

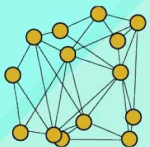


UNIVERSITY OF
TORONTO

1st ANNUAL **BIM REPORT**

FOR THE GREATER TORONTO AREA

2018



torontoBIMcommunity
connecting architects engineers contractors owners operators



RESCON
RESIDENTIAL CONSTRUCTION
COUNCIL OF ONTARIO



BUILDING TALL
RESEARCH CENTRE

www.buildingtall.utoronto.ca

Foreword

The First Annual BIM Survey in the Greater Toronto Area (GTA) was conducted by researchers at the Building Tall Research Centre at University of Toronto in collaboration with Toronto BIM Community (tBIMc) and the Residential Construction Council of Ontario (RESCON).

The Building Tall Research Centre is housed within the Civil Engineering Department at the University of Toronto and its mission is to cluster, highlight, and promote research related to tall buildings from multidisciplinary technical perspectives. The Residential Construction Council of Ontario (RESCON) is Ontario's leading association of residential builders committed to providing leadership and fostering innovation in the industry. Toronto BIM Community (tBIMc) is the local BIM community in the GTA, and an affiliate of buildingSMART Canada. tBIMc's mandate is to promote the use of BIM from design through construction and into operations, as well as to share ideas and facilitate opportunities to create solutions to the shared challenges faced by the local BIM community.

This project was motivated by the lack of a credible benchmark for BIM implementation in the GTA. With over 250 respondents of the survey and more than 20 in-person interviews, this survey is the first BIM survey of this scope to be completed in Canada. This survey will be repeated every year for the next five years by Building Tall and its reach is expected to grow beyond the boundaries of the GTA and to expand across Canada. The insights from this project will be shared with the industry as a whole on a yearly basis.

We would like to sincerely thank Claudia Cozzitorto and tBIMc board members for their assistance in preparing the survey, Richard Lyall and the RESCON membership for their financial support and for their assistance in data collection, and all the participants and interviewees for their time and valuable insights. Finally, we would like to acknowledge the financial support of Canada's Federal Government through the NSERC Grant number CRDPJ 479087-15.

The research team from Building Tall welcomes feedback from anybody who reads this report and has any suggestions on how to improve the future iterations of this survey. Please don't hesitate to email arash.shahi@utoronto.ca with your comments or reach out to any of us at Building Tall, or our partners at RESCON and tBIMc.

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Executive Summary

The data collection method for this report included an online survey of approximately 110 questions, which was distributed to architects, designers, engineers, construction managers, and builders currently working in the Greater Toronto Area (GTA) in Ontario, Canada. To extend the reach of the survey to the local community, QR Codes with links to the survey were distributed to design and engineering firms in downtown Toronto. The survey was also posted on the websites of Building Tall, tBIMc, and RESCON and promoted through social media, news feeds, and other industry-focused publications.

This survey had 252 respondents. Previous Canadian BIM surveys had 78 respondents in 2013 and 127 respondents in 2016; the reach of this survey in a local geographic area (GTA) provides meaningful insights to the practice in this area. The composition of respondents, and their organizations are detailed in the report and were consistent with similar surveys in the U.K. and other jurisdictions.

The survey was complemented with a series of more than 20 in-person interviews with industry representatives from diverse backgrounds. The purpose of these interviews was to validate some of the findings of the survey and to collect data on aspects of BIM implementation that were not captured through the survey.

The local Architecture, Engineering, and Construction (AEC) industries seem to be well aware of BIM practices. More than 60% of the respondents indicated that they are extremely or quite confident in their knowledge and skills in BIM, with only 11% not confident at all and others ranging in between. The confidence levels per sector are detailed in the report, with BIM professionals understandably leading the way, followed by Architects, Engineers, and Construction professionals, in that order. Interestingly, 95% of all respondents in this survey are already using BIM or expect to be in just three years.

With 88% of respondents strongly believing that BIM can benefit a project during its construction, we expect the research and development investments in this area to grow significantly over the next three to five years. Industry organizations, including RESCON and tBIMc, are expected to take the lead in this area, while being supported by the academic community and government agencies.

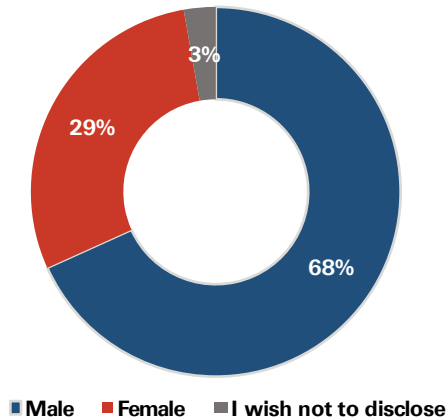
Most developed countries have adopted a top-down approach to BIM implementation, where government mandate has been put in place with incentives and support to bring the industry on-board. However, Canada is relying on the industry to take the lead on BIM implementation, slowly motivating clients and government agencies to introduce BIM requirements. Lack of mandate and client demand were consistently pointed out amongst the main barriers to BIM implementation. As of 2018, Canada remains the only G7 country with no in-place or announced BIM mandate.

Finally, respondents were asked about the future of the construction industry. The use of BIM for facility management, automated-code compliance, and electronic permitting (e-permitting) were identified as the most useful future applications; cloud-based systems, virtual and augmented reality, 3D printing, and drones were identified as the technologies with most influence on the industry in the near future.

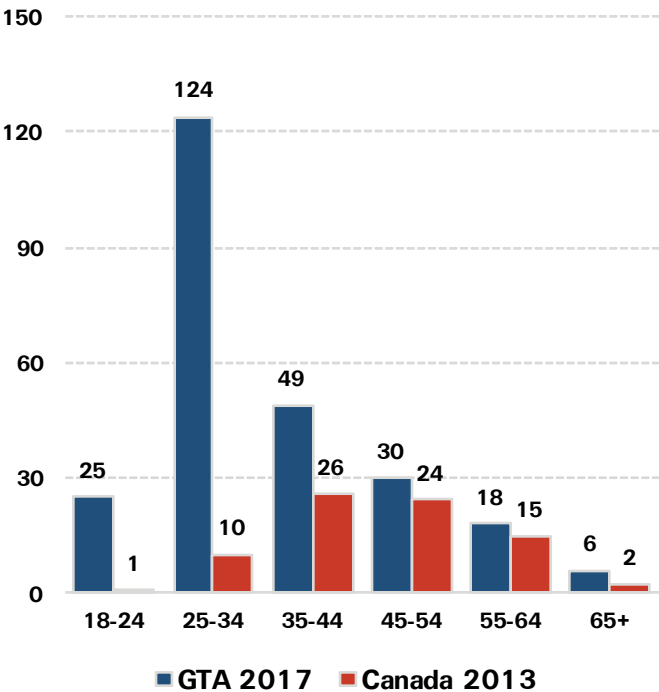
Getting to Know the Respondents

This survey reached 252 respondents from the GTA alone. Compared to other National BIM surveys across Canada, which included 78 respondents in 2013 and 127 respondents in 2016, the reach of this survey in a local geographic area provides meaningful insights to the practices in this area.

Before taking a deep look into the breakdown of responses, we would like to get to know the respondents. Since the audience for this survey included professionals from Architecture, Engineering, and Construction (AEC), it was not surprising that 68% of the respondents were male. According to Statistics Canada, the construction industry remains male dominated with a whopping 88% male workers, closely followed by Civil, Mechanical, and Electrical Engineering at 87%, and Architecture at 72%.



