UNIVERSITY OF TORONTO

3rd Annual

BIM Report

2020 | A Benchmark of BIM use in Canada

torontoBIMcommunity

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AEC innovation lab

Contents

Foreword

The annual BIM survey is a collaborative effort between academia and industry to capture and illustrate the state of BIM implementation within the architecture, engineering, construction and facility management industries (AEC/FM) in Canada. It is conducted by the Building Innovation Research Centre at University of Toronto in collaboration with Residential Construction Council of Ontario (RESCON), Toronto BIM Community (tBIMc) and this year with AECO Innovation Lab. The effort was motivated by the lack of – and thus need for – an industry benchmark for BIM practices in Canada.

The first survey was published in 2018, involving 252 participants and 20 in-person interviews within the Greater Toronto Area (GTA). In 2019, with the assistance of local and national organizations such as CanBIM and BuildingSMART Canada, the scope of the second survey was extended to a national level and received 398 responses. The third survey was distributed through different channels – primarily tBIMc, CanBIM and social media – targeting professionals Canada-wide. However, participation was similar to the first survey in that it garnered only 222 responses.

Note that surveys were circulated primarily within the BIM community and hence, the analysis does not represent all AEC/FM industries in Canada. Although great efforts were made to advertise the survey throughout the industry – including promoting it at industry events,

in Daily Commercial News and targeted invitations to AEC firms – uptake by BIM non-users was minimal. The results of this report must therefore be considered from this viewpoint.

While the first two reports provided snapshot analyses, the current report combines the results of the past three years. It is focused on the overall state of BIM in Canada, and will serve as a benchmark. In addition, the combined dataset provides the opportunity to analyze participants by their characteristics, such as discipline or age, and interpret the results from their perspective. Such analyses were not possible from previous surveys, as there was not sufficient data to yield credible and generalizable conclusions.

Around the world, countries are integrating innovative BIM-based processes and analyses throughout their AEC/FM industry. Most, if not all, achieved this in a top-down approach through national mandates requiring BIM for all public and/or private projects. Canada remains the only G7 country without a national BIM mandate. Instead, the BIM momentum is being driven outward from the middle by the design community. As the visibility of BIM grows, the push upstream to owners and downstream to contractors is making evident the value of BIM processes and efficiencies. Governments and regulators are recognizing the potential for reducing time and red tape, and for improving process transparency. We anticipate that these annual reports will capture this revolution as BIM philosophies are embraced throughout the Canadian industry.

We would like to give special thanks to Claudia Cozzitorto and tBIMc board members for their invaluable assistance in preparing and distributing the survey, Richard Lyall and the RESCON membership for their financial support and for their assistance in data collection, and all of the participants and interviewees over the past three years for their time and valuable insights. Finally, the incredible support of the Natural Sciences and Engineering Research Council through Grant CRDPJ 530550-18 is gratefully acknowledged.

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Executive Summary

This report explored views about BIM from a range of professions in Canada over the past three years, and provides valuable documentation and benchmarking indicators of Canada's BIM transition progress and process. There were over 800 responses collected during this period.

The geographic distribution, demographics and background of the respondents, as well as characteristics of their organizations are detailed in the first section of the report. Industry professionals from Ontario accounted for 76% of respondents.

Awareness of, and familiarity with, BIM practices in the AEC industry continues to increase. Nearly all (99%) participants knew about BIM, and 82% were active BIM users. However, most surveys were circulated within the BIM community to respondents already using BIM in their organizations, therefore these numbers do not represent the rate of BIM adoption throughout the AEC/FM industries in Canada. Also, the report does not extensively reflect the viewpoint of those working in traditional practices that have not yet adopted BIM.

While 72% of respondents felt confident in their BIM knowledge, only 66% felt confident in their BIM skills. When compared to the 82% rate of BIM use, this reveals a need for more BIM training opportunities. Ninety per cent of participant organizations have adopted BIM in their current operational workflow, and 80% of the remainder indicated that they have plans to implement BIM in the next few years.

Sharing BIM files outside of the organization provides an indication of how BIM's potential as a collaboration and communication tool is being adopted by industry. Eighty-eight per cent of the participants shared their BIM files with at least one external organization, with one-third of participants engaging five or more parties. The benefits of BIM are greatly leveraged in a collaborative setting, and although a centralized model facilitates coordination, collaborative design can add complexity – nearly half of survey participants encountered interoperability obstacles in their projects. Despite the potential of OpenBIM to address this and allow for seamless collaboration, 43% of participants were not aware of OpenBIM and more than three-quarters had no experience using it. While significant improvements have been achieved for OpenBIM in recent years, 60% of participants acknowledged the need for an industry standard.

Ninety-four per cent of participants acknowledged that BIM is the future of project information and design practices. To accelerate this progress, however, steps need to be taken to remove barriers that hinder a broader implementation in the industry. Among those using BIM, lack of client demand and slow progress of industry toward BIM were two key barriers. For non-users, an industry-standard cost-benefit benchmark is needed. Such benchmarks can resolve doubts regarding the return on investment of undertaking the transition to using BIM and how, in the long run, BIM can bring cost efficiency and profitability.

Respondents and Organizations

Respondents and Organizations

The first survey targeted professionals in the province of Ontario and received 252 responses. In the second year, the expansion nation-wide attracted 398 participants with 30% from outside Ontario. The third year had 222 responses, 23% of which came from outside Ontario.

Figure 1 illustrates how the 872 total respondents are distributed across Canada. Overall, Ontario accounts for the majority of respondents (76%), followed by Alberta (8%), British Columbia (6%)

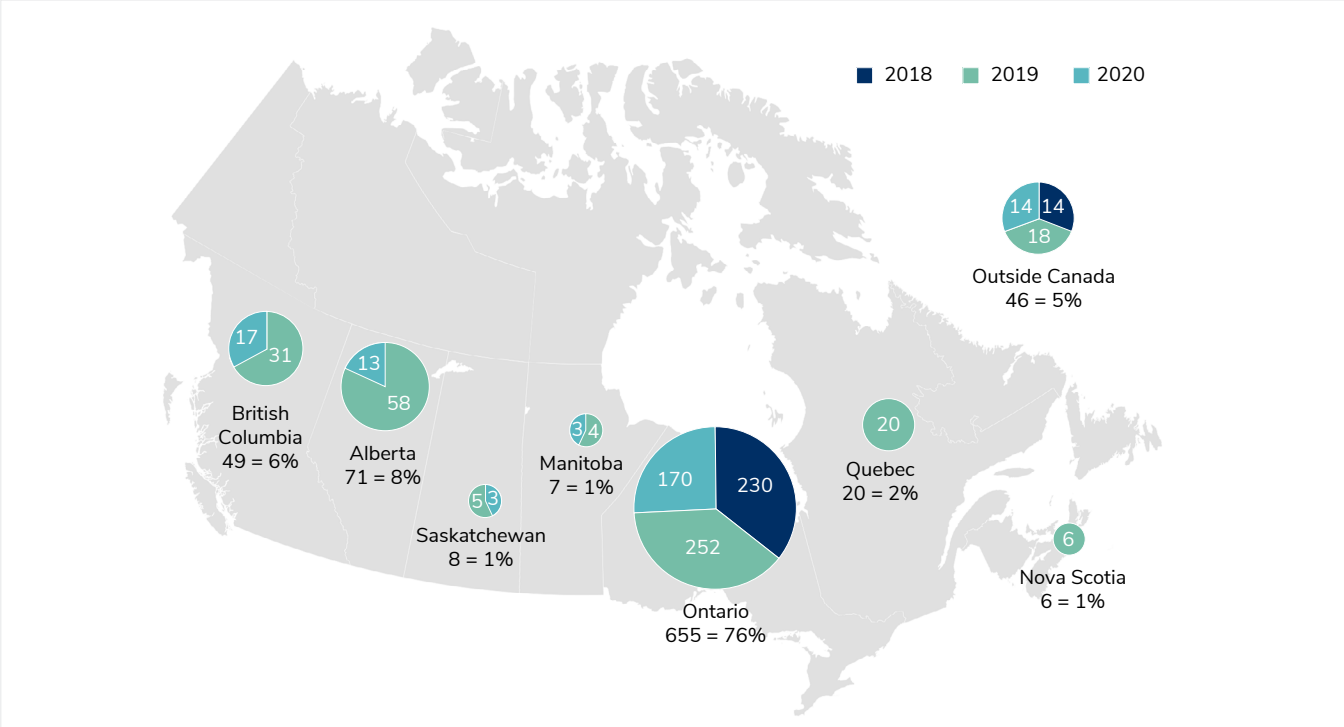


Figure 1. Survey's reach throughout Canada

and Quebec (2%). Few responses were collected from the provinces of Saskatchewan, Manitoba and Nova Scotia, and no participation was recorded from other Canadian jurisdictions. The survey attracted 46 participants from outside Canada.

Figure 2 shows the age distribution of respondents across the three years. Notably, more than half of the participants were under the age of 35. The age distribution of respondents within each province was consistent with the three-year national average.

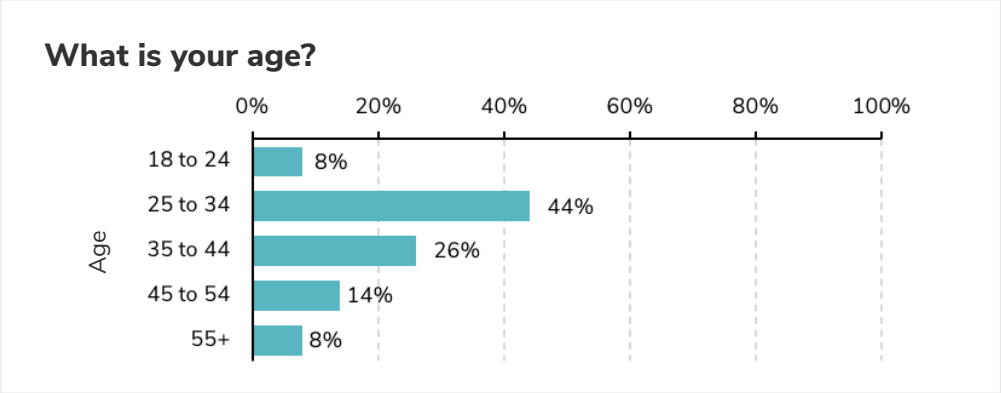


Figure 2. Distribution of respondents' age

Despite the high participation of young professionals in the survey, close to half (46%) of the participants had more than 10 years of experience in their discipline. This provided a unique opportunity to grasp the viewpoint of the younger generation of experienced industry professionals and acquire a deeper understanding of the future of BIM in Canada and its underlying processes, benefits and barriers of implementation.

