveness of Technology Strategies to Address the Risk of Not Retaining Enough Skilled Employees

According to Those Who Consider That Challenge a Risk to Their Business



Contribution of Technology Use to Employee Retention

SmartMarket Brief

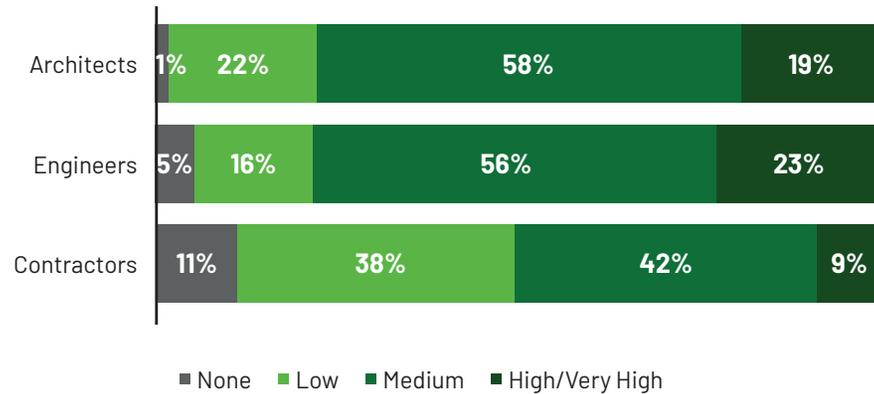
THE MAJORITY OF ARCHITECTS AND ENGINEERS BELIEVE THAT TECHNOLOGY USE AND DIGITAL PROCESSES CONTRIBUTE TO EMPLOYEE RETENTION

Architects, engineers and contractors were asked to rate the degree to which technology use and digital processes contribute to employee retention on a five-point scale from none to very high, and the results are shown in the chart at right. In addition, those who rated it high/very high are shown below by their level of technology engagement.

Most architects and engineers see at least a medium impact on their retention efforts from their technology deployment, but contractors are currently less certain. The chart below makes clear, though, that those who have invested in workflow automation and document access more frequently report a high impact on retention than those who have not.

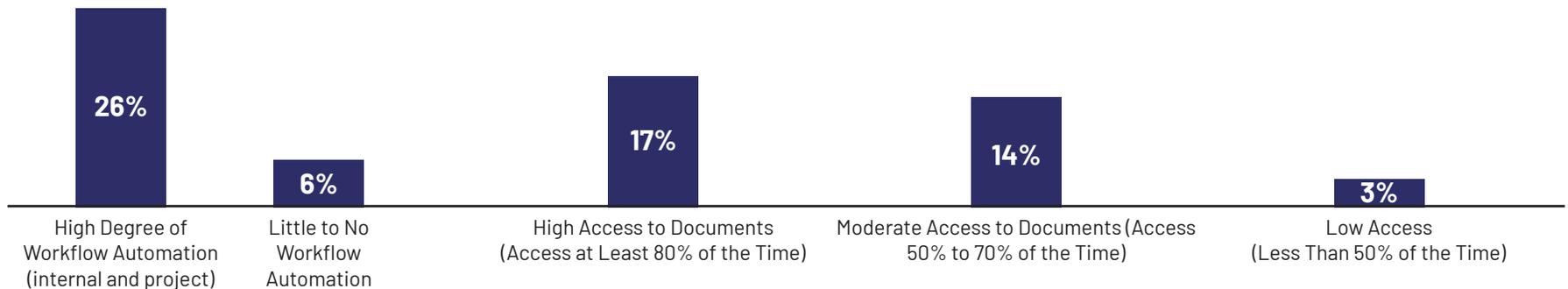
Degree to Which Technology Use and Digital Processes Contribute to Retaining Employees

By Type of Company



Company's Technology Usage and Digital Processes Make a High/Very High Contribution to Retaining Employees