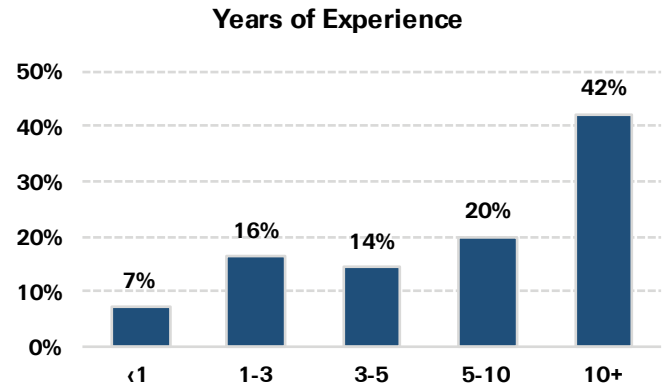
Age Groups



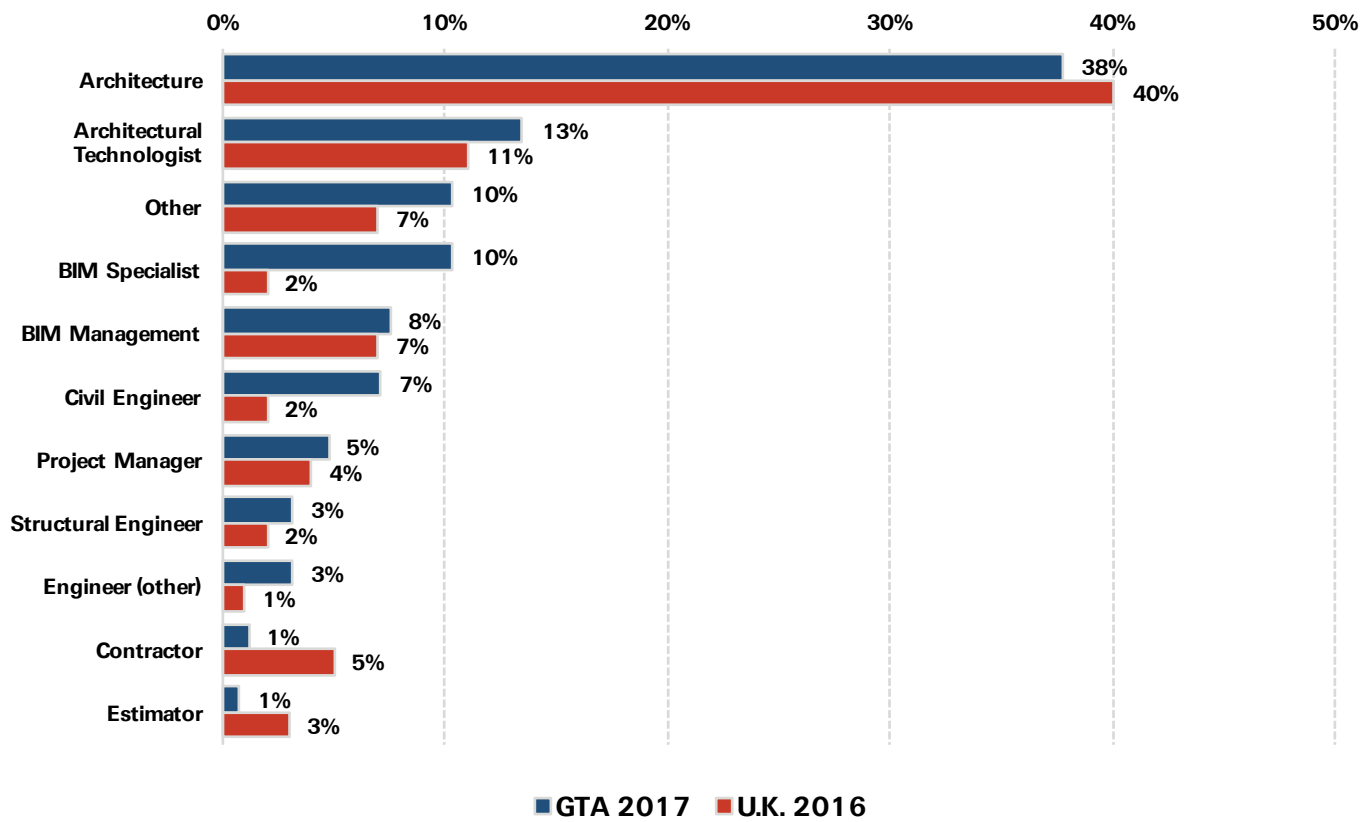
The age distribution of the respondents for this survey was very interesting. Almost half of the respondents (48%) fall between the ages of 25-34, which demonstrates the active participation of young professionals.

This age distribution is not representative of the industry. In fact, the average age of a construction worker in Canada in 2017 was 42 years old and the average age of an architect was 43 years old. This highly skewed age distribution can be explained by the fact that the 25-34 age group were most enthusiastic in completing an online survey. It further shows that this particular age group is more engaged on BIM related topics, including a survey, which was echoed in many of the interviews completed as part of this research.

Despite the high participation rate from the 25-34 age group, 42% of respondents have been practising in their professions for over 10 years. This shows that most of the feedback is coming from experienced professionals who have been involved in the AEC industry for a long time and have seen the changes that BIM has brought to their organization and to the industry as a whole.

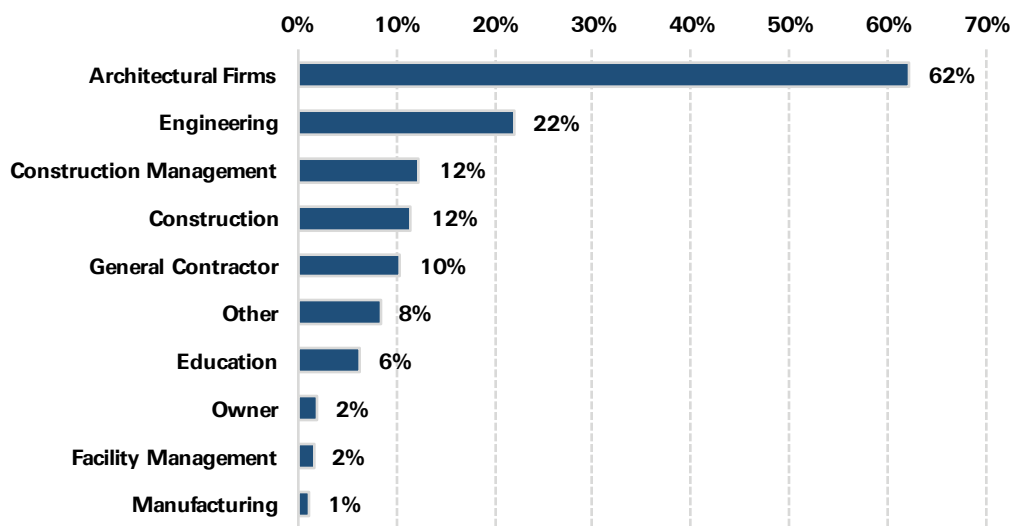


As with many other national and international BIM surveys, the professionals from the architecture industry dominated the respondents. Specifically, 51% of respondents have a background in architecture, including architectural technologists. Engineers represented 13% of respondents, with 10% identified as “Other” disciplines, which included software development, Virtual Design and Construction (VDC), and education. The high architect participation can be explained through their active use of BIM in their workplace and their higher interest level to participate in BIM-related exercises, including online surveys.



Getting to Know the Organizations

Understanding the background, experience, and demographics of the respondents helps in shaping a context around their responses. Their experience also comes from the organizations where they work, and therefore we would like to understand what these organizations are and how they operate.

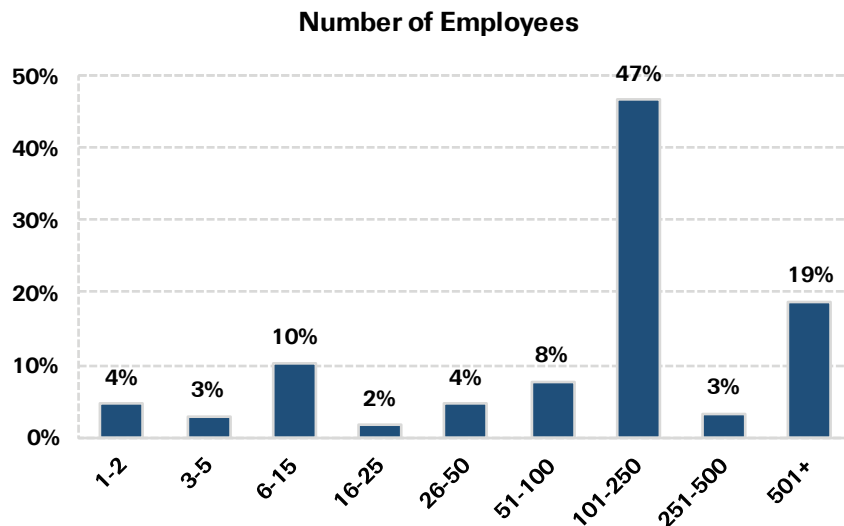


Respondents were asked to select all options that best describe their organization’s type. Since most organizations work in more than one discipline, the reported percentages are not exclusive.