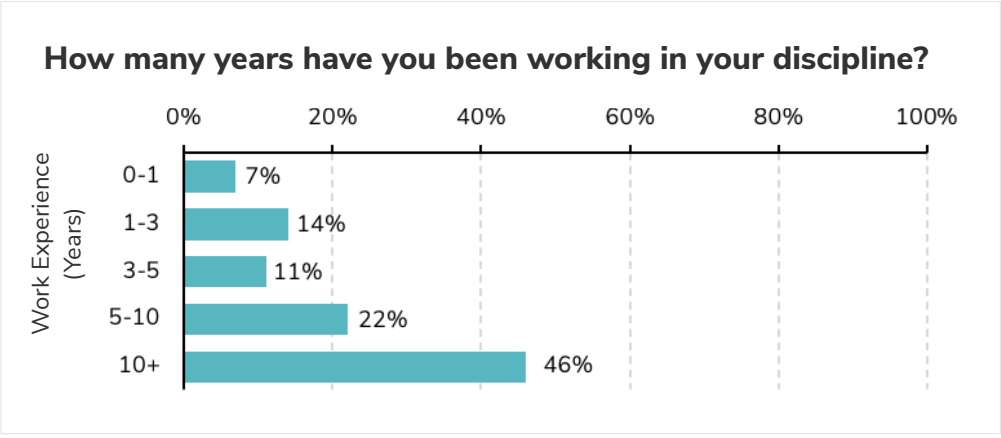


Figure 3. Respondents' years of work experience

The survey included professionals from a broad range of disciplines within the Canadian AEC/FM industries. As shown in Figure 4, 38% of participants are involved in architecture, including architects, architectural technologists and interior designers. BIM specialization was the second most represented discipline at 30% of participants, comprised of BIM technicians/specialists, BIM coordinators/managers, and virtual design and construction (VDC) coordinators/managers. This is followed by engineering, including civil, structural, and mechanical engineers, and construction, including project coordinators/managers, contractors and estimators, each accounting for 10% of participants. The remaining 12% worked in other disciplines such as education, visualization, facility management, manufacturing, real-estate, software development and law.

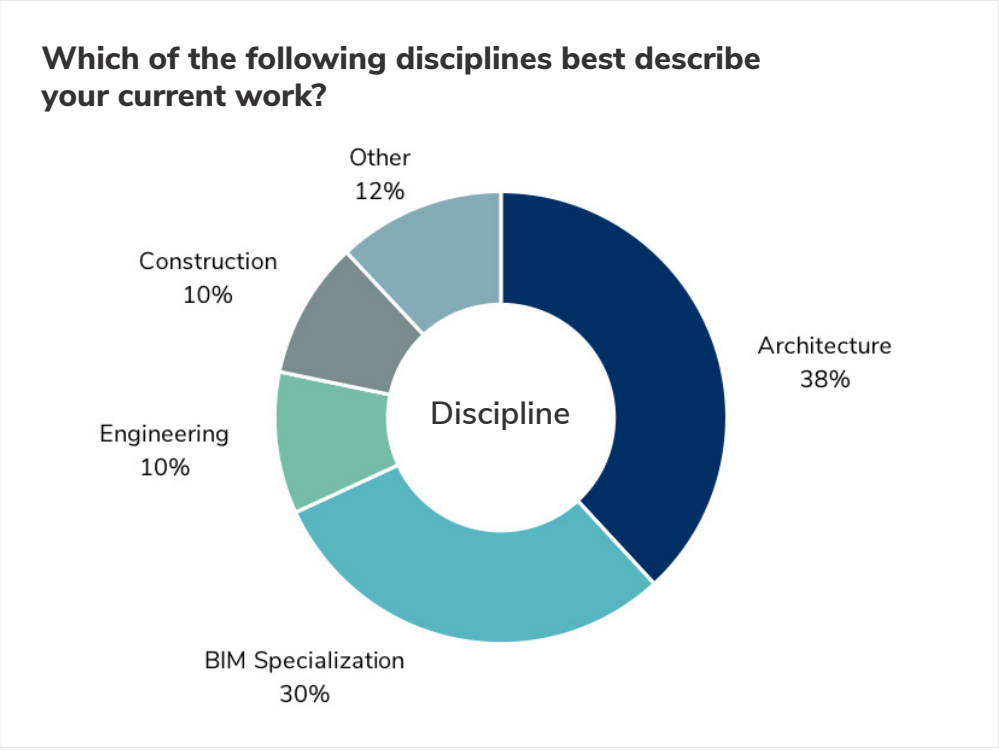


Figure 4. Respondent disciplines

While the previous questions aimed to get to know the respondents, the next section is about their organization. Figure 5 shows how participants described their employer. Note that since organizations can work in multiple areas of practice, participants could choose as many options as needed. More than half of the participants worked in architecture firms. Engineering, consulting and contractor organizations were the next most common practices with 26%, 20% and 16% of participants respectively. Multi-disciplinary firms held 14% of participants, most of whom were BIM specialists and engineers. There is a relatively high presence (22%) of BIM specialists in general contractor and subcontractor organizations. This is comparable to 40% of BIM specialized participants in engineering, 36% in architecture and 28% in consulting firms. Other practices, though represented, had lower participation rates in the surveys.

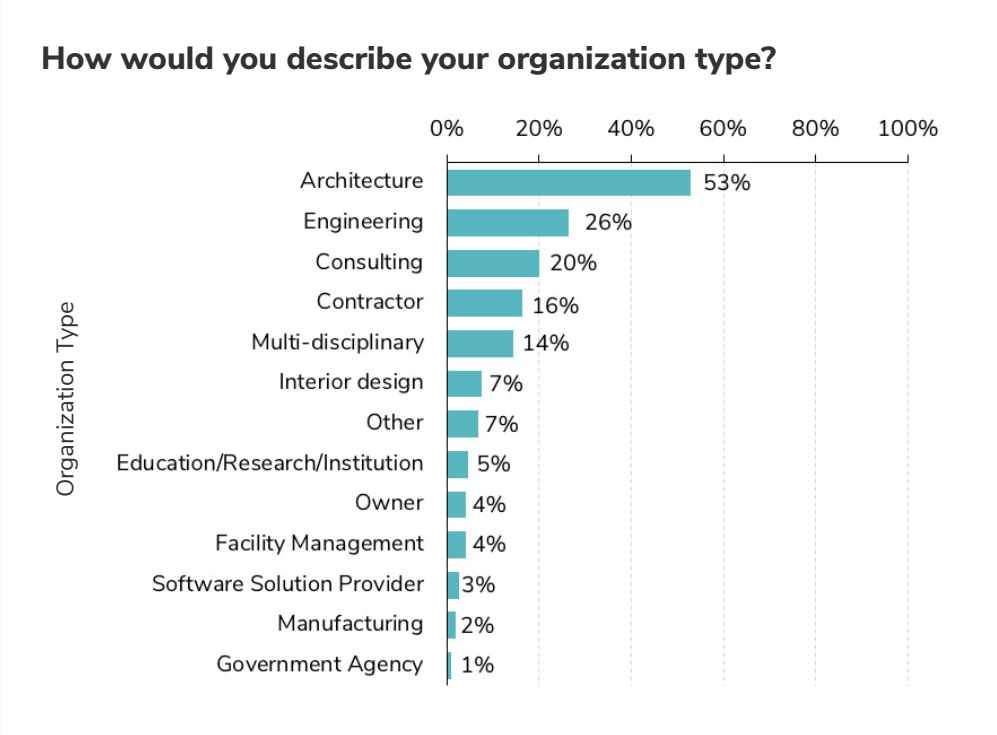


Figure 5. Organization type

Figure 6 shows the distribution of participants with respect to the size of their organization. The organizations of participants in our BIM surveys were evenly distributed.

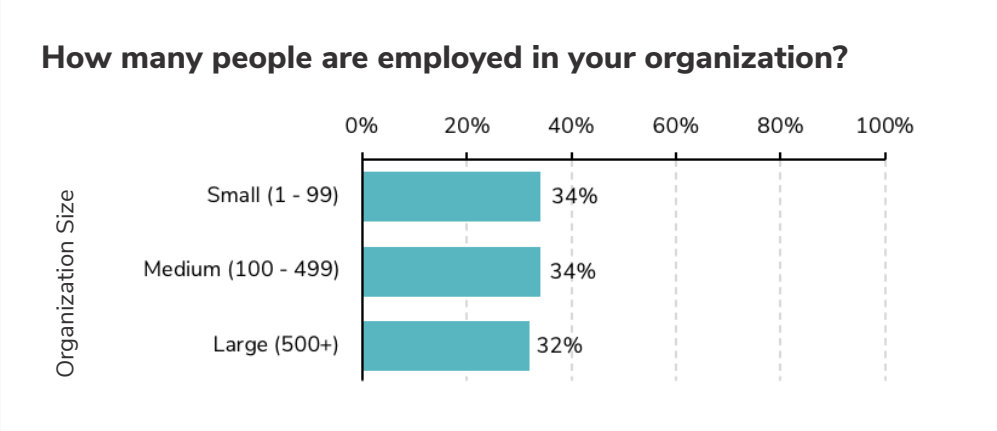


Figure 6. Employment, by organization

BIM Use and Awareness

BIM Use and Awareness

Nearly all (99%) participants knew about BIM, and 82% were in fact active BIM users. Of the remaining 18% who were identified as BIM non-users, only 1% were completely unaware of BIM. Note that the surveys were mostly circulated within the BIM community and hence, the above numbers do not imply the rate of BIM adoption throughout the AEC/FM industries in Canada.