By Level of Technology Engagement



Managing Market, Supply Chain and Technology Risks

SmartMarket Brief

INTRODUCTION

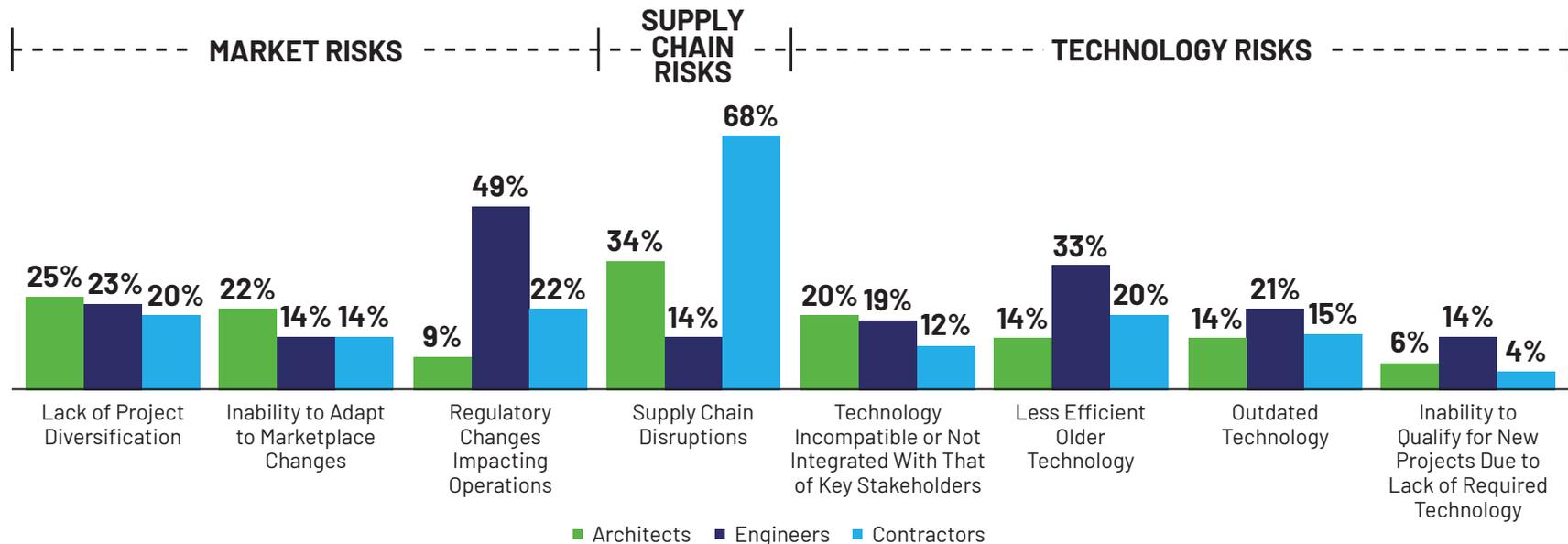
This section explores three additional types of risks: market risks, supply chain risks and technology risks. The share who consider specific aspects of those risks to have a major impact on their company are shown in the chart below.

OTHER TOPICS ADDRESSED IN THIS SECTION

- MEANS OF ADDRESSING THESE RISKS: The utilization and effectiveness of various means to help address these risks.
- TOP WAYS TO INCREASE BUSINESS RESILIENCE: A summary of the answers to an open-ended question asked of the respondents about the best ways to increase the resilience of their business.



Risks That Have a Major Impact on Their Company



Minimize Market Risks

SmartMarket Brief

ENGINEERS ARE HIGHLY CONCERNED ABOUT REGULATORY CHANGES AS A MARKET RISK

As shown in the chart on the previous page, half of the engineers cite concern about regulatory changes. It is also the top market concern for contractors although only 22% select it.