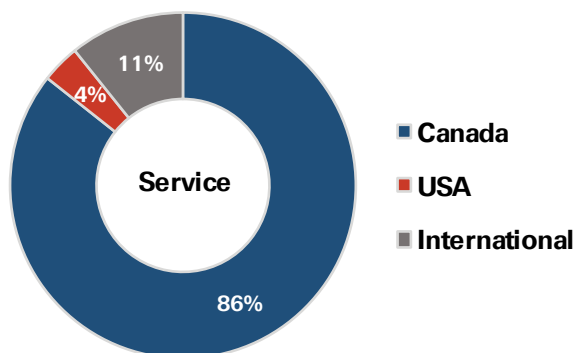
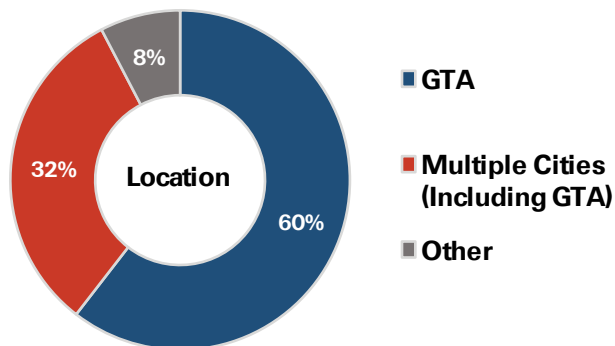
Most respondents (62%) have a presence in the architecture industry. Surprisingly, 34% of respondents are also involved in the construction processes, combining the contributions from construction management, construction, and general contractors. Given that only 10% of respondents indicated that they have a background in the construction discipline, this result was interesting. The adoption of new technology, including BIM, in the AEC industry presents new opportunities and introduced new positions such as Virtual Design and Construction (VDC) coordinator, BIM specialist, and BIM manager, which allows for transferrable skills across disciplines.

From the survey respondents, 22% were involved in Engineering processes. Engineering professionals are gradually adopting BIM and BIM-based analytical tools in their fields of work, and their participation is expected to grow in coming years. Limited responses were received from Owner and Operators in this survey.

Almost half of the respondents (47%) worked in organizations that employ 101-250 people, which indicated that a significant portion of participants' organizations are in the medium size range.



About 60% of organizations were exclusively based in the GTA, and almost one-third (32%) of the respondents indicated they have offices in various cities, including at least one office in the GTA.



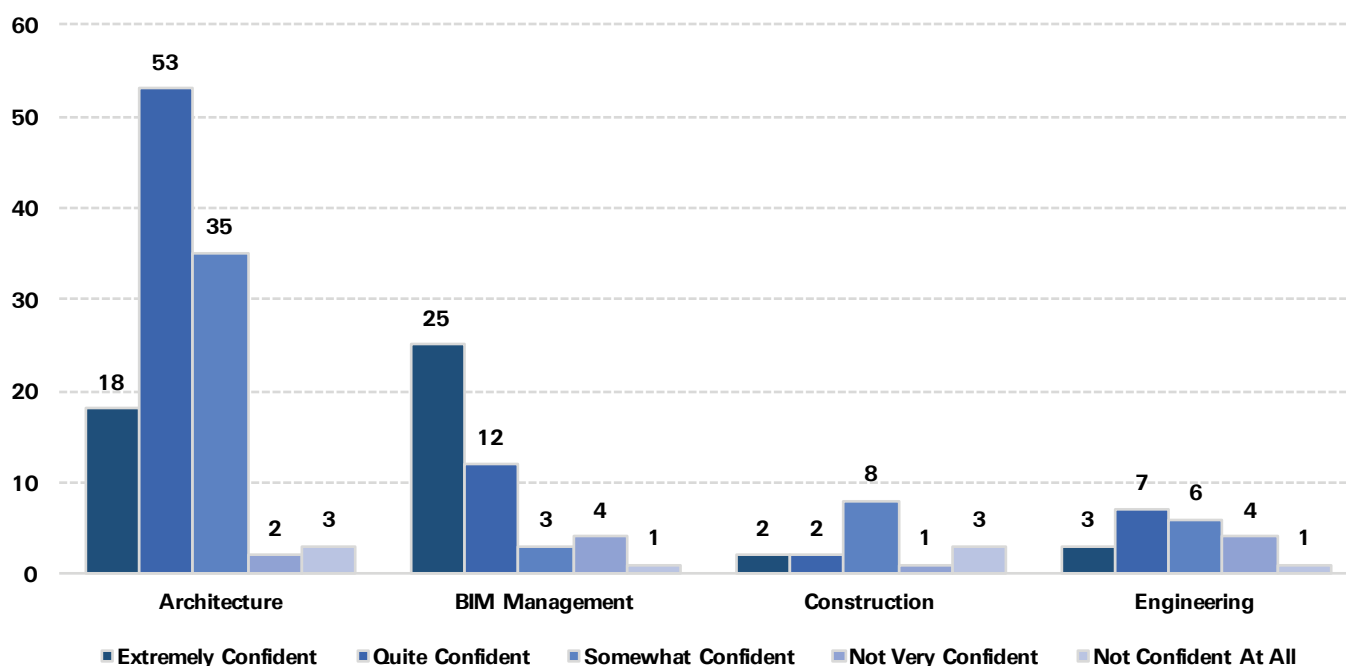
Most organizations (86%) provide professional services in Canada, while 4% and 11% of the organizations perform their work in the U.S., and internationally, respectively.

During the interviews it was pointed out that having BIM expertise has helped a number of Canadian companies to get international contracts, particularly in Europe.

BIM Awareness, Adoption, and Implementation

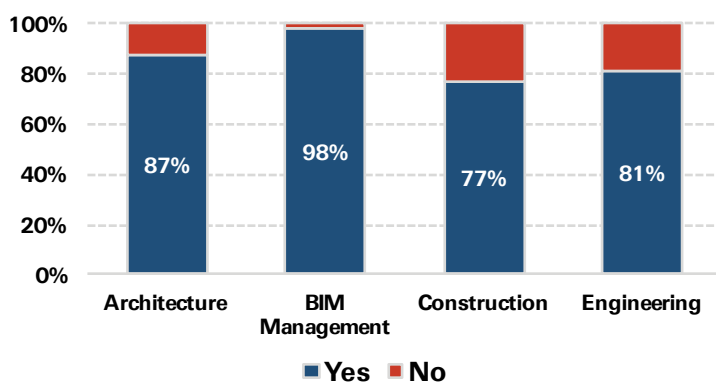
Over three-quarters of respondents (78%) indicated that they were aware of and currently using BIM. The remaining 22% were aware of BIM, but were not currently BIM users. Respondents with backgrounds in Architecture and Engineering indicated a varying degree of confidence level, while the majority of respondents in the Construction industry are somewhat confident in their skills and knowledge in BIM. About one-quarter of respondents in the Engineering and Construction fields are lacking skills and knowledge in BIM, which indicates a need for training and education in the future.

How confident are you in your knowledge and skills in BIM?



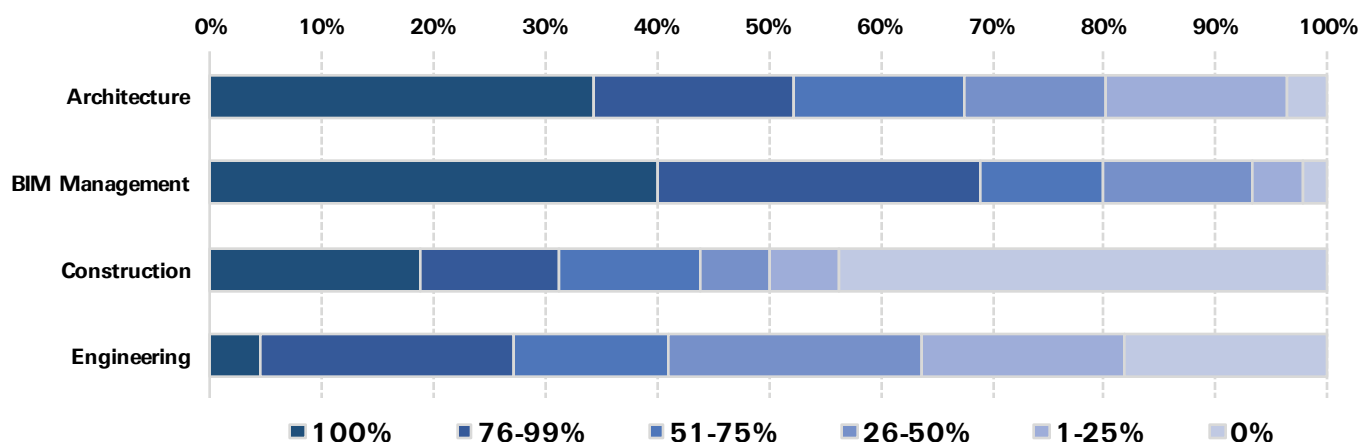
63% of the respondents in the GTA survey said they are extremely or quite confident in their knowledge and skills in BIM, with only 11% lacking.

Within your organization, have you ever adopted BIM for projects you have been involved with?



While respondents in the AEC discipline indicated a relatively high adoption rate for BIM in previous projects, the extent of BIM use on projects varies across disciplines. Architecture, Engineering, and Construction had an increasing number of projects with no BIM involvement, in that order. This indicates a lack of continuity in the use of BIM from design to construction.