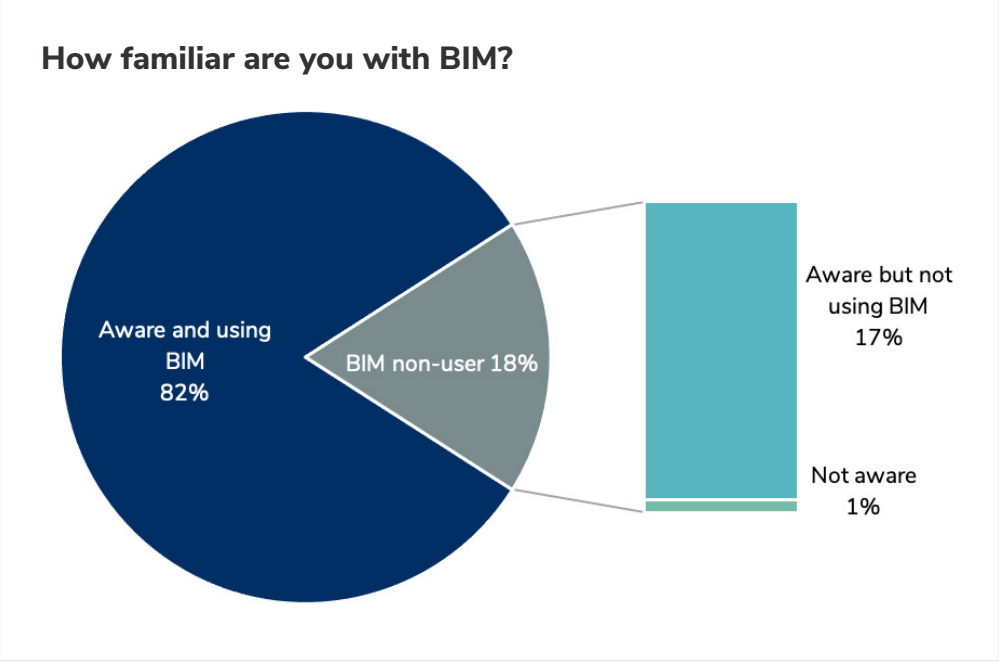


Figure 7. BIM use and awareness by individuals

Figure 8 shows the rate of BIM use and awareness among the age groups. BIM was more widely used by professionals 35 to 44 years old where 89% were actively using BIM in their practices. Two-thirds of professionals over the age of 55 were using BIM.

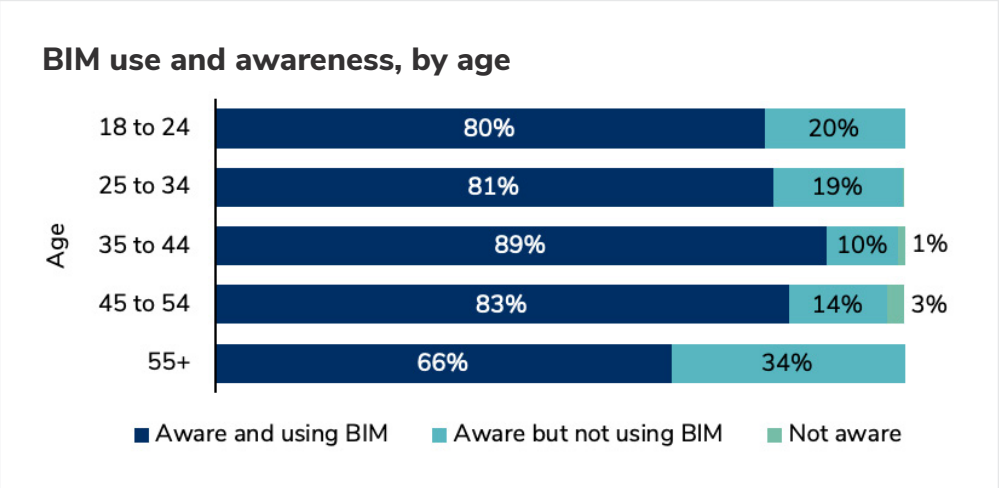


Figure 8. BIM use and awareness among age groups

A key factor in the successful adoption of BIM is the knowledge and skill of individuals in BIM processes. The next questions measured how confident participants felt about their BIM knowledge and skills. Close to three-quarters (72%) of participants were confident of their BIM knowledge and 66% were skillful in BIM processes (Figure 9). There is a significant gap between the 82% rate of using BIM (Figure 7) and the 66% confidence in BIM skills among participants. This highlights the opportunity to create more training venues for those wishing to improve their BIM use and understanding.

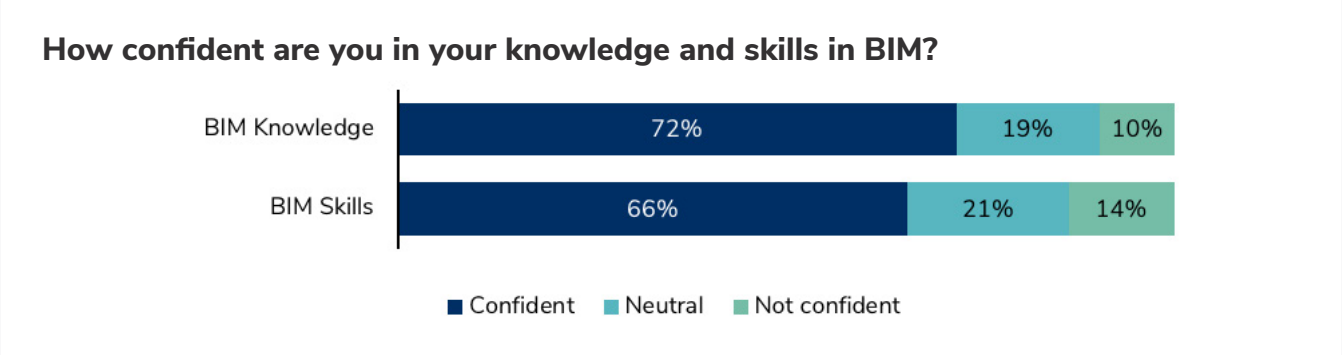


Figure 9. Confidence in BIM knowledge and skills

At the organizational level, 90% of respondent firms were using BIM regularly. Of the remaining 10% that had not yet adopted BIM, 8% had plans to adopt BIM within one to five years, and only 2% did not see themselves using BIM for the foreseeable future.

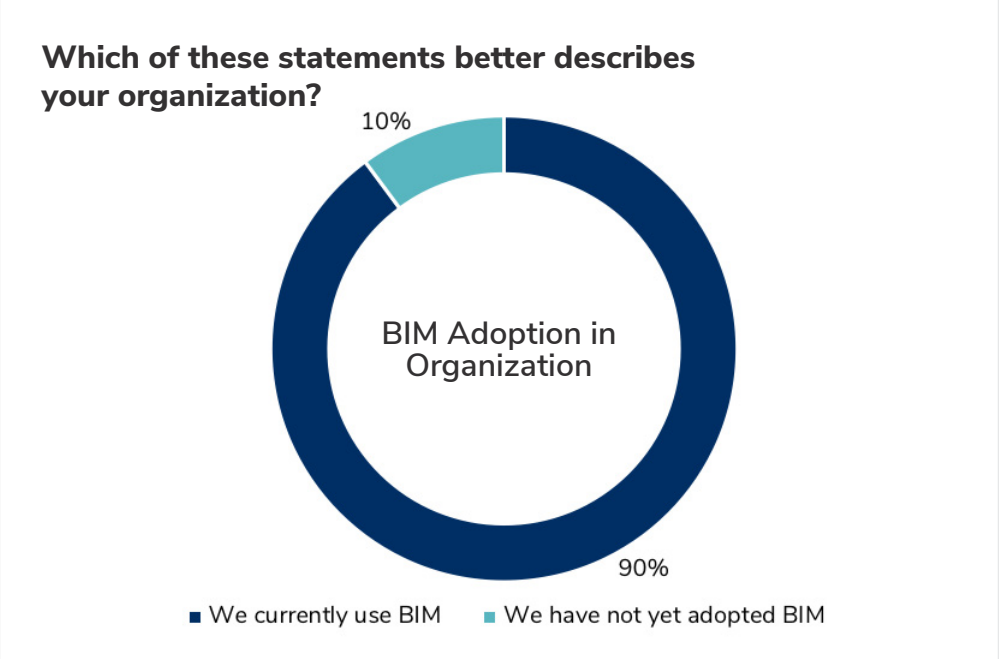


Figure 10. BIM adoption in organizations

The use of BIM among the participants is slightly greater in large organizations than small practices. Ninety-five per cent of participants who worked in large organizations stated that they were using BIM, as opposed to 78% of those in organizations of less than 50 employees.