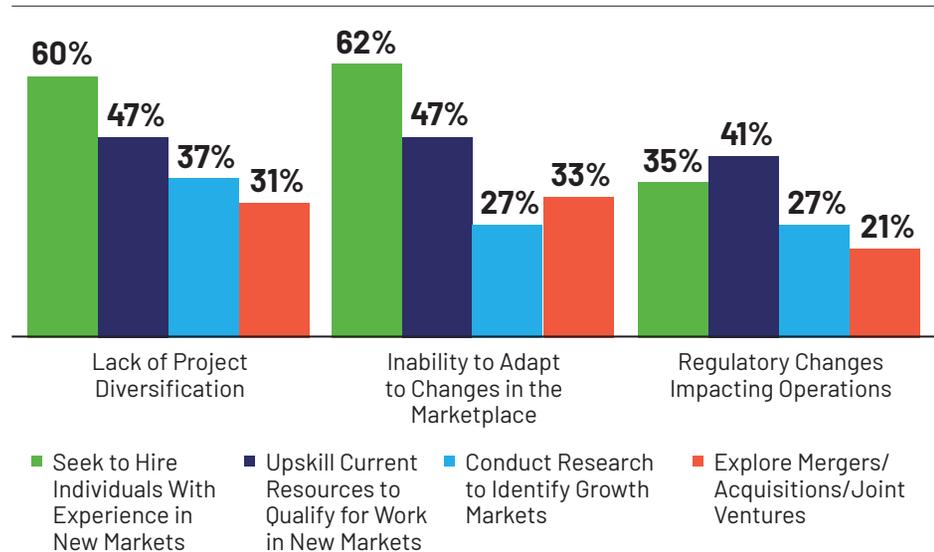
- Lack of project diversification is relatively evenly divided between architects, engineers and contractors.
- Architects are more concerned about their ability to adapt to marketplace changes than are engineers or contractors.

MOST OF THE STRATEGIES DEPLOYED TO MANAGE MARKET RISK ARE CONSIDERED AT LEAST MODERATELY EFFECTIVE

Those with concern about market risks were asked if they use any of the four strategies shown in the chart at upper right to address them. The chart at lower right shows their rating of relative effectiveness for the ones that they use.

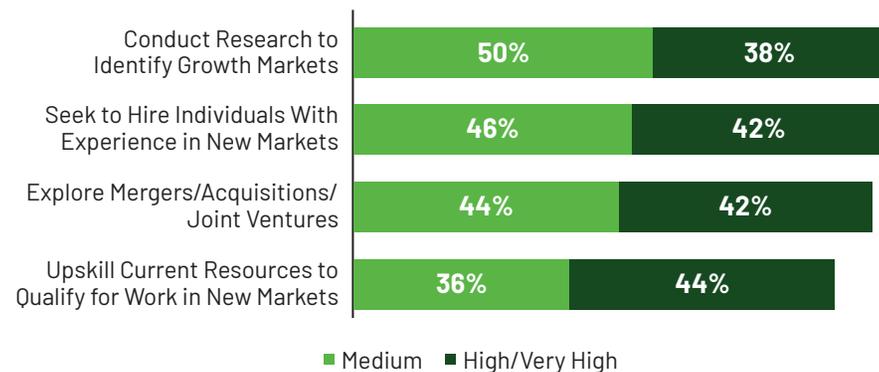
- Hiring individuals with experience in new markets is widely used to address lack of project diversification and the inability to adapt to changes in the marketplace.
- Upskilling current resources is also widely used for both of those challenges, and is the most widely used strategy to deal with regulatory changes.
- A large percentage of those using all four strategies consider them at least moderately effective, which suggests that the industry may benefit from more research to identify growth markets and more exploration of mergers, acquisitions and joint ventures.
- Surprisingly, upskilling current resources also has the highest share of users who rate it high/very high, but fewer who rate it moderately than the other options.