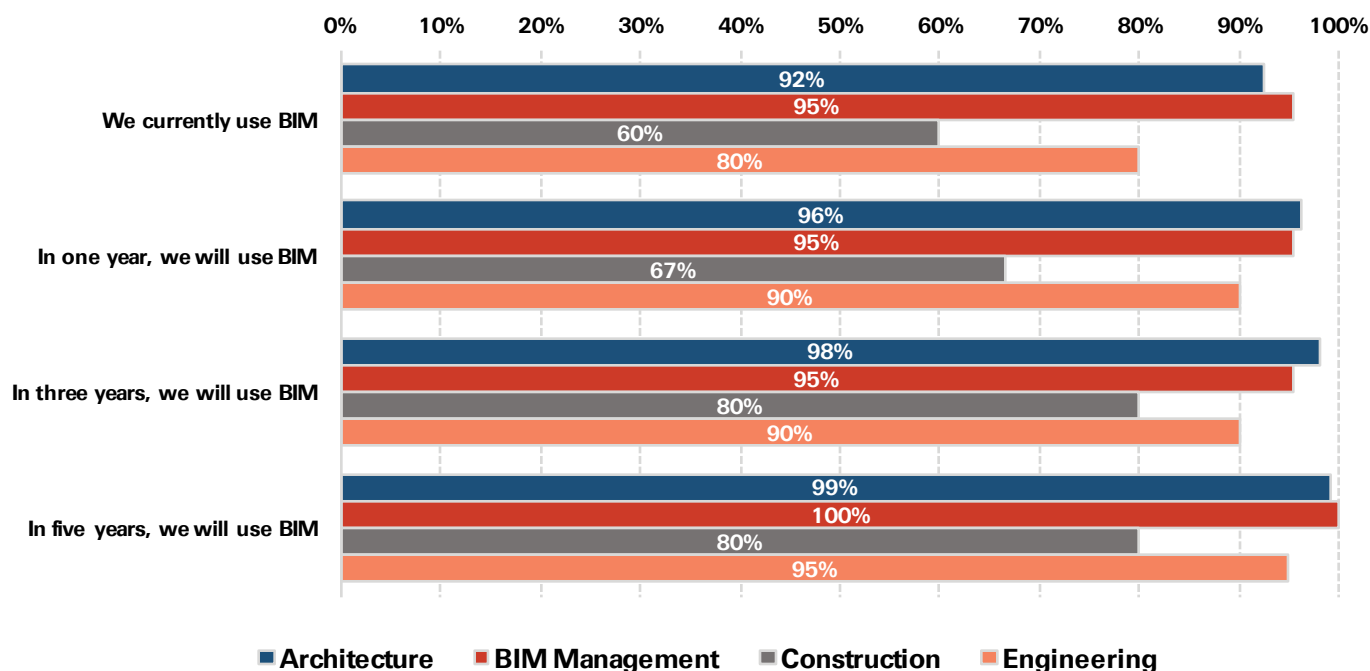
Approximately in what percentage of projects have you used BIM in the last 12 months?



Over half of the respondents used BIM in at least 75% of the projects in the last 12 months, which shows that the use of BIM is gaining momentum in the GTA's AEC industry. In a previous question, it was noted that 13% of the respondents had not adopted BIM in any of their projects within their organization, but the number of respondents that have not used BIM over the last 12 months is only 8%. The 5% discrepancy between these two numbers can be explained by users who have not adopted BIM in their own organization but have worked on a BIM project over the last year, perhaps where another stakeholder demanded or used BIM.

95% of all respondents in the 2018 survey are either using BIM or expect to be in just three years!

Which of these statements better describes your organization?



While respondents in the Architecture and BIM discipline have already adopted and use BIM within their organizations, the Engineering and Construction industry will likely see a rise in BIM adoption in the next few years.

The participants were asked on their perception of BIM adoption within their organizations, and the results were interesting with 95% expecting that in three years they will be using BIM. The results were consistent with other surveys in Canada and U.K.

Previous U.K. surveys showed an increase in BIM adoption in companies and the trend is likely to occur with GTA respondents.

There are a number of practices and processes that impact the adoption of BIM in an organization. In an effort to benchmark the extent that various processes are used in the local AEC industry in GTA, respondents were asked to think about the projects they were involved in over the last 12 months (with or without BIM) and indicate whether they ever participated in any of these processes.

Almost all processes have shown increasing trends in the previous BIM surveys in U.K., except for the production of 2D digital drawings, which indicated a decline in the use of CAD-related tools. It would be interesting to see how GTA numbers perform over time, which will be captured through future BIM surveys.

The GTA is in a unique position where 91% of respondents have produced 3D digital drawings, but 89% were also involved in 2D digital drawings. This shows that even though firms are moving towards 3D digital models, they still need to maintain their 2D drawings. It is expected that with a government mandate, this duplication in the work process will be reduced.

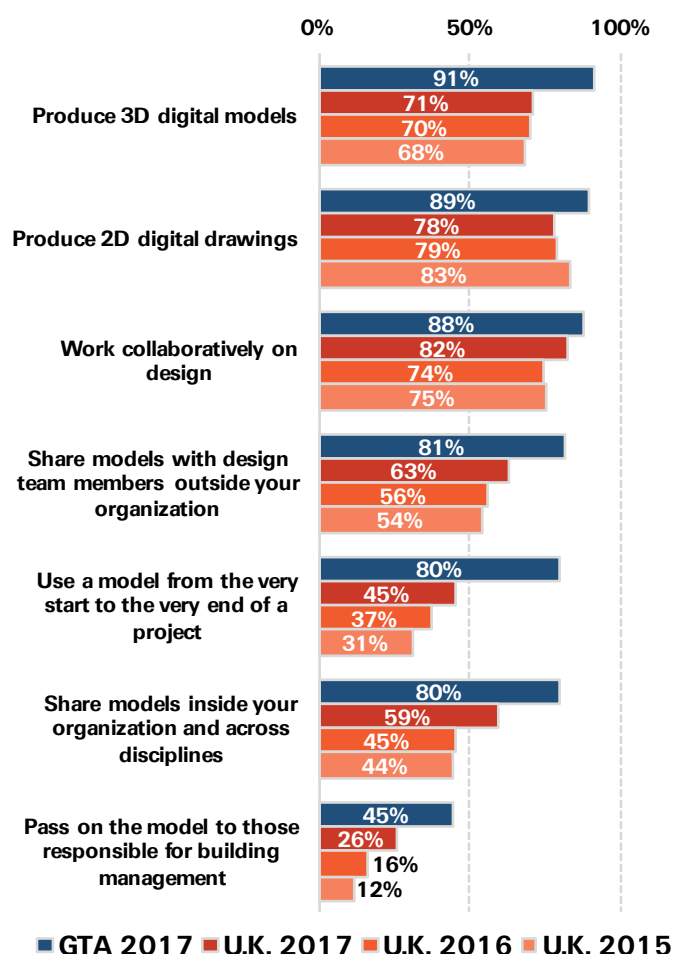
Another explanation is that 3D models are being developed for visualization purposes and not being used to the full extent of their capabilities. The 2D drawings are therefore still needed for providing sufficient levels of detail.

The question that needs to be answered is: will the GTA follow a similar pattern to that shown in the U.K. surveys?

And if so, how long will it take for the 2D drawings to be replaced by 3D models? An important observation is that only 45% of respondents in the GTA agree that they pass the model to those responsible for the continued management of the building. This number is even lower in U.K., but has been growing over the last three years from 12% to 26%.

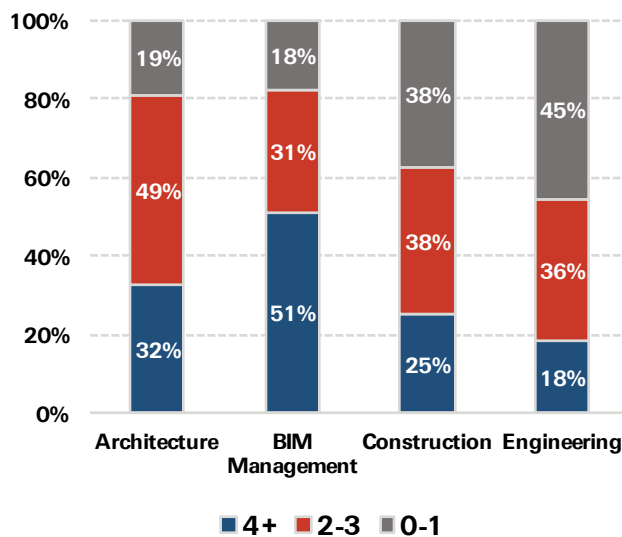
It is clear that owners and operators need to be educated on the use of BIM and the benefits need to be highlighted so that the efforts made during the design and construction in developing and maintaining BIM are fully leveraged during the operation and maintenance of a building or facility.