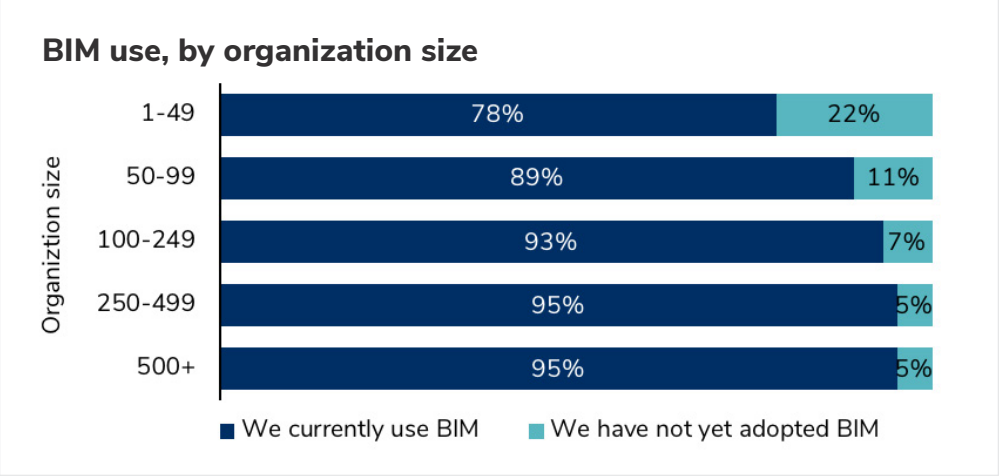


Figure 11. BIM use in organizations per size

As shown in Figure 12, 68% of participants indicated that they used BIM in more than half of their projects with 30% using BIM in all their projects. Only 8% were not involved in any BIM projects.

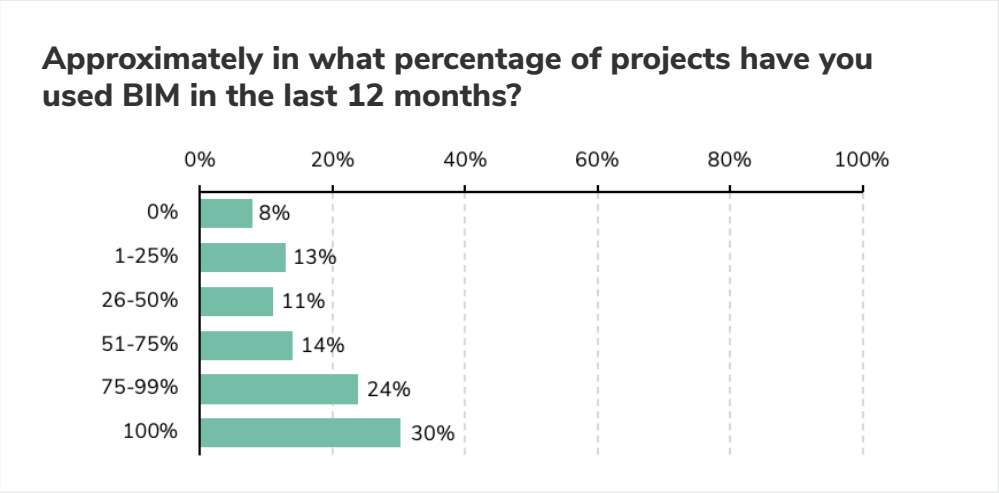


Figure 12. Frequency of BIM projects

Sixty-one per cent of participants aged 35 to 44 used BIM in 75% or more of their projects (Figure 13). Although those 55 and older were the least likely to be involved in BIM projects, the majority (58%) used BIM on at least half of their projects.

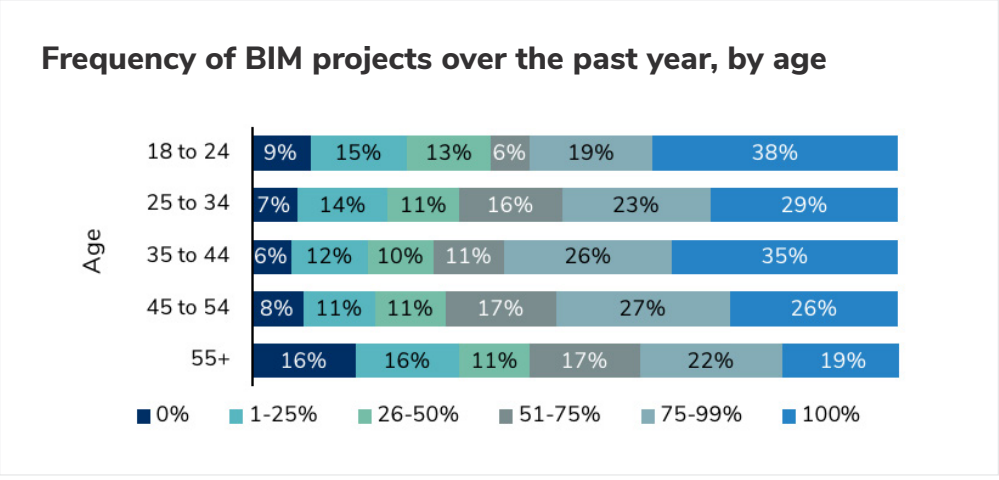


Figure 13. Frequency of BIM projects among age groups

Sharing BIM files with those outside of one's organization provides an indication of how BIM's potential as a collaboration and communication tool is being adopted in industry.

As illustrated in Figure 14, 88% of the participants shared their BIM files with at least one external organization. One-third of participants engaged five or more parties in their collaborative environment. The benefits of BIM are greatly leveraged in a collaborative setting where most or all of the stakeholders contribute to the model. Although a centralized model facilitates coordination, collaborative design can add complexity to the processes within the project. Research continues to resolve some of those issues, including the investigation of block chain based collaboration platforms to improve security, trust and transparency.

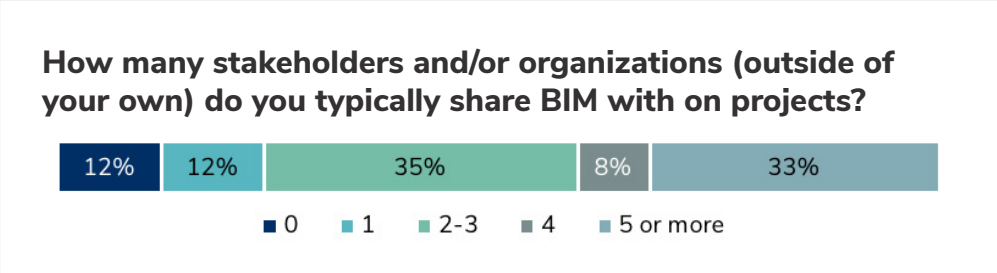


Figure 14. Number of organizations with which survey participants shared BIM

When examining file sharing through the lens of organization size, the progress made by larger organizations is evident. As the size got larger, the degree of file sharing also increased (Figure 15). This may be due to the involvement of large organizations in more complex and large-scale projects, in which owners support the use of BIM.

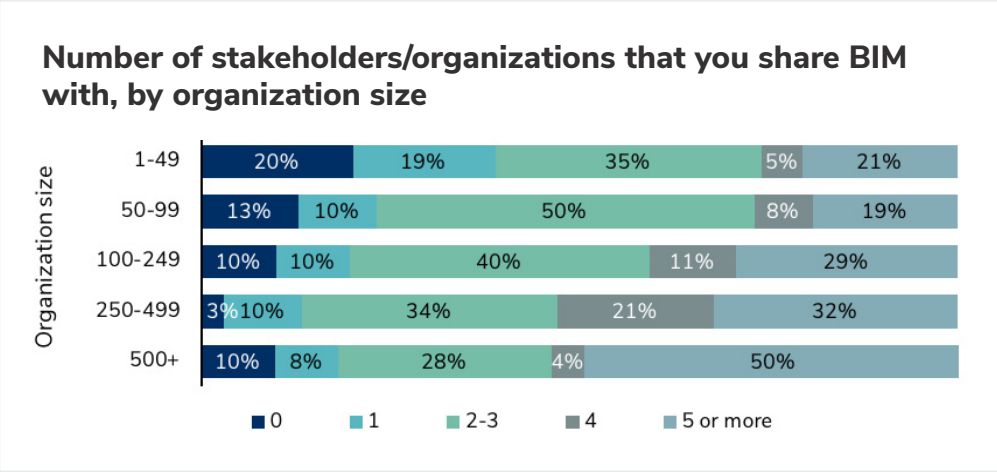


Figure 15. Sharing BIM files by organization size

Ninety-two per cent of participants acknowledged that they hear more about BIM these days. However, close to half (46%) voiced reservations about believing everything they heard about BIM.

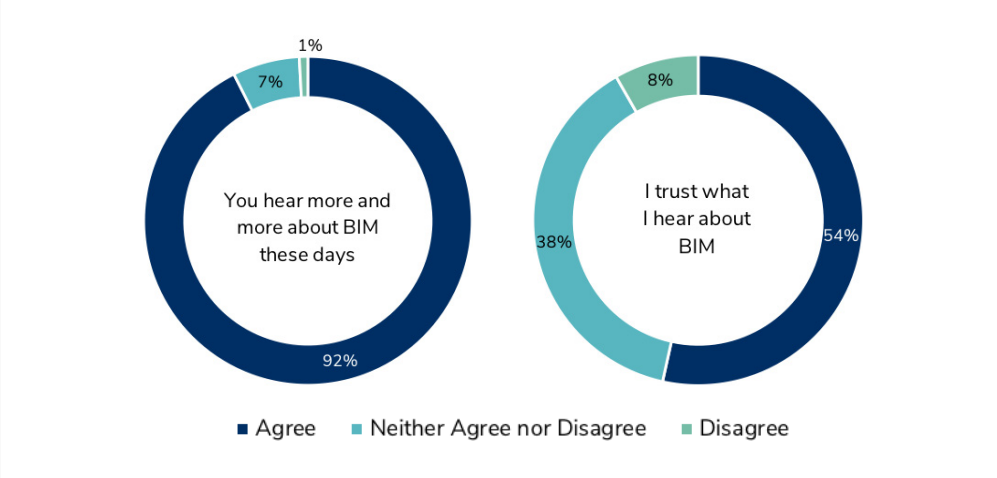


Figure 16. BIM in AEC/FM community

Figure 17 illustrates the main uses of BIM as reported by the participants in three broad categories. The top four uses of BIM, denoted by the dark blue bars, represent high level uses that engage multiple stakeholders. The next four are mostly field applications, attracted by 40% to 47% of participants. These uses include scheduling, estimating, inspection and data management. The last group shown as light teal bars represent several analysis methods – a growing field of BIM applications that include optimization and energy simulation.

