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The Adoption of Building Information Modelling in Canada

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Abstract: The First Annual BIM Survey was published in 2018 to understand the local adoption of Building Information Modelling (BIM) in the architecture, engineering, and construction (AEC) industries in the Greater Toronto Area. Technical analyses for the survey were also presented in the 2018 CSCE Conference in New Brunswick. Subsequently, the Second Annual BIM Survey was conducted in collaboration with the Residential Construction Council of Ontario, Canada BIM Council, BuildingSMART Canada, and local BIM chapters to engage AEC professionals in Canada. In this paper, sample results of the second survey are presented and benchmarked against those in the first survey. Cross-examinations of provinces and perspectives of BIM users and non-users are also discussed. This study serves as one of the milestones for BIM transition in Canada and aims to present a holistic view of the role that BIM plays in the future of the AEC industry.

1 INTRODUCTION

In 2018, the Building Tall Research Centre (BTRC) at the University of Toronto reported the First Annual BIM Survey to gauge the adoption and implementation of Building Information Models (BIM) in the architecture, engineering, and construction (AEC) industries in the Greater Toronto Area (GTA). The pilot project was developed because of the limited knowledge in BIM adoption in the local AEC community. The 2018 survey was well received by industry professionals as it garnered 252 participants from the GTA region (McCabe et al. 2018). Technical analyses of the survey were presented in the 2018 Canadian Society for Civil Engineering (CSCE) conference in New Brunswick (Zhang et al. 2018). After the publication of the 2018 survey and CSCE conference paper, two national BIM organizations – Canada BIM Council (CanBIM) and buildingSMART Canada – reached out to researchers at the BTRC and proposed to launch a national BIM survey. Similar to the First, the Second Annual BIM Survey was announced and opened in October 2018 at a Toronto BIM Community event and closed the following February. Collaborating with Residential Construction Council of Ontario, CanBIM, buildingSMART Canada, and local BIM chapters, the 2019 survey was disseminated across Canada. The timeline of the First and Second Annual BIM Surveys is shown in Figure 1.

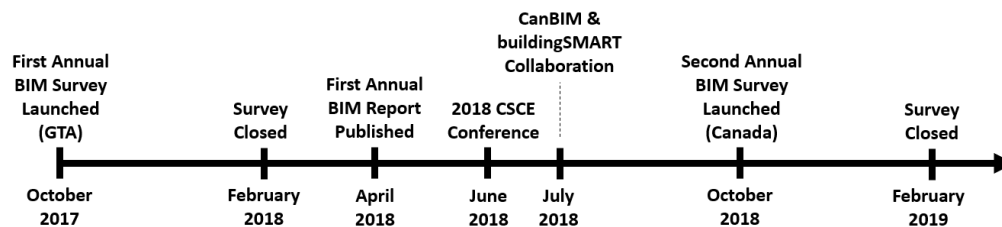


Figure 1: Project Timeline

In this paper, sample results from the Second Annual BIM Survey are presented, along with benchmark analyses for the first survey. Cross-examinations for different provinces and perspectives of BIM users and non-users are also discussed. The contribution of this study is to provide a holistic perspective of the adoption and implementation of BIM in the Canadian AEC industry.

2 SECOND ANNUAL BIM SURVEY

A BIM task force based in the United Kingdom (UK) – National Building Specifications (NBS) – has been publishing annual reports that summarize the adoption of BIM for the UK nation. Their survey questions were partially adapted in the 2018 survey. The 2019 survey follows a similar format to that of the 2018 survey, with some adjustments to fit the scope of capturing the nation-wide perspectives. Table 1 shows the 2019 survey questions, and a preview of the questionnaire can be found on SurveyMonkey in [English](#) and [French](#) versions.

Table 1: Survey Questions

Section	No.	Description
1. General Information	Q1	Which of these better explains your main role?
	Q2	How many years have you been working as a professional in your discipline?
	Q3	What is your age?
	Q4	In what province/territory is the office in which you primarily work?
	Q5	In what city are you currently working?
	Q6	How would you describe your organization type? (14 options)
	Q7	How many people are employed in your organization (including yourself)?
	Q8	Where is your organization currently doing most of their work?
	Q9	Which of the following project types have you participated in the past 12 months? (10 options)
	Q10	How familiar are you with BIM?
	Q11	Which statements best describes your organization?
2. BIM Experience	Q12	Thinking about the projects you were involved within the last 12 months, did you ever...? (7 options)
	Q13	How confident are you in your knowledge and skills in BIM? (2 sub-questions)
	Q14	Do you agree or disagree with the following BIM beliefs? (10 sub-questions)
	Q15	Within your firm, have you ever adopted BIM for projects you have been involved with?
	Q16	Approximately in what percentage of projects have you used BIM in the last 12 months?
	Q17	How many stakeholders and/or organizations (outside of your own) do you typically share BIM with on a project?
	Q18	What are your thoughts on Open BIM? (5 sub-questions)
	Q19	Over the last 12 months, which of the following tools did you mainly use? (19 options)
	Q20	What do you use BIM for? (18 options)
	Q21	What are the main barriers to using BIM? (18 options)
	Q22	Do you agree or disagree with the following BIM benefits? (15 sub-questions)
3. BIM Resources and Future of Industry	Q23	Which of the following sources of information about BIM are you most likely to use? (11 options)
	Q24	Which of the following Canadian BIM resources are you currently aware of? (6 options)
	Q25	In your opinion, how likely are the following technologies to have a significant influence on the industry over the next 10 years? (10 sub-questions)

The survey consisted of three sections: General Information, BIM Experience, and BIM Resources and Future of the Industry. Respondents' demographics, background, and company information were collected in the first section. Then, participants were asked to share their BIM experience, such as the level of familiarity with BIM technology, the functionality of BIM, and perceived benefits and barriers for adopting BIM in projects. Finally, insights on BIM resources and the future trend of the construction industry were gathered in the last section. Many questions contained sub-questions. For example, Question 12 (Figure 2) focused on BIM experience by asking participants about common BIM activities. In addition, "option" questions (e.g., Q21 – BIM barriers) were presented throughout the survey. These questions prompted a "yes" or "no" response, and so they were also categorized as sub-questions. As a result, the entire survey contained over 100 sub-questions. As a result, the entire survey contained over 100 questions. The typical completion time was approximately 12 minutes.

12. Thinking about the projects you were involved with over the last 12 months, did you ever...

	Yes	No
Work collaboratively on design	<input type="radio"/>	<input type="radio"/>
Produce 2D digital drawings	<input type="radio"/>	<input type="radio"/>
Produce 3D digital models	<input type="radio"/>	<input type="radio"/>
Share models with design team members outside your organization	<input type="radio"/>	<input type="radio"/>
Share models inside your organization, across disciplines	<input type="radio"/>	<input type="radio"/>
Use a model from the very start to the very end of a project	<input type="radio"/>	<input type="radio"/>
Pass on the model to those who are responsible for the continued management of the building	<input type="radio"/>	<input type="radio"/>

Figure 2: Sub-questions for Question 12

3 SECOND ANNUAL BIM SURVEY

The second survey received 398 responses from the Canadian AEC professionals. The response rate was a significant improvement compared to 2018 survey of 252 participants and to the previous two externally-driven efforts for BIM Surveys in Canada, which garnered 78 and 127 responses in 2013 and 2016 (NBS 2013, NBS 2016), respectively.

The following sections provide sample results of the 2019 survey, including participants' demographics, BIM awareness and usage, confidence in BIM knowledge and skills, BIM applications, and BIM beliefs. Benchmarking analyses of the 2019 survey against the 2018 survey for the GTA region are also presented.

3.1 Participation by Province

Figure 3 shows the participation of each province for the 2019 BIM survey. Of the 398 responses received, more than half (65%) are from Ontario. After all, the 2019 survey was first released and promoted in Ontario, and the local BIM community in the GTA region is very active compared to other metropolitan centres in Canada. Response rates from Alberta, British Columbia, and Quebec are indicated at 17%, 9%, and 6%, respectively. Few industry professionals from Nova Scotia, Manitoba and Saskatchewan participated in the survey, which together accounted for 4% of the total number of participants. No responses were collected

from the remaining three provinces and territories. In proportion to the province population (Figure 4), Quebec is significantly under represented by 18% and Ontario is overly represented by 25%. Future efforts should be focused on actively engaging provinces outside of Ontario to better represent the AEC community in other provinces and understand the adoption and implementation of BIM in Canada.

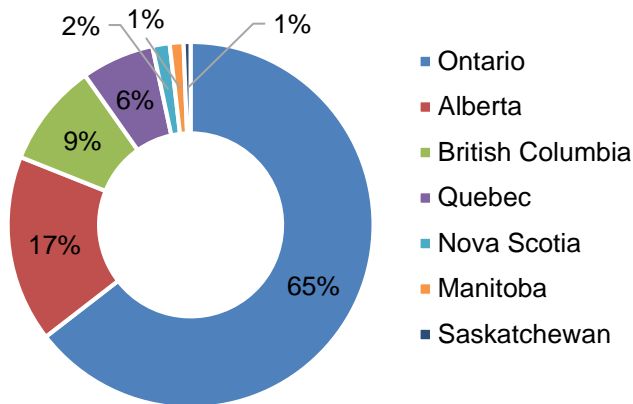


Figure 3: Participation from Each Province

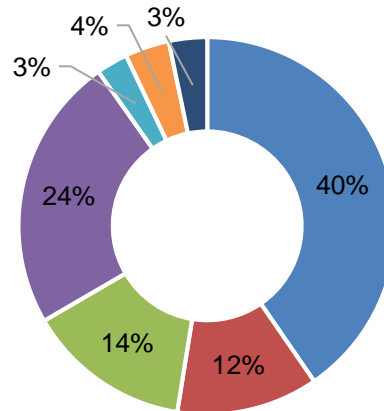


Figure 4: Population by Province (Statistics Canada 2018)

3.2 BIM Awareness and Usage

Figure 5 summarizes participants' BIM awareness and usage. A slight increase (8%) in participants' awareness and usage was indicated when comparing the 2019 and 2018 survey for the GTA region. The responses across the rest of Canada were consistent with the GTA results in the 2019 survey. However, the distribution of participants, as indicated in Figure 5, is strongly represented by the Ontario province, and so the awareness and usage levels were further investigated for the province of British Columbia, Alberta, Ontario, and Quebec.

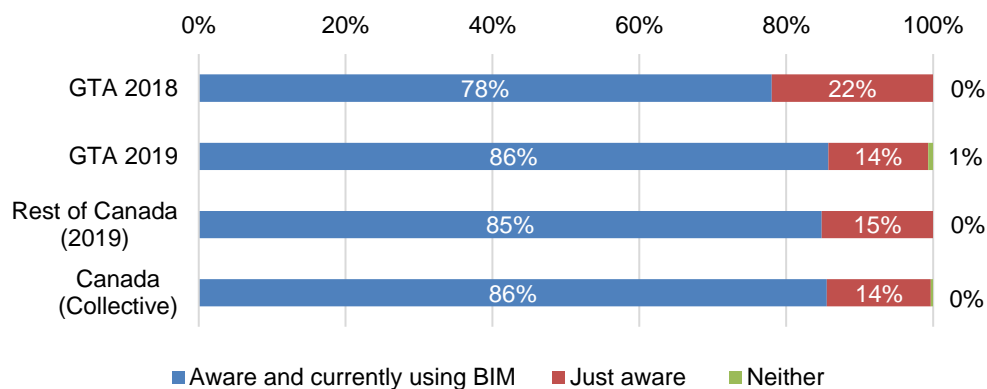


Figure 5: BIM Awareness and Usage

Figure 6 indicates that over 80% of participants are aware of and are currently using BIM amongst the group of four provinces (G4P). In particular, Quebec shows a 94% active user rate amongst the participants. Because the 2018 survey is a Canada-wide effort and no previous data were available for benchmarking, it will be interesting to compare the results of the 2019 survey to those of the 2020 survey.

Based on a similar approach adopted in the 2018 survey and the UK BIM reports, participants were categorized into two groups: BIM users and non-users. Users are those aware and currently using BIM; non-users are the others (Zhang et al. 2018). These two groups will be used in the subsequent sections.

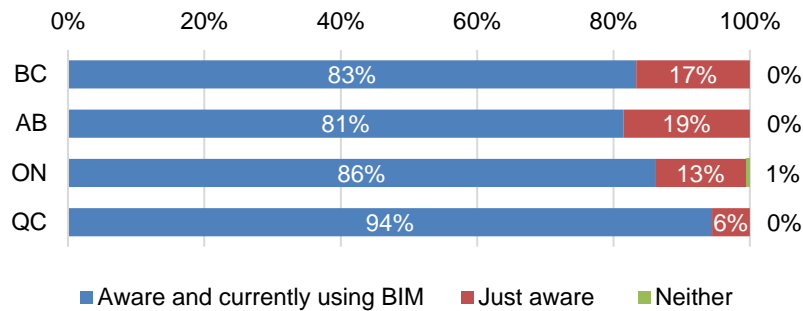


Figure 6: BIM Awareness and Usage amongst the G4P

3.3 Confidence in BIM Knowledge and Skills

Figure 7 shows participants' confidence in BIM knowledge and skills. Over 74% of BIM users responded "Confident" or "Quite Confident" in BIM knowledge and skills. Of the non-users, only 39% were "Quite Confident" in their BIM knowledge and 22% were "Confident" or "Quite Confident" in their BIM skills. For those who are "Quite Confident" in their BIM knowledge, users and non-users have almost the same response rate, but non-users are less confident in their skills. Since non-users do not use BIM on a regular basis, a gap in confidence is expected. However, with adequate education and proper technical training, the gap can be reduced.

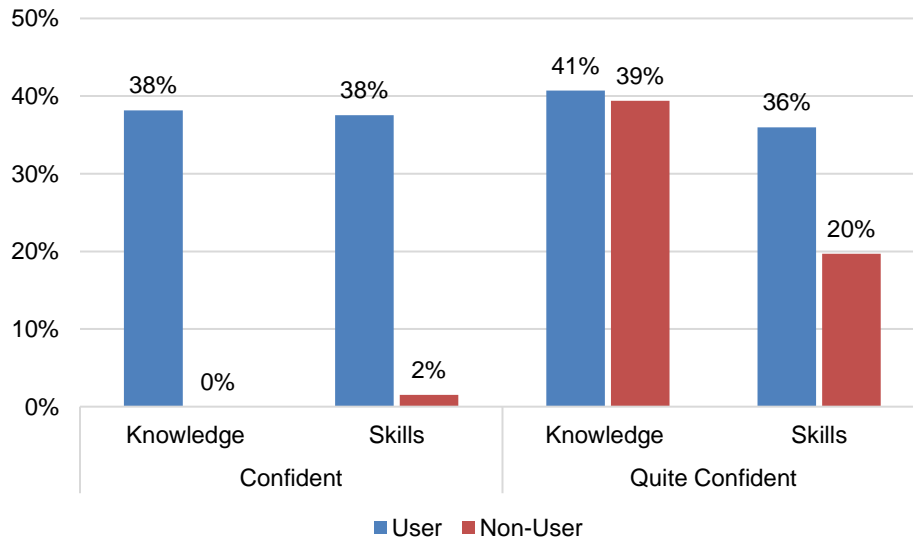


Figure 7: User and Non-User's Confidence in BIM Knowledge and Skills

3.4 BIM Applications

The "information" aspect in BIM is often overlooked by industry professionals who primarily use the technology for modelling and providing 3D visualization of a physical asset. However, the information is valuable to project stakeholders because they make informed decisions based on the different applications offered in a BIM database. The applications of BIM extend to many areas, such as coordination,

communication, visualization, design, and scheduling. Question 20 was designed to understand BIM applications in the Canadian AEC industry. It is noted that the 2018 survey and UK BIM reports did not inquire about the application of BIM in construction projects. So, this question provides new insight to the adoption and implementation of BIM in the industry.

Arranged in descending order for the overall responses, Figure 8 shows the top four BIM applications selected by the participants: coordination, visualization, collaboration, and clash detection. The responses of the G4P are included to show differences between the participants from each province. Quebec shows a significantly higher rate of application compared to the other three provinces – almost 90% for all four BIM applications. Possible reasons for the higher rates in Quebec may be the small number of participants from Quebec, the progressive attitudes of the Quebec participants, or the greater use of these BIM applications. By comparison, Ontario has lowest response rate for three of the four applications, which indicates a more conservative perspective on the uses of BIM in the province.

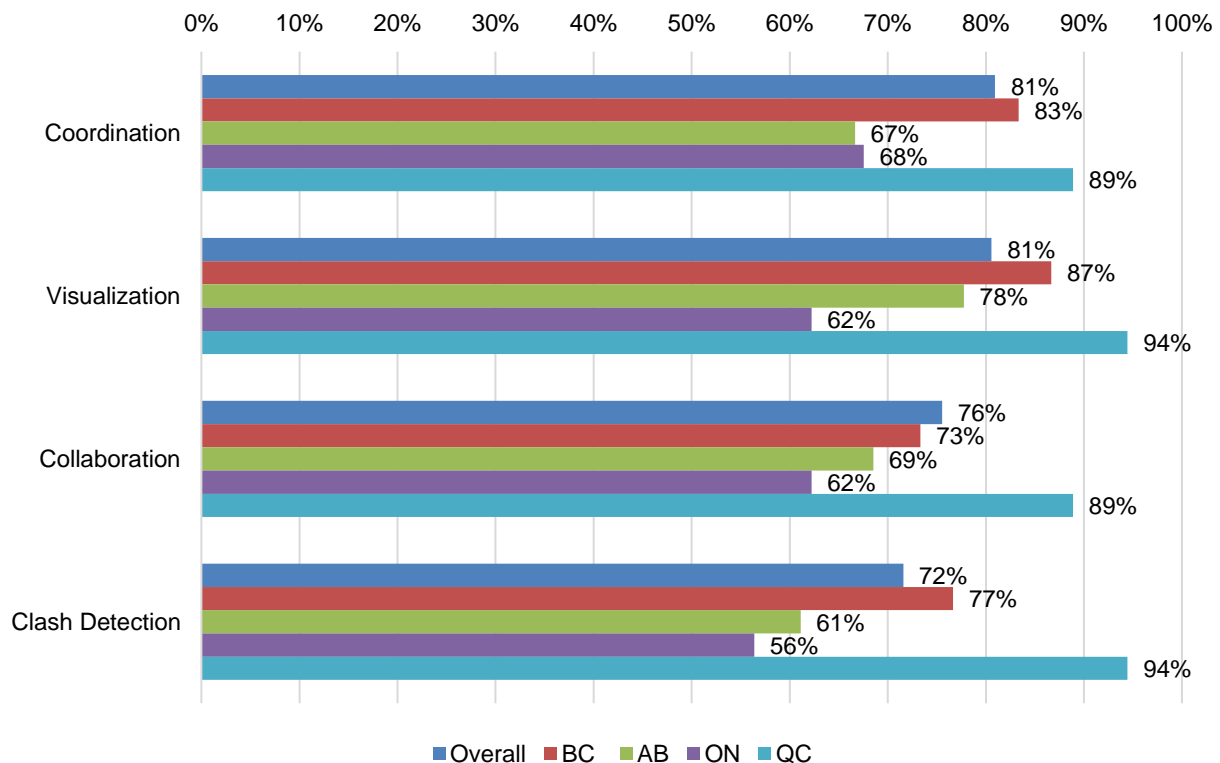


Figure 8: Top Four BIM Applications

The top four BIM applications are commonly identified in construction projects. A more interesting perspective is to identify applications that are not commonly implemented in projects, which are shown in Figure 9. The overall responses show that the lowest ranked four BIM applications are estimating, structural analysis, inspection, and facility management. Again, Quebec shows significantly greater use of these applications compared to other provinces, which may be an effect of the lower number of respondents. The other three provinces showed similar response rates. Although estimating is listed as one of the bottom four BIM-enabled applications, it is quite different than quantity take-off (QTO), which is actually ranked at 7th overall of the 18 listed applications for Question 20. QTO provides a mean to reduce the onerous process for tallying construction materials; however, estimating accounts for labour, equipment, and other contingency costs, which is currently difficult to implement in BIM. The other three applications are possible in the BIM environment; however, barriers such as software compatibility, lack of training, or resistance to

change, have made the process difficult for the industry professionals to realize the potential applications of BIM.

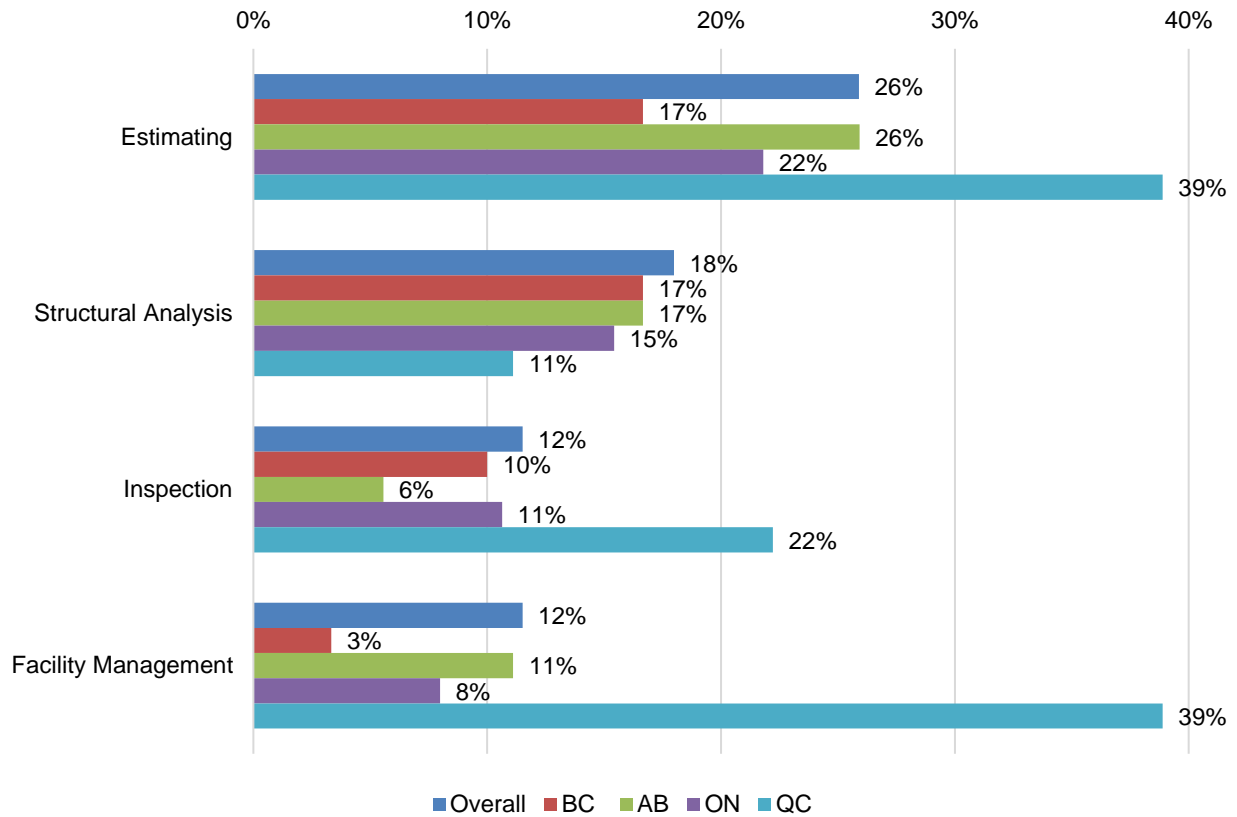


Figure 9: Bottom Four BIM Applications

3.5 BIM Beliefs

The following sections provide discussions on the cross-examination of the G4P and comparison of the first and second surveys for the GTA region.

3.5.1 BIM Beliefs across the G4P

Four BIM beliefs are shown in Figure 10. These beliefs were selected to understand the paradigm shift behind the process of BIM adoption. Again, Ontario shows the lowest response rate for the four beliefs. A significant portion of participants believe that clients do not understand the benefits of BIM; however, similar response rates indicated that they think the clients, owners, and government will increasingly ask them to adopt BIM. Clearly, the industry is transitioning to a BIM-enabled culture. Otherwise, their companies may not be as competitive and will inevitably get left behind.