Regarding the projects you were involved with over the last 12 months (with or without BIM), did you ever...



“It is very important to understand the difference between BIM process and BIM tools. Simply using a BIM tool does not mean you are embracing the full benefits of the BIM process.” – Andre Carvalho (Operation Chair - tBIMc)

How many parties (outside of your organization) do you typically share the BIM with?



45% of Engineering respondents and 38% Construction respondents indicated that they share models only internally or with one external party, whereas over 80% of BIM and Architecture respondents share their files with at least two parties outside of their organization. BIM-driven projects foster a collaborative environment and to leverage the potential benefits of BIM, it needs to be shared with as many as stakeholders as possible. The research team will closely monitor these metrics over the next three-five years as an indicator of the level of BIM sophistication within the local AEC industry.

“For a successful BIM process, you need all stakeholders at the table from the beginning.”
– Expert Interviewee

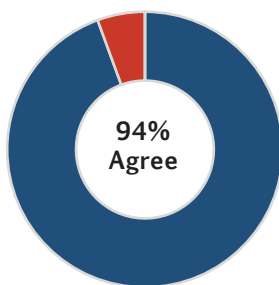
“We are at a place where nobody is doing anything that does not involve 3D to some degree.”
– Expert Interviewee

BIM Beliefs, Benefits, and Barriers

An important aspect of the GTA survey was to capture local industry's beliefs around BIM, the perceived benefits, and barriers that limit the implementation of BIM. The following sections summarize some of the key findings of the survey in this context.

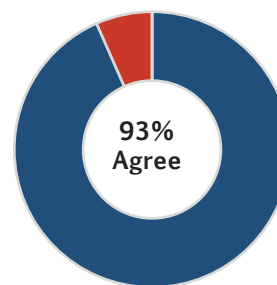
BIM is the future of project information.

There is an overwhelming agreement (94%) that BIM is the future of project information. Only 6% of respondents are neutral about this statement, and none disagreed.



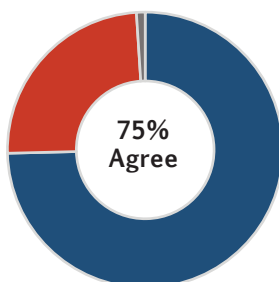
You hear more about BIM these days.

The concept of BIM has gained significant attention in the AEC industry and people are more likely to hear about BIM and BIM-related products. Over 93% of respondents agree with this statement.



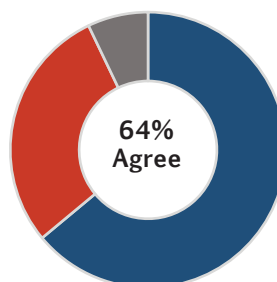
Using BIM results in operation and maintenance savings.

75% of respondents believe that adopting BIM in projects and incorporating BIM-based processes in the operation and maintenance phase of a building will result in cost savings. Only 24% remain neutral about this statement, and 1% disagree.



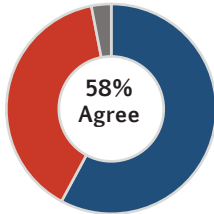
The industry is not clear enough on what BIM can do.

64% of respondents agree that the industry as a whole does not understand the full potential of BIM, which highlights the immediate need for educating the industry on the benefits of BIM.



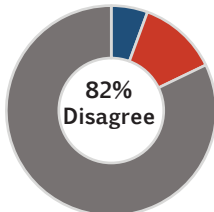
Clients don't understand the benefits of BIM.

Only 58% of respondents agree with this statement; 39% remain neutral. While there is work to be done in educating the owners on the benefits of BIM, this response suggests that there are other factors that are prohibiting more owners to demand BIM on their projects.



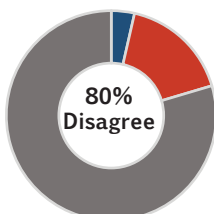
BIM is just a software.

82% disagree that BIM is just a software. Respondents seem to agree that BIM has many functionalities beyond a software tool. This percentage is expected to grow over the next three-five years as more people get educated on the benefits of BIM.



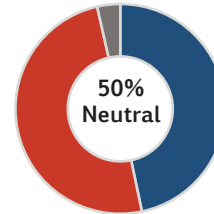
BIM is only for new builds, not refurbishment.

While 80% respondents disagree, certain projects definitely do not need BIM in the current industry. Construction is slow to adopt to new technology, and it may be several years before we see BIM being used in refurbishment projects.



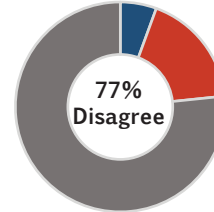
I trust what I hear about BIM.

Interestingly, 50% of respondents remain neutral about this statement; only 47% trust what they hear about BIM. Clearly, this is a problem in our AEC industry that needs to be addressed.



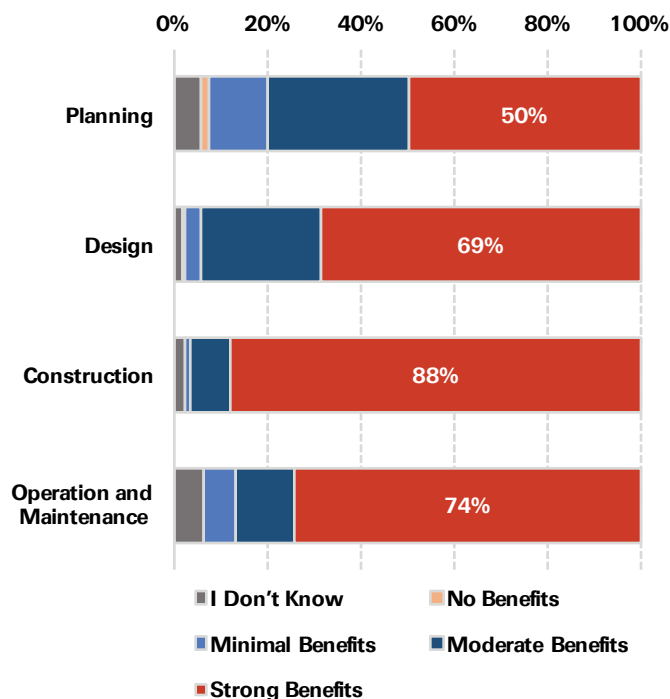
BIM is just for large organizations.

Even though 77% disagree that BIM is just for large organizations, incorporating BIM into existing organizational workflows in small or mid-size companies are an issue that was raised numerous times during the interviews.



“The smaller the project, the harder it is to convince people to use BIM.”
– Expert Interviewee

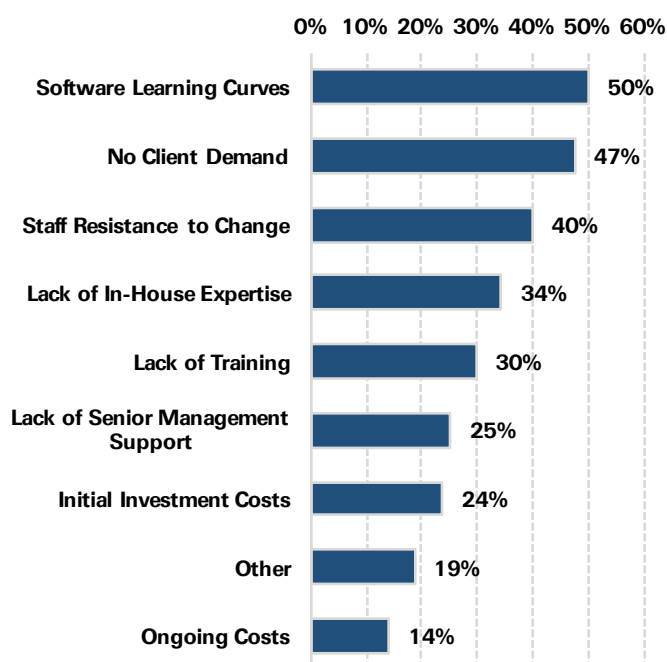
In your opinion, how much would each phase of a project benefit from BIM?



Respondents believe that adopting and implementing BIM will benefit the four phases of a building life cycle. In particular, they believe that adopting BIM will have significant benefits for the construction phase.

Implementing BIM in construction will create a new array of opportunities and challenges. For instance, clashes can be identified prior to construction and components can be designed and manufactured to fit the schematic layout. Efficient construction techniques that can be implemented on a BIM platform, including lean construction and pre-cast construction, can be used to increase the productivity of the construction projects.