A significant increase in the use of BIM for communication over the past two years may be attributed to the advancement and increased ubiquity of purpose-built mobile technologies for construction applications, particularly among those on the job site. In contrast, quality control and optimization each fell by 15% since 2018. A limited number of participants chose energy analysis and facility management, both of which have great potential in Canada.

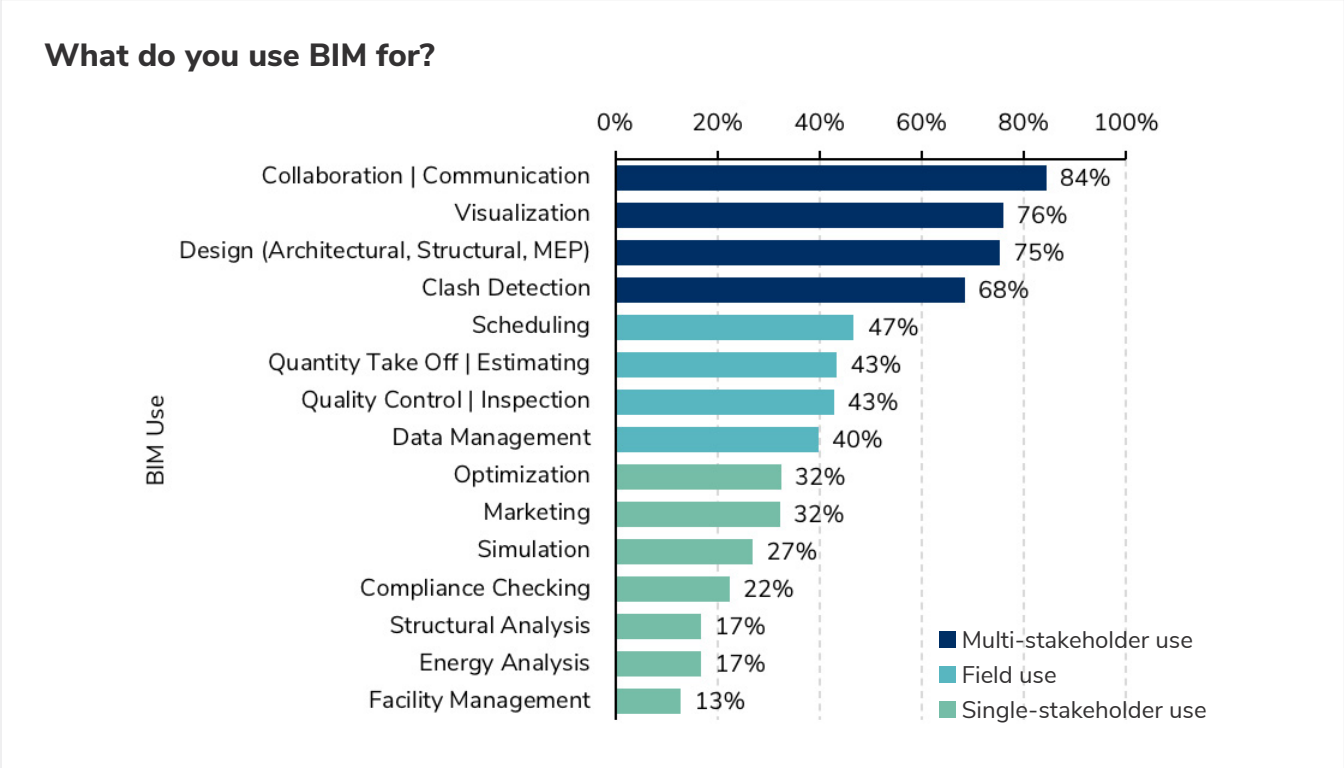


Figure 17. BIM uses

BIM Experience, Benefits and Barriers

BIM Experience, Benefits and Barriers

Adopting BIM can open new opportunities for organizations, but change can be difficult. Exploring the impacts of BIM on the AEC/FM community, the participants identified benefits from, and barriers to, the implementation of BIM.

The vast majority of participants agreed that effective adoption of BIM necessitates changes in their workflows, practices and procedures. Similarly, three-quarters agreed that BIM presents opportunities to expand their project profiles and can make it easier to work internationally.

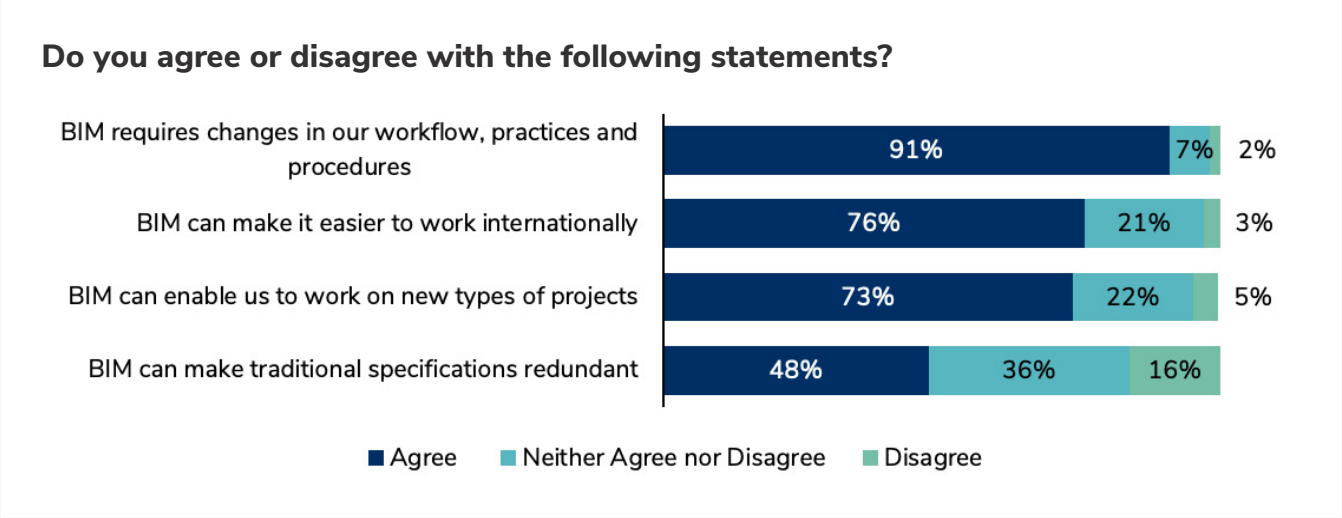


Figure 18. Effect of BIM on organizational processes

However, the participants were divided as to whether BIM may change the way in which traditional specifications are developed and used. In Figure 17, only 22% of participants indicated compliance checking as a current use of BIM, whether it was checking for code or contract provisions. As tools continue to be developed and adopted, it is envisioned that compliance checking will become as ubiquitous as spell-checking.

BIM consistently shows promising benefits, which was reflected in the opinion of survey respondents. Only 2% to 6% of respondents disagreed that BIM improves project visualization, cost efficiency, O&M savings, profitability and the speed of project delivery. With the perceived operational and financial benefits, one might wonder why BIM has not been adopted by every stakeholder in the industry.

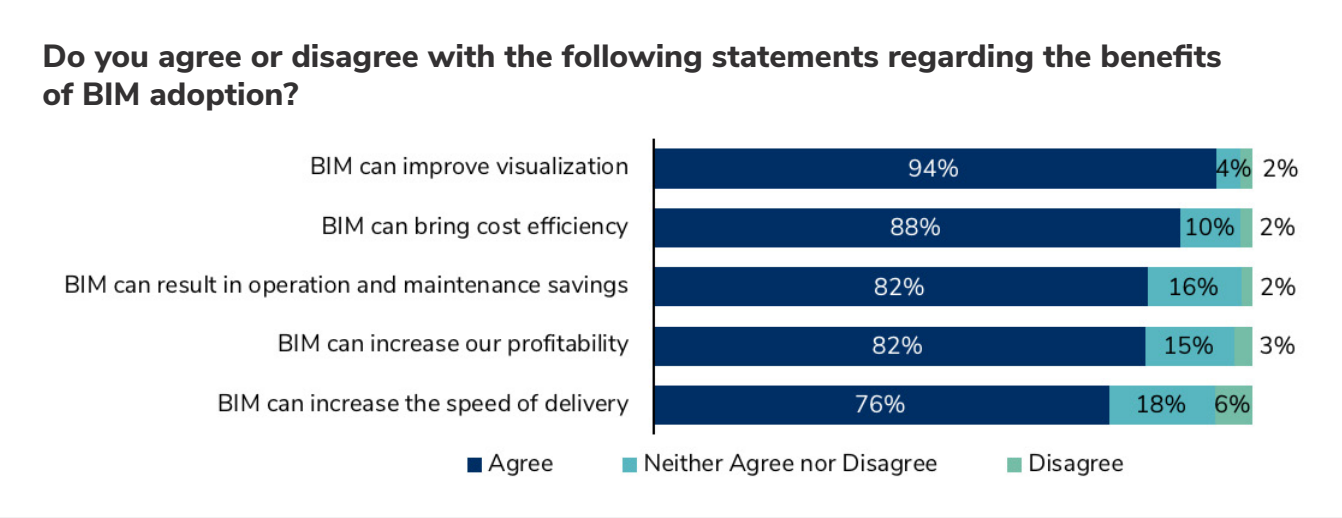


Figure 19. BIM benefits

Introducing a new technology to an organization is often a challenge. Figure 20 shows some of those barriers: the dark blue bars represent industry level barriers, the turquoise bars indicate company level barriers and the light teal bars represent barriers to individuals.