Means in Use to Minimize Market Risks



Effectiveness of Means Deployed to Manage Market Risks

According to Those Using Them



Minimize Supply Chain Risks

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MANY CONTRACTORS ARE CONCERNED ABOUT THE IMPACT OF SUPPLY CHAIN DISRUPTIONS ON THEIR BUSINESSES

As the chart on page 40 shows, over two thirds of contractors believe supply chain disruptions can have a major impact on their business. Over one third of architects agree, but engineers are less concerned. Contractors bear the brunt of rising costs in the supply chain, and for architects, such disruptions may cause poor substitutions or disgruntled clients.

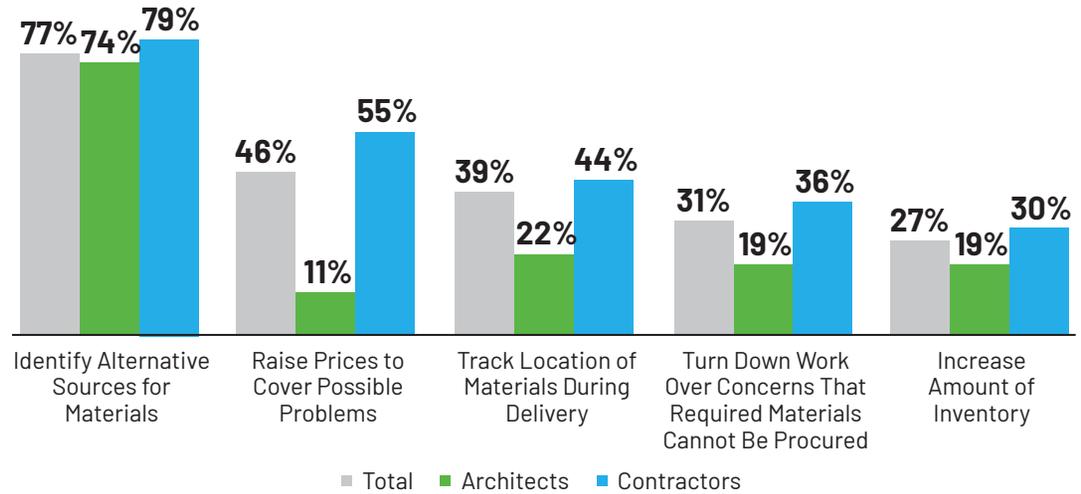
CONTRACTORS USE MULTIPLE STRATEGIES TO MINIMIZE SUPPLY CHAIN DISRUPTION RISKS

A high share of architects and contractors identify alternative sources for materials to minimize their supply chain disruption risks. This is clearly the top strategy, and it is rated as highly effective by over half of those who use it.

Raising prices to cover possible problems and turning down work is far more common among contractors than architects, but these also have the lowest share who consider them at least moderately effective at managing these risks.

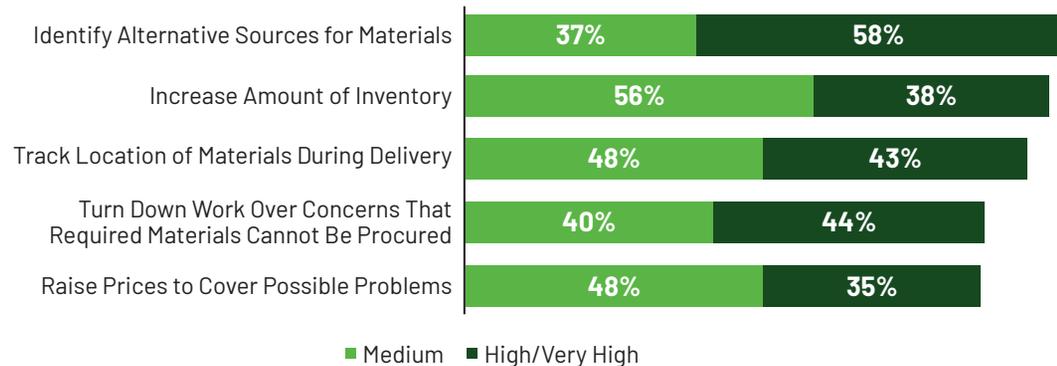
Contractors more frequently utilize the remaining approaches, which makes sense since they are directly responsible for getting materials to the jobsites. Increasing the amount of inventory is considered a moderately effective approach by many, but tracking the location of materials during delivery is noted by a bigger share of users as highly/very highly effective at addressing risk.