Barriers to using BIM in your organization

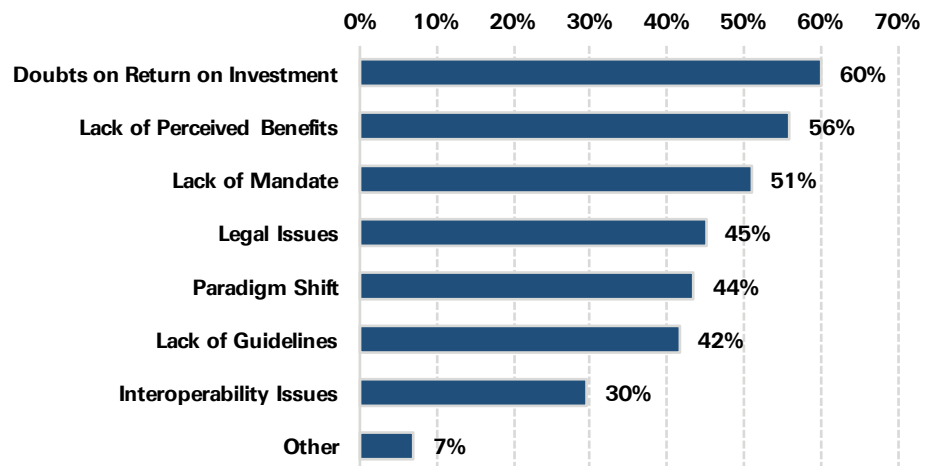


Learning curves for BIM software are identified as the No. 1 barrier in implementing BIM in organizations, followed closely by lack of client mandate. Learning curves are more of an issue for older employees that have been using 2D drawings for a long period of time and are resistant to change, which is also identified as a separate and significant barrier.

It is expected that as owners and governments realize the advantages of BIM, there will be a stronger demand for BIM on projects, which can significantly facilitate the implementation of BIM across the AEC industry. Also, as younger generation of workers enter the workforce, the learning curves will diminish.

88% of respondents strongly believe that BIM can benefit a project during Construction.

Industry-wide Barriers for BIM Implementation



When asked about industry-wide barriers against BIM implementation, doubts on ROI and lack of perceived benefits are on the top of the list, closely followed by the lack of mandate.

The same pool of respondents already indicated that BIM can be beneficial to all phases of a project, so the main issue here is that the owners, including the government, do not fully understand the benefits of BIM and perhaps the main industry-wide barrier to BIM implementation is education. We need to educate the owners on the benefit of BIM and once the benefits are documented and communicated to the owners and clients, we should expect to see a sharp increase in BIM implementation across the industry.

Another interesting observation is that 42% of respondents identified lack of guidelines as an issue for industry-wide implementation of BIM. This particular barrier is something that the industry itself, with the help of academia and groups such as BuildingSMART and tBIMc can effectively overcome.

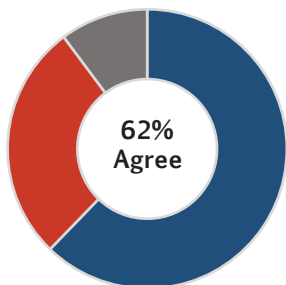
“By delivering everything in CAD, companies will not be competitive in the very near future.”

- Expert Interviewee

42% of respondents identified lack of guidelines as a barrier for industry-wide implementation of BIM.

BIM and Governance

BIM should be mandated by the government.



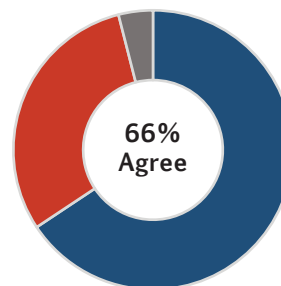
There is a strong belief that BIM should be mandated by the government in one form or another. Canada, compared to the other G7 nations, is the only country without a national mandate for the use of BIM on public-sector projects. To drive the adoption of BIM in private-sector projects, a national mandate needs to first be established. The adoption of BIM in the public-sector work will trickle down into the private- and commercial-sector work and increase the use and awareness of BIM in projects.

“We need to have a top-down approach through government mandate, otherwise we will be spinning our wheels for sometime.”
– Expert Interviewee

62% of respondents agreed that BIM should be mandated by the government, with only 10% opposing it!

Government agencies will increasingly insist on us (industry) adopting BIM.

There seems to be a consensus within the industry that the government mandate for BIM is coming. Almost two-thirds (66%) of respondents believe that government agencies will increasingly insist on BIM adoption.



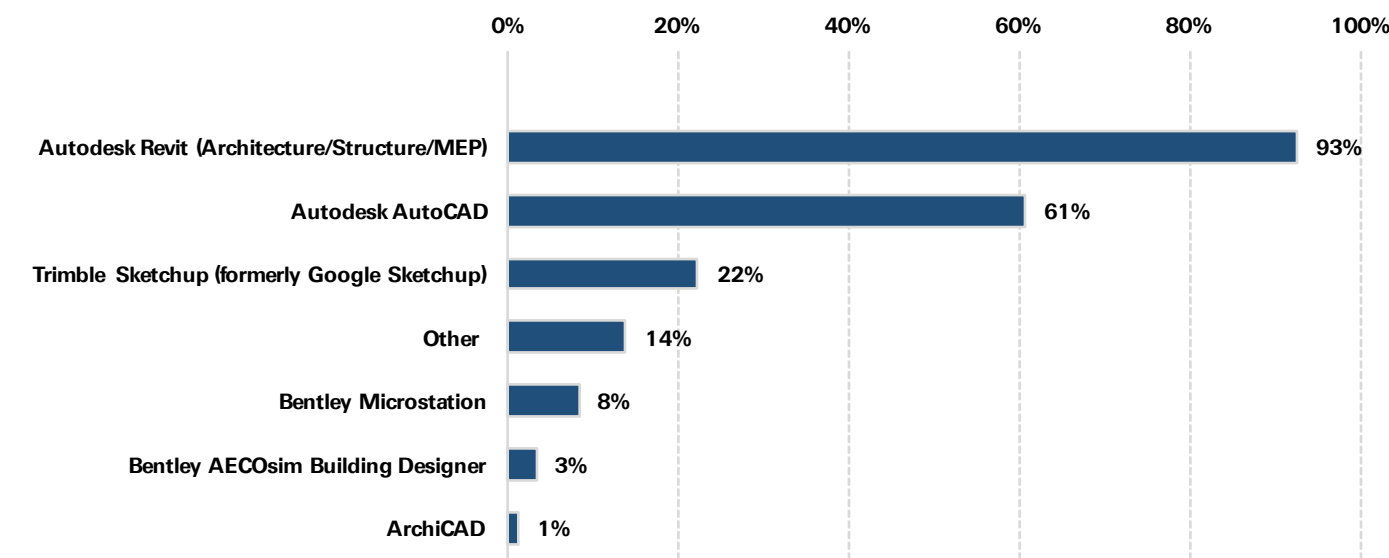
“A Canadian BIM mandate will lessen the risks on architects, engineers and contractors and maximize the benefits to owners and operators. The AECOO can truly work collaboratively when BIM Standards have been established.” – Claudia Cozzitorto
(Executive Director - tBIMc)

BIM Resources

Autodesk products, including Revit and AutoCAD dominate the GTA market. European markets show a wider range of diversity in products, but Autodesk seems to have a complete control over the GTA and perhaps the Canadian market.

Respondents indicated that they may use additional drafting and modelling tools for their work as supplementary BIM tools for simulation, analysis and estimation. The “Other” category in this question, included Rhino, Grasshopper, Dynamo, Tekla, Navisworks, BIM360, 3ds Max and Civil 3D.

When producing drawings or models over the last 12 months, which of the following tools did you mainly use? (Check all that apply.)