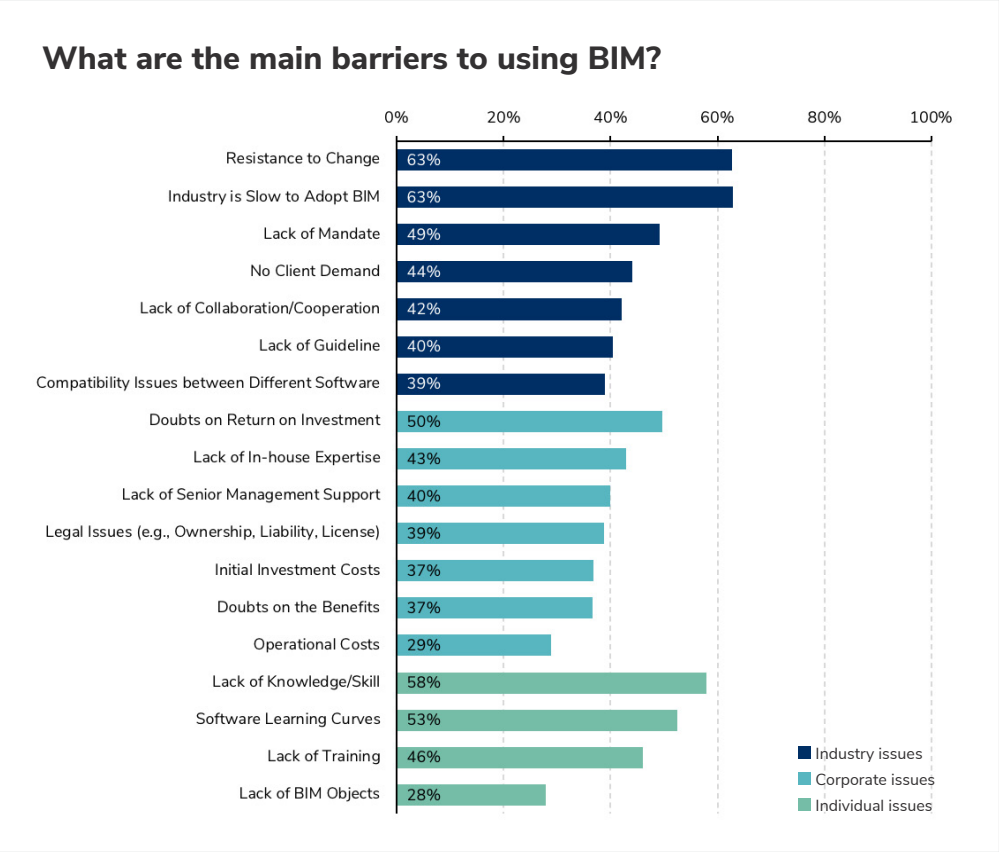


Figure 20. BIM adoption barriers averaged over three years

The resistance to change and industry's slow adoption of BIM were identified as the top barriers in the industry and across all categories at 63% agreement. Participants were less likely to see barriers at the corporate level, possibly because most of them were already using BIM. Nonetheless, sizeable capital investments, doubts on benefits and high operational costs contribute to the uncertainty in BIM's value proposition, which can inhibit organizations to adopt BIM. At the individual level, more than half of the participants identified the knowledge and skill gap as a major barrier to BIM adoption.

BIM Resources

BIM Resources

Participants were asked to report the sources of information they used to gain knowledge and seek advice about BIM. Clearly, most participants use a variety of sources to find what they need.

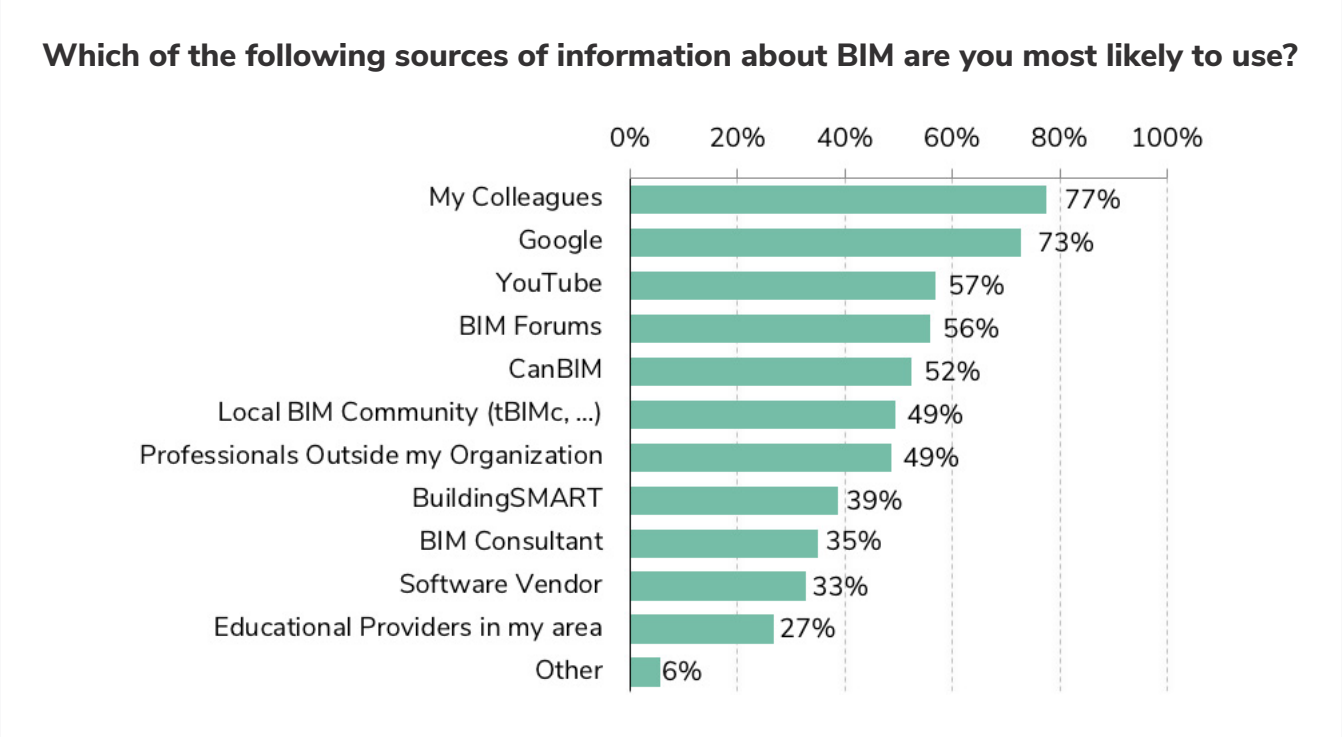


Figure 21. BIM sources of information

While Canadian BIM resources are regularly sourced by the participants, 45% reported that they were unaware of these resources.

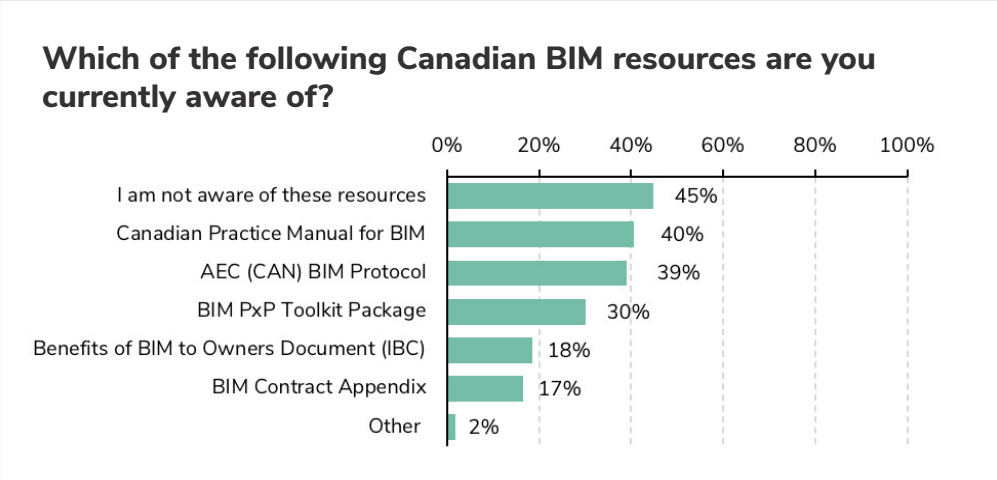


Figure 22. Canadian BIM resources

Figure 23 shows the BIM tools that were used by 5% or more of participants. Responses were similar over the three years.

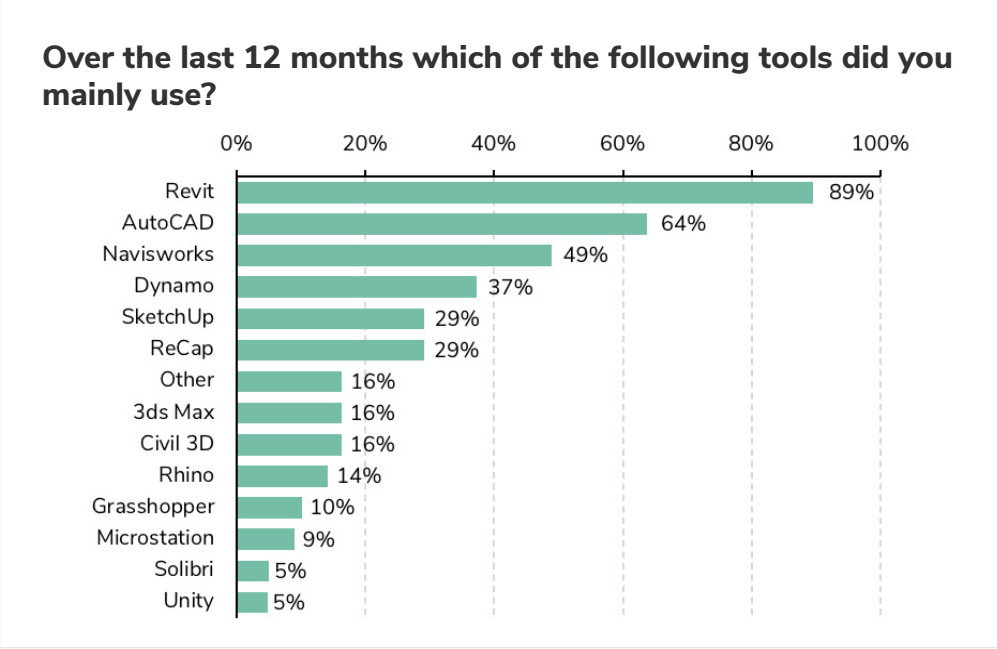


Figure 23. BIM software tools

buildingSMART[1] (2017) defines OpenBIM as a collaborative process that allows vendor-neutral workflows for seamless collaboration among project members. It aims to address the interoperability obstacles in the industry, which nearly half of the survey participants encountered in their projects. Despite its potential, 43% of participants were not aware of OpenBIM and more than three-quarters had no experience using it. Among those using OpenBIM, BIM360 was the most common collaboration/sharing platform. Substantial improvements have been achieved for OpenBIM in recent years; however, 60% of participants acknowledged there is still a need for an industry-wide standard.