Approaches Currently Taken to Minimize Disruption to Supply Chains



Effectiveness of Approaches Used to Manage Supply Chain Risks

According Those Using Them



Minimize Technology Risks

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THE MOST EFFECTIVE MEANS OF MINIMIZING TECHNOLOGY RISKS IS THE USE OF CLOUD-BASED COLLABORATION SOLUTIONS

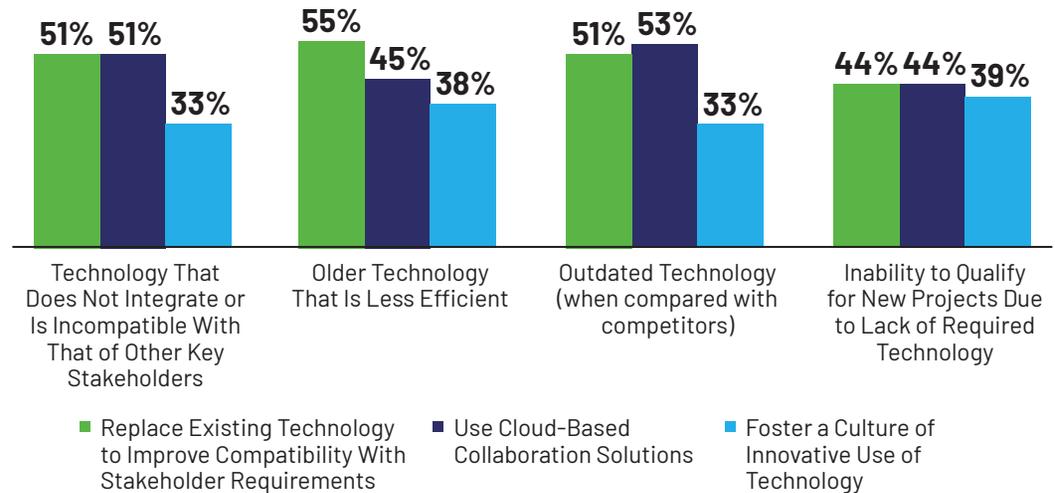
The chart on page 40 shows that largely, only a moderate share of architects, engineers and contractors are concerned about technology risks having a major impact on their businesses, with fewer than one quarter selecting any of these risks, except the engineers, who are concerned about their company using older technology that is less efficient.

However, as the chart at upper right reveals, many are nonetheless investing in upgrading their technology to improve compatibility with stakeholder requirements and in using cloud-based collaboration solutions. This may suggest that, rather than adopting these approaches to avoid negative outcomes related to technology, the industry is embracing them because of the opportunities they provide.

Promisingly, though, the users also find them effective at managing their technology risk, with nearly all giving medium or higher ratings. In particular, cloud-based solutions are seen by over half of those who use them as highly effective, a compelling argument for their use.

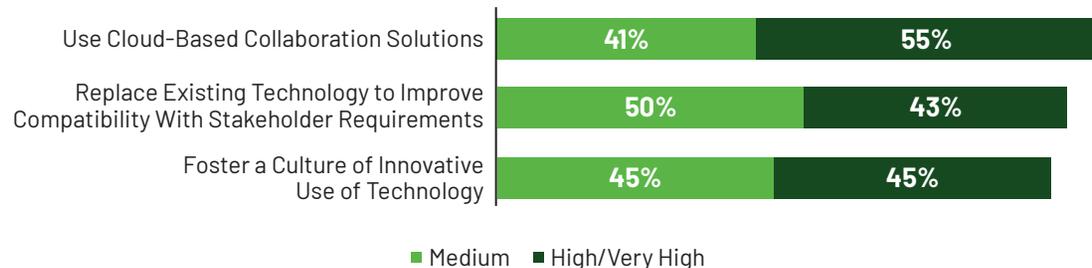
The findings also suggest that the industry has more to gain from fostering a culture of innovative use of technology. Those who have done so rate its effectiveness at mitigating risk very high, but it clearly lags in terms of implementation for many of the technology challenges in the study.