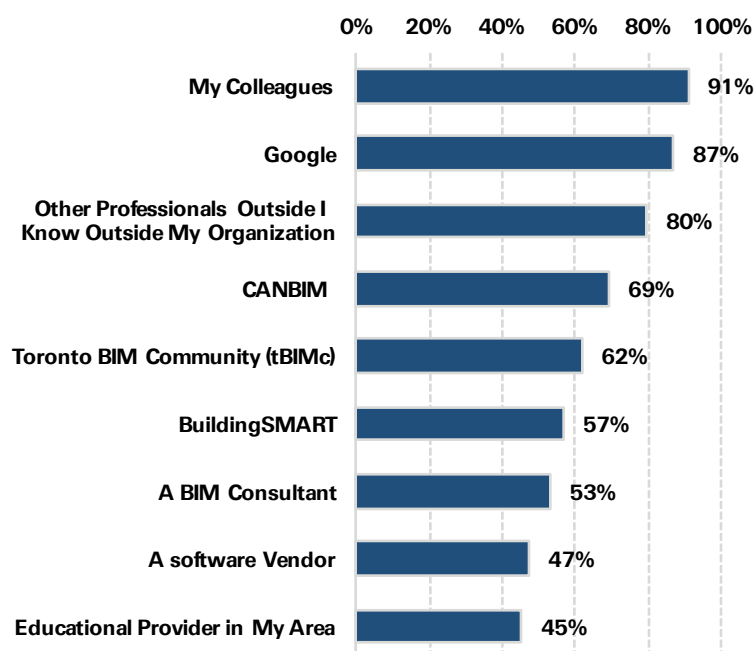


“The BIM tools that you know and use today may soon disappear or be replaced, but the BIM process is here to stay.”
– Andre Carvalho (Operation Chair - tBIMc)

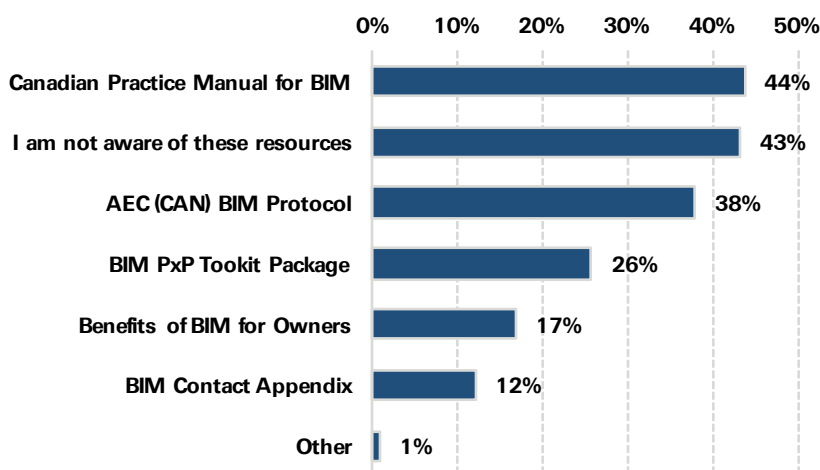
Where do you get your information about BIM?

The majority of respondents indicated that they go to their colleagues as the first source of information when they have problems or questions about BIM. This signifies the importance of having capable and competent expertise in the organization who can educate their peers about the use of BIM.

Not surprisingly, Google is also a major source of information for BIM users. Google can direct users to the appropriate forums to seek advice about BIM. This signifies the importance of online BIM resources at local, national, and international levels.



Which of the following Canadian BIM resources are you currently aware of?



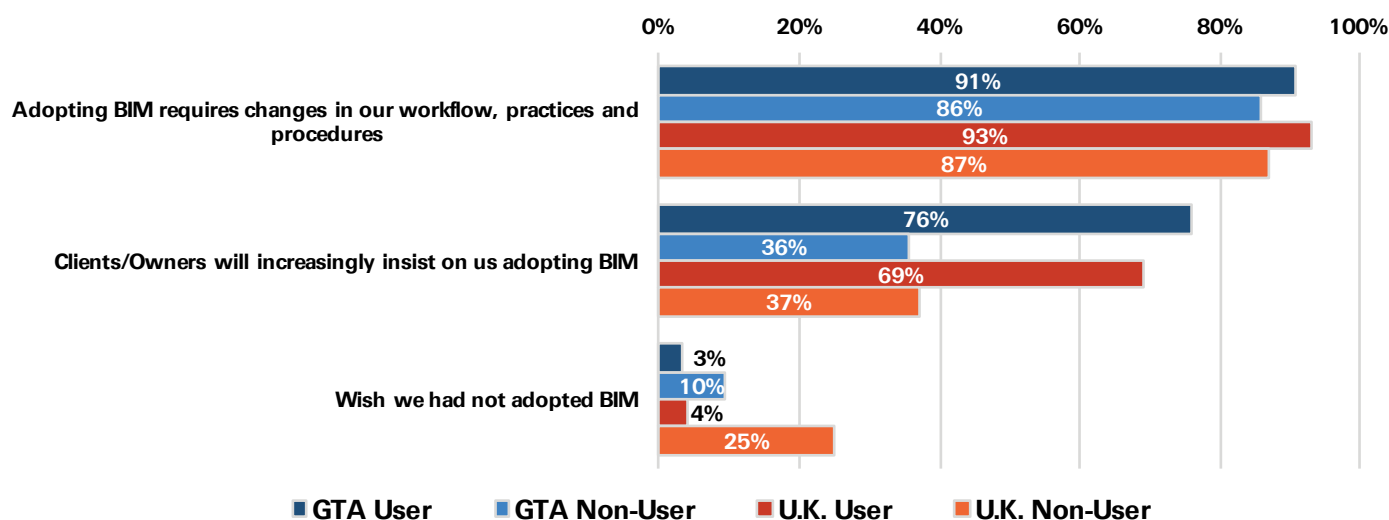
There are currently several Canadian BIM practice guidelines for the professional to follow as best practices. However, a significant portion of respondents (43%) are not aware of these resources. This indicates a lack of awareness of the BIM resources and the disjointed nature of existing BIM best practices.

Collaborative environments and common best practices need to be established to ensure an efficient and effective adoption of BIM in the AEC industries.

Perspectives of Users vs. Non-Users

One objective of this survey was to capture and compare the perspectives of users and non-users and identify where the gaps exist. These gaps are the main sources of misconceptions and false information that may exist regarding BIM practices in the industry.

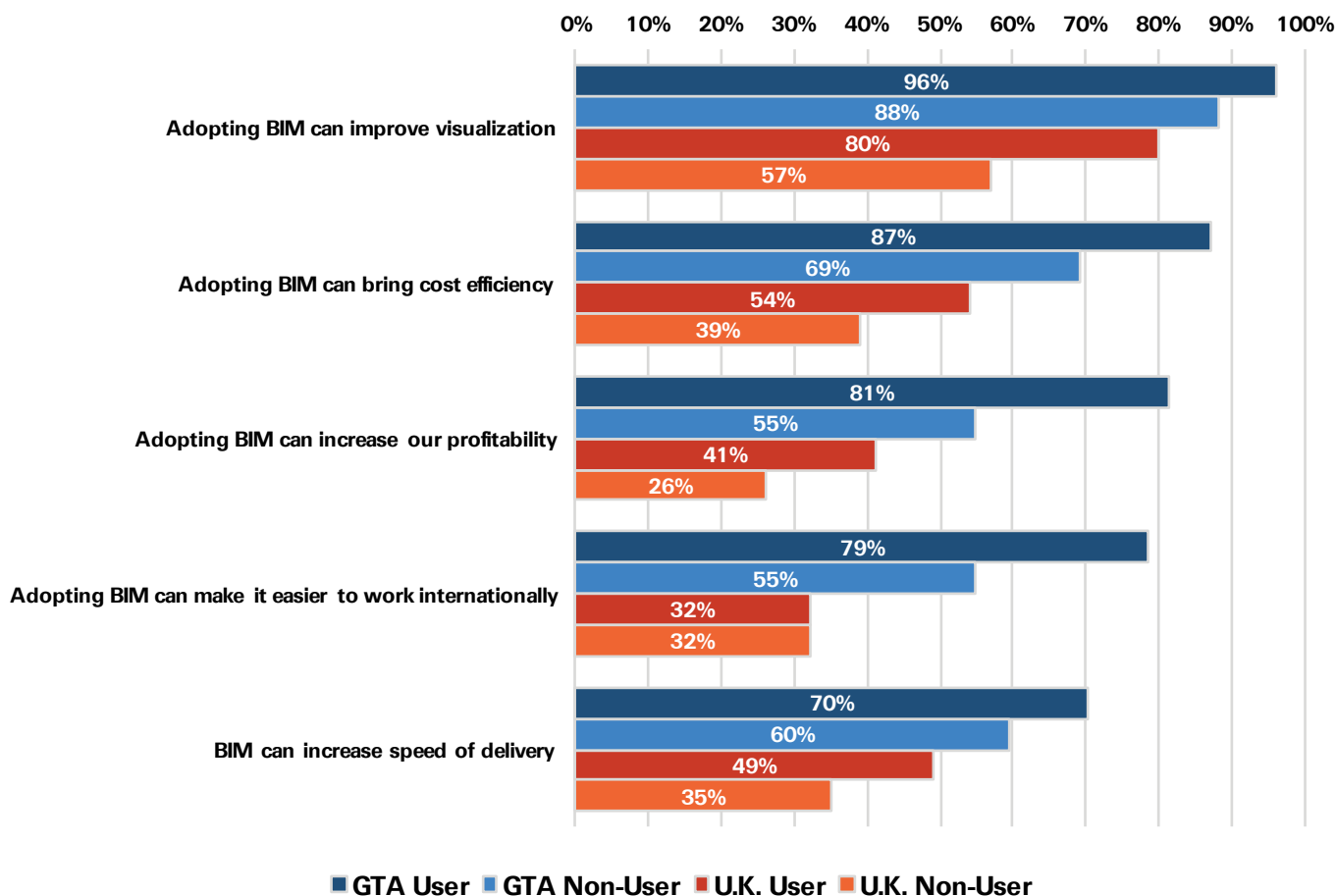
U.K. has adopted the same strategy in one of its surveys, which allowed us to benchmark the user/non-user perspective of GTA participants against those in U.K.