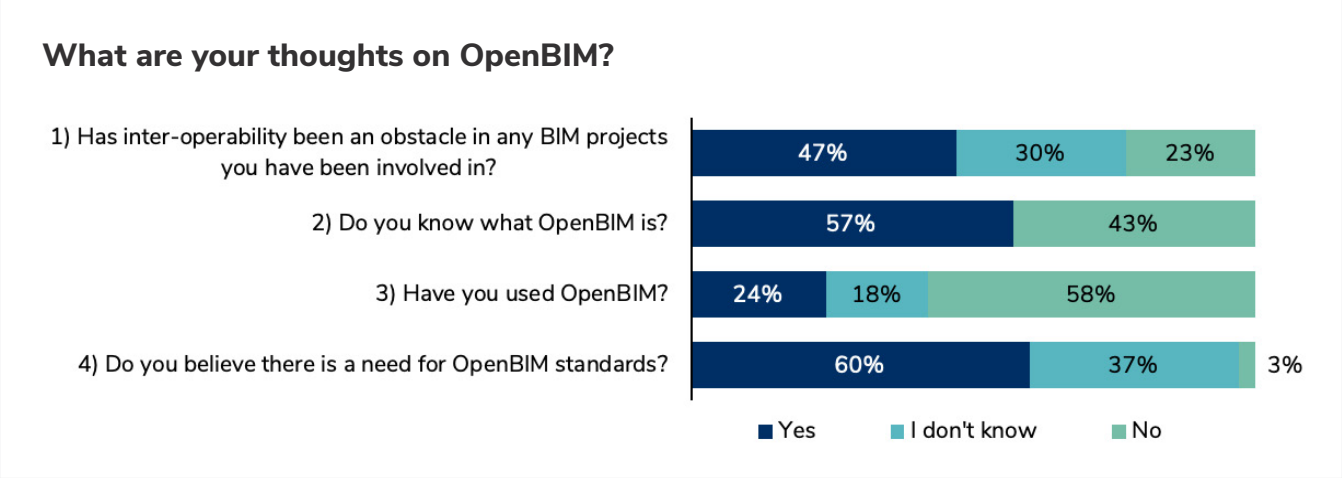
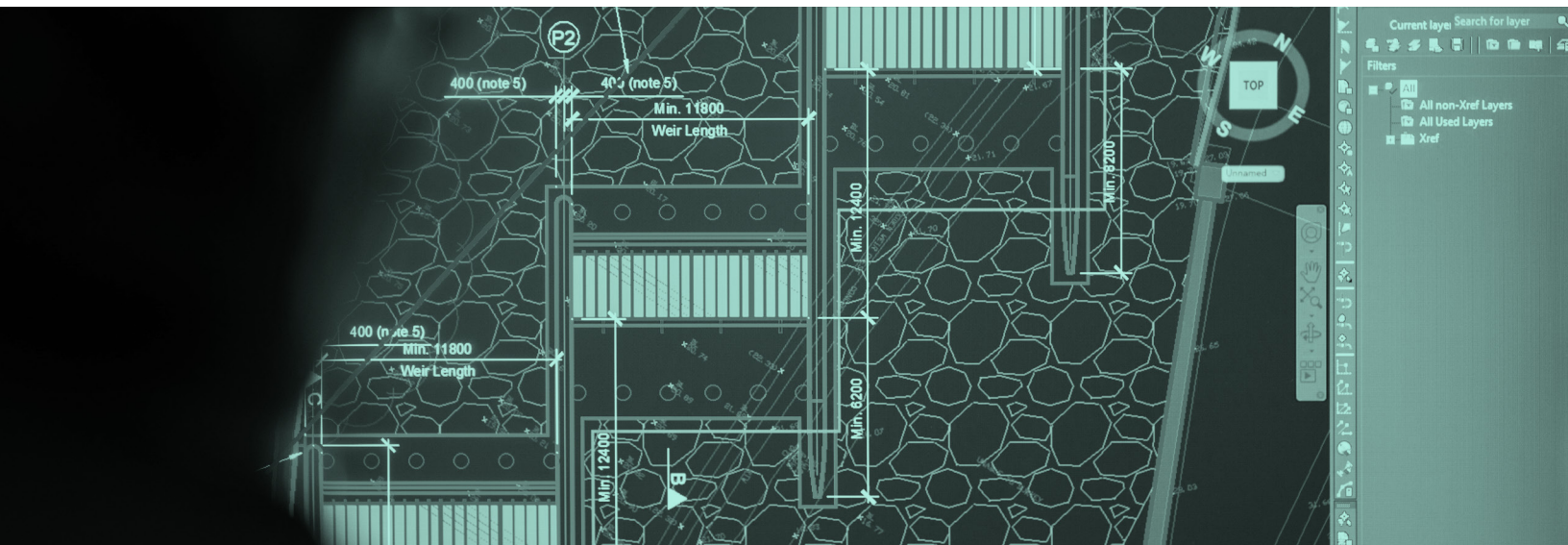


Figure 24. Interoperability issues and OpenBIM

[1] buildingSMART Canada. (2017). Canadian Practice Manual for BIM.



Perspectives of the Disciplines

Perspectives of the Disciplines

Figure 25 shows the top three uses of BIM among disciplines. Collaboration/communication was in the top two for all disciplines. Visualization ranked second or third for everyone but engineering-related disciplines and clash detection ranked second or third for everyone but those in architecture disciplines.

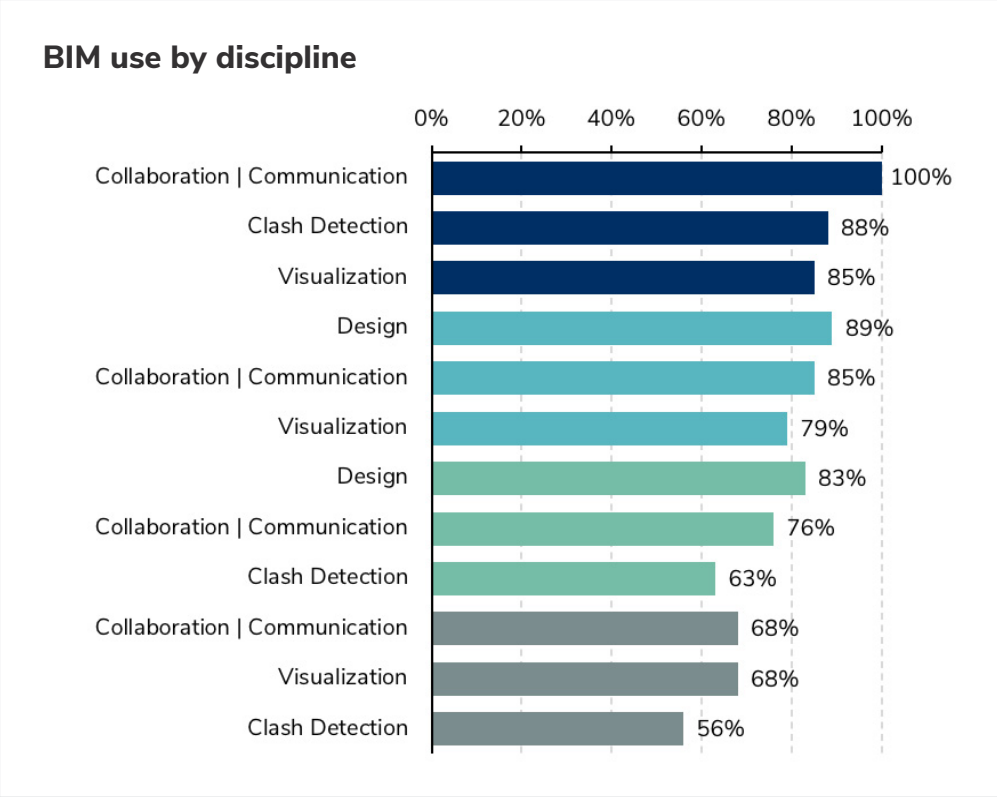


Figure 25. Top BIM uses among disciplines

Resistance to change, inertia of the industry toward BIM adoption and lack of knowledge and skill were deemed the most important barriers of BIM adoption by all disciplines, but with varied intensity. Overall, BIM specialists showed the strongest opinions while architects were the most optimistic.