Means in Use to Minimize Technology Risks



Effectiveness of Approaches Used to Manage Technology Risks

According to Those Using Them



Increase Business Resilience

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AEC RESPONDENTS CONSIDER WORKFORCE, CLIENTS, TECHNOLOGY AND BUSINESS PRACTICES AS THE TOP WAYS TO INCREASE THEIR BUSINESS RESILIENCE

The final question of the survey was an open-ended prompt asking the architects, engineers and contractors to describe the top ways they increase their business resilience. Their responses were analyzed and put into the categories, shown in the ranked list at right.

- A well-skilled workforce is most frequently mentioned, either through recruiting, hiring or retaining the right talent, or through education of existing employees to make sure they can fulfill what is required.
- Next in importance is having a broad-based market. In addition, other market forces include better evaluation of the business landscape.
- Technology also ranks highly as a means to increase the resilience of their business. Improved cyber/data security also made it into the top nine items mentioned.
- Finally, there is recognition of the importance of having good processes and practices. These include business factors like using good business practices and how they select projects and partners, and processes like improved communication and collaboration.

Their unprompted comments echo the rest of the findings, and they provide an outline of the top areas that companies should actively evaluate to gauge their overall resilience.

TOP WAYS RESPONDENTS INCREASE BUSINESS RESILIENCE

- 1 Recruiting/Hiring/Retaining the Right Talent
- 2 Training/Education
- 3 Diversify Projects/Client Base
- 4 Stay Abreast of New Technology and Keep Current
- 5 Adopt Better Business Practices
- 6 Improve Communication/Processes/Collaboration
- 7 Be Vigilant/Evaluate Business Landscape Better
- 8 Improved Cyber/Data Security
- 9 Be More Selective in Project Decisions/Partners

Methodology

The purpose of this study is to provide insight into the experiences and perceptions of US architects, engineers and contractors regarding their data resiliency and how it impacts their business. Specific topics include access to project documents and information, cybersecurity, the risks associated with workforce challenges and the impacts of various business risks.

To examine this, an online survey was conducted from May 24 to July 3, 2023, among 279 architects, engineers and contractors. Respondents were recruited using the Dodge Architect and Contractor Panels and a third-party fieldwork vendor.

PROFILE OF RESPONDENTS

All respondents had to be located in the US and either be a senior manager, directly involved in projects, in HR/talent management, technology management or finance/accounting at their company. In addition, they had to meet an annual billings/project construction value revenue: \$3 million for architects, engineers and specialty trade contractors, and \$10 million for general contractors and construction managers.

The report includes analysis by the following groups:

- 79 Architects
- 43 Engineers (including those who work for companies that provide civil, structural, MEP and environmental services)
- 157 Contractors
 - 84 General Contractors/Construction Managers (Referred to as general contractors in the analysis for the sake of brevity)
 - 73 Specialty Trade Contractors

ANALYTICAL VARIABLES BY FIRM TYPE UTILIZED

A few analytical variables are used to consider the responses of architects and contractors. The sample size of the engineers did not allow for further divisions by these categories.

SIZE OF COMPANY

- Architects by Annual Billings
 - Small: Under \$10M
 - Midsize: \$10M to under \$50M
 - Large: \$50M or more
- Contractors by Annual Construction Value of Projects
 - Small: Under \$10M
 - Midsize: \$10M to under \$100M
 - Large: \$100M or more

CONTRACTORS' TYPE OF WORK

- Primarily engage in the construction of building projects (vertical construction): 123 respondents
- Primarily engage in nonbuilding projects (civil/horizontal construction): 33 respondents

LEVEL OF ENGAGEMENT WITH TECHNOLOGY

Two ways of looking at technology engagement are utilized in the analysis.

Automation of Workflows

- High/Very High Levels of Automation of Project Workflows With External Parties: 34% of all respondents (37% of architects, 47% of engineers and 29% of contractors)
- High/Very High Levels of Automation of Internal Workflows Between Functions: 43% of all respondents (49% of architects, 56% of engineers and 37% of contractors)
- **Access to Documents:** For more information of the responses that inform the analysis by access to documents, see page 10.

Contacts & Resources

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DODGE EDITORIAL TEAM

Stephen A. Jones leads Dodge Construction Network's Industry Insights Research division and is the primary author of this report. He is active in numerous industry organizations and frequently speaks at industry events around the world. Before Dodge, Jones was a vice president with Primavera Systems (now part of Oracle). Prior to that, he was principal and a Board of Directors member with Burt Hill, a major A/E firm (now Stantec). He holds a BA from Johns Hopkins and an MBA from Wharton. steve.jones@construction.com

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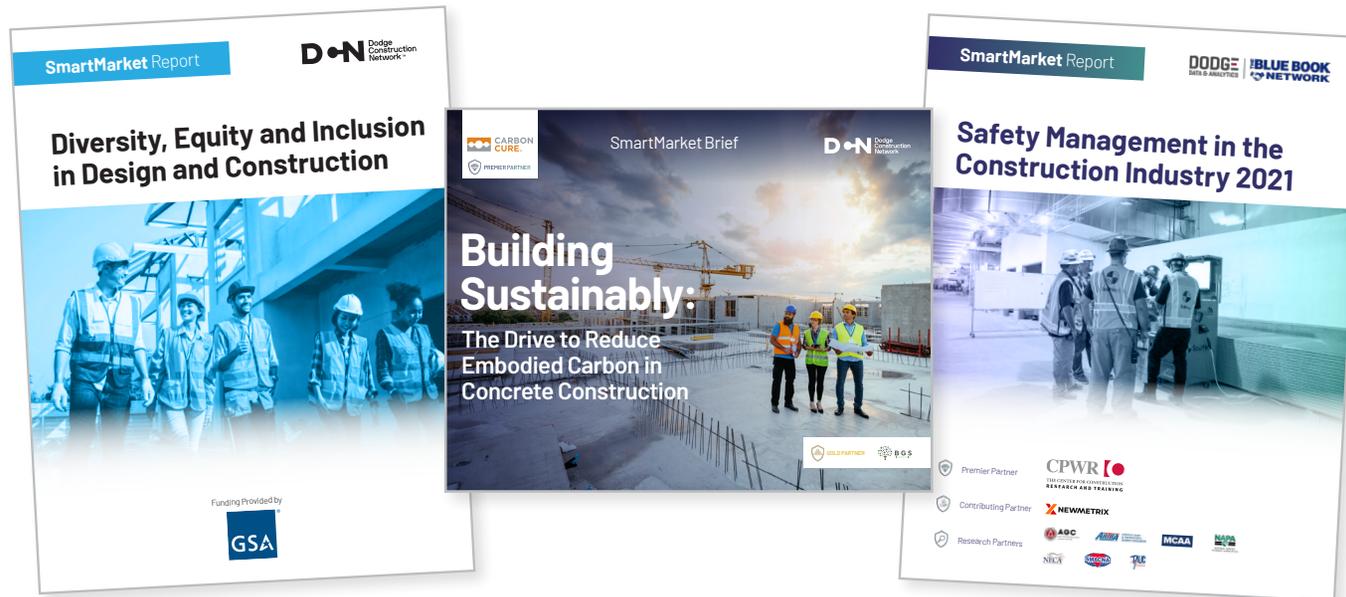
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