There is a consistent belief among the surveyed users and non-users in both the GTA and the U.K. that adopting BIM requires changes in the workflow. BIM users from the GTA and U.K. surveys generally agree that clients/owners will increasingly insist on using BIM, whereas non-users have less confidence in this trend. What is perhaps most interesting is the consistency of the responses from both U.K. and GTA user and non-user groups. The difference between user and non-user groups is expected, but is likely to diminish as clients continue to understand the benefits of BIM and increase the demand for BIM in public and private projects.

76% of BIM users in the GTA believe that government agencies will increasingly insist on adopting BIM.

From the GTA respondents, both users and non-users agree that BIM can improve visualization. The user group seems more convinced that BIM can bring cost efficiency, increase profitability, and increase the speed of delivery. The cost-benefit of using BIM seems to be a source of disagreement between user and non-user groups, with users showing a strong belief that BIM will improve their cost efficiency and profitability.



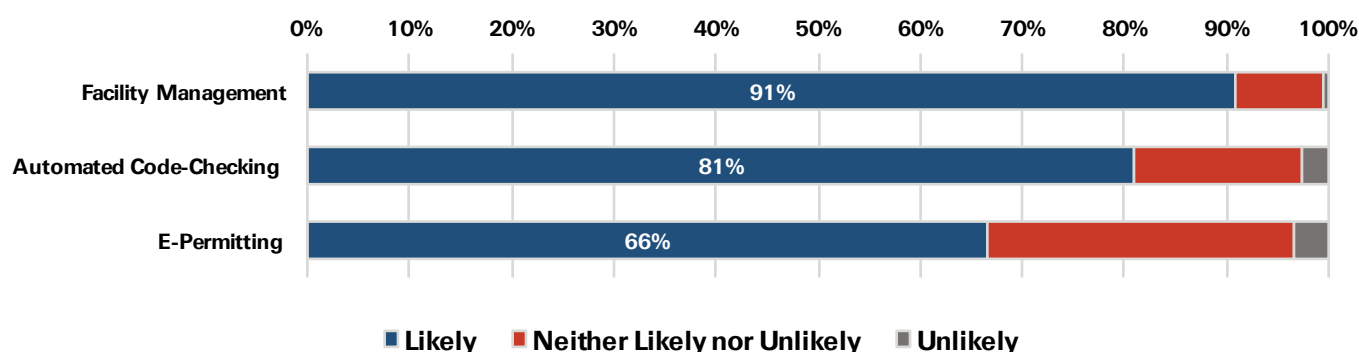
The discrepancy between GTA and U.K. respondent is significant for the notion that adopting BIM facilitates international competitiveness. There is a consensus between user and non-user for the U.K. survey as only one-third of participants agree with this statement; whereas, over half of the GTA respondents agree with this statement, and the BIM users agree much more strongly than non-users. The concept of Open-BIM in the U.K. may present a challenge to the industry because of interoperability issues that arise for the sharing of BIM across different platforms. The North American industry is largely dominated by Autodesk as the common source of BIM platform. The use of common platform will lead to international opportunities for firms because of the minimum issues with interoperability.

Future of the Construction Industry

The local AEC industry is gradually adopting BIM in pursuit of increased productivity and enhanced competitiveness in the local and global marketplace. Other related practices that have been highlighted in recent years include facility management, automated code compliance, and e-permitting.

Participants strongly believe that BIM and facility management will go hand-in-hand as the technology continues to improve and complement the operation and maintenance of a facility. Automated code compliance is also attracting significant attention due to the challenges with manual code compliance practices and ever-increasing duration of permitting processes in dense urban centres, such as the City of Toronto. E-permitting has already been established in a number of countries and to varying degrees. The Residential Construction Council of Ontario, University of Toronto, Ontario Government, and Federal Government of Canada have all been involved in a number of initiatives regarding e-permitting in recent years, and it is expected that municipalities in the GTA will eventually follow in the footsteps of other advanced municipalities around the world and implement e-permitting practices. This survey clearly shows that the industry participants agree that e-permitting is likely coming to GTA in the near future.

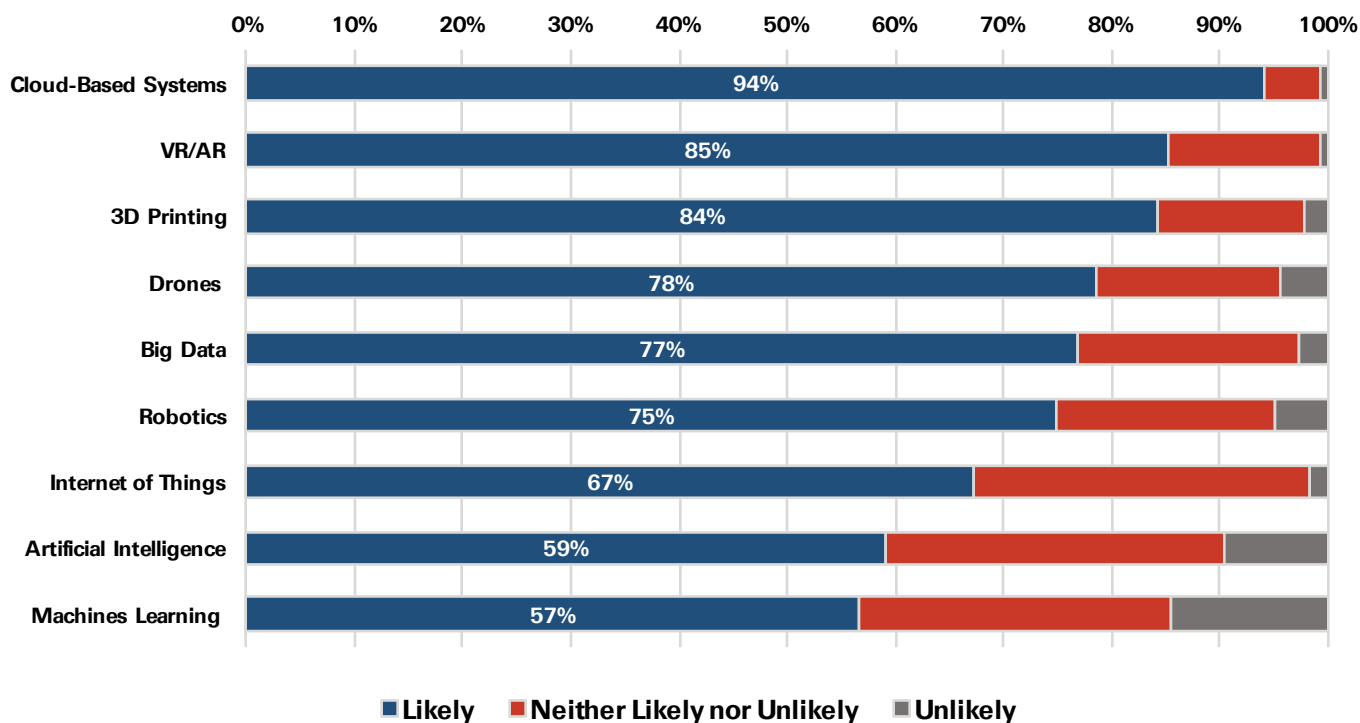
In your opinion, which of the following applications could be useful in the future of the construction industry?



“We spend a lot of resources in developing the BIM for our projects, but need to print off 2D drawing and submit paper copies for permitting. There is a great deal of potential being wasted.” – Expert Interviewee

The future of the construction industry will be influenced by technologies that can maximize the productivity of existing systems and processes. Participants of this survey believed that cloud-based systems, virtual and augmented reality and 3D printing will have a significant influence on the construction industry over the next 10 years. The future surveys will continue to monitor these and other trends within the local AEC industry.

In your opinion, how likely are the following technologies to have a significant influence on the construction industry over the next 10 years?



“The future is already here - it’s just not very evenly distributed.”
- William Gibson

Building Tall Research Centre gratefully acknowledges the financial support from the Residential Construction Council of Ontario (RESCON) and the Natural Sciences and Engineering Research Council of Canada (NSERC) in completing this project.





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