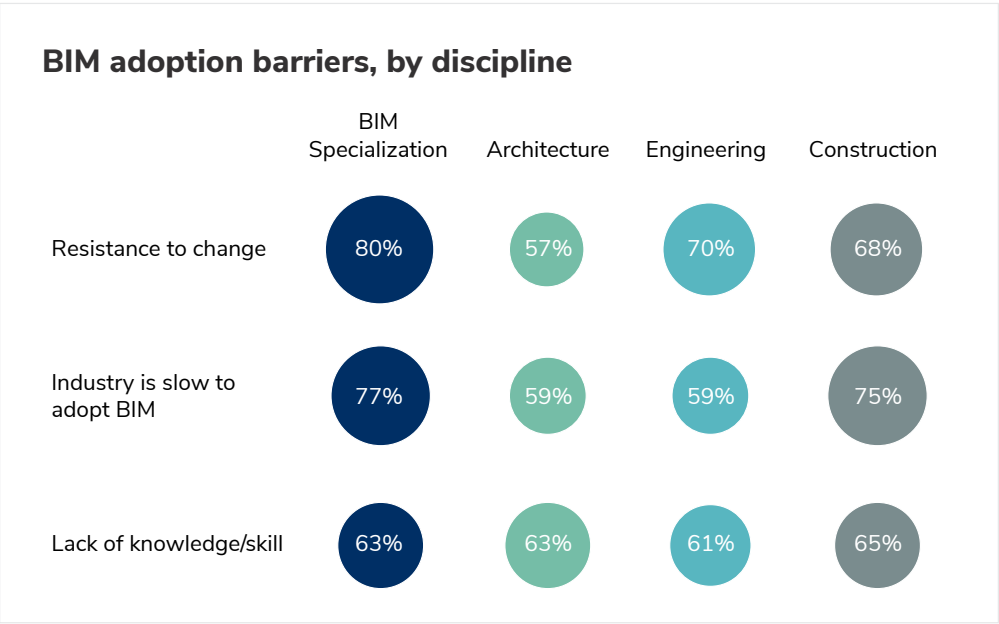


Figure 26. Top three barriers of BIM adoption among disciplines

Future of Industry

Future of Industry

There was an overwhelming consensus among BIM users and non-users that they would get left behind if they didn't adopt BIM.

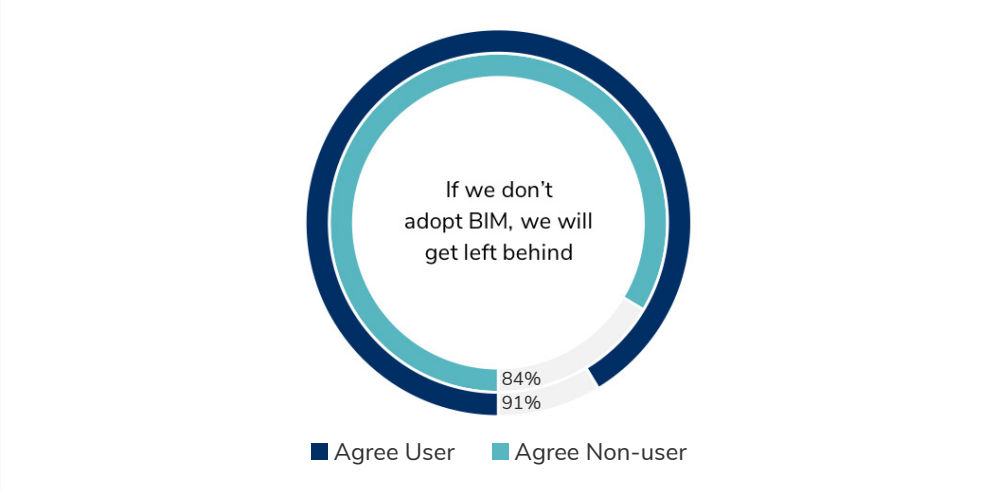


Figure 27. Attitude of BIM users vs. non-users toward BIM adoption

Additionally, 87% of BIM non-users and 96% of users agreed that BIM is the future of project information. But, how can we get there?

While the majority agreed that governments will increasingly insist on adopting BIM in future, fewer agreed that BIM should be mandated.

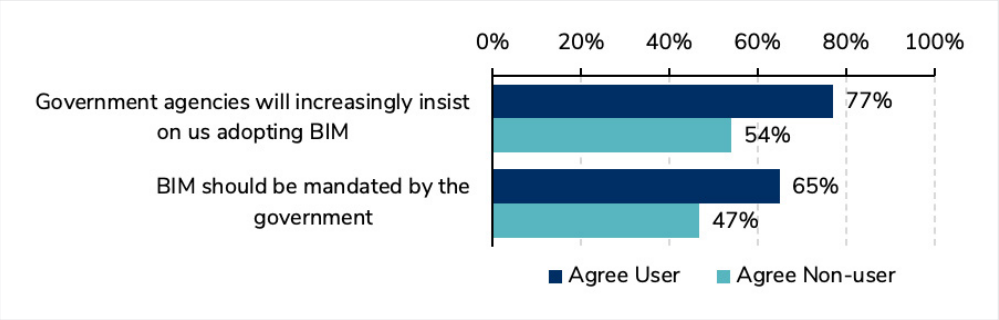


Figure 28. BIM mandate

Only 6% of participants did not believe that BIM could streamline the permitting process and help automate code compliance checking.

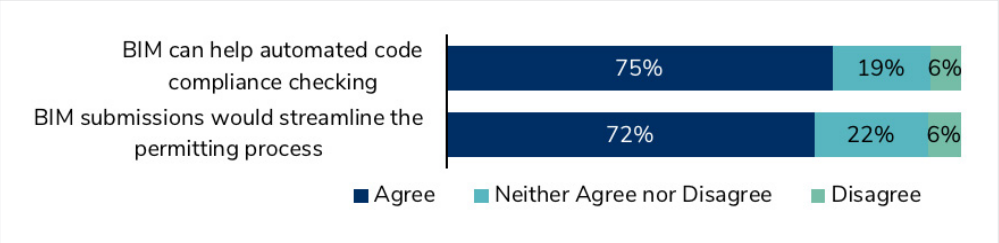


Figure 29. BIM and E-permitting

Additional technologies are influencing the industry. According to the respondents, virtual and augmented reality (VR/AR) have the highest potential to influence the industry over the next 10 years. Reality capture technologies, particularly laser scanning, are key to the efficient creation of virtual models for existing facilities. E-permitting and automated code examination also garnered more than 80% support from participants.

Clearly, there is broad agreement that technology is here to stay and that the AEC/FM industry is going to a lot of change over the next decade.

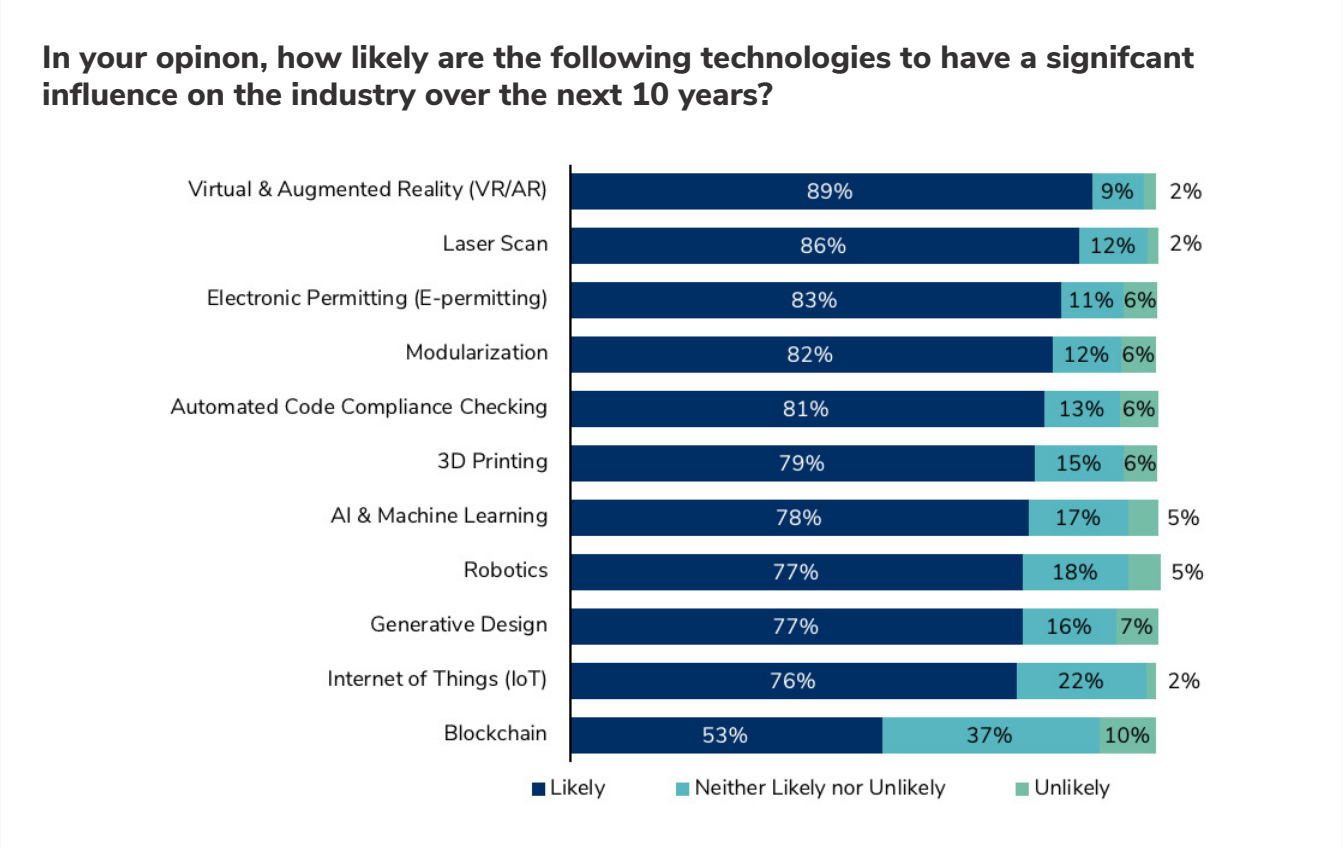


Figure 30. Construction industry and future technologies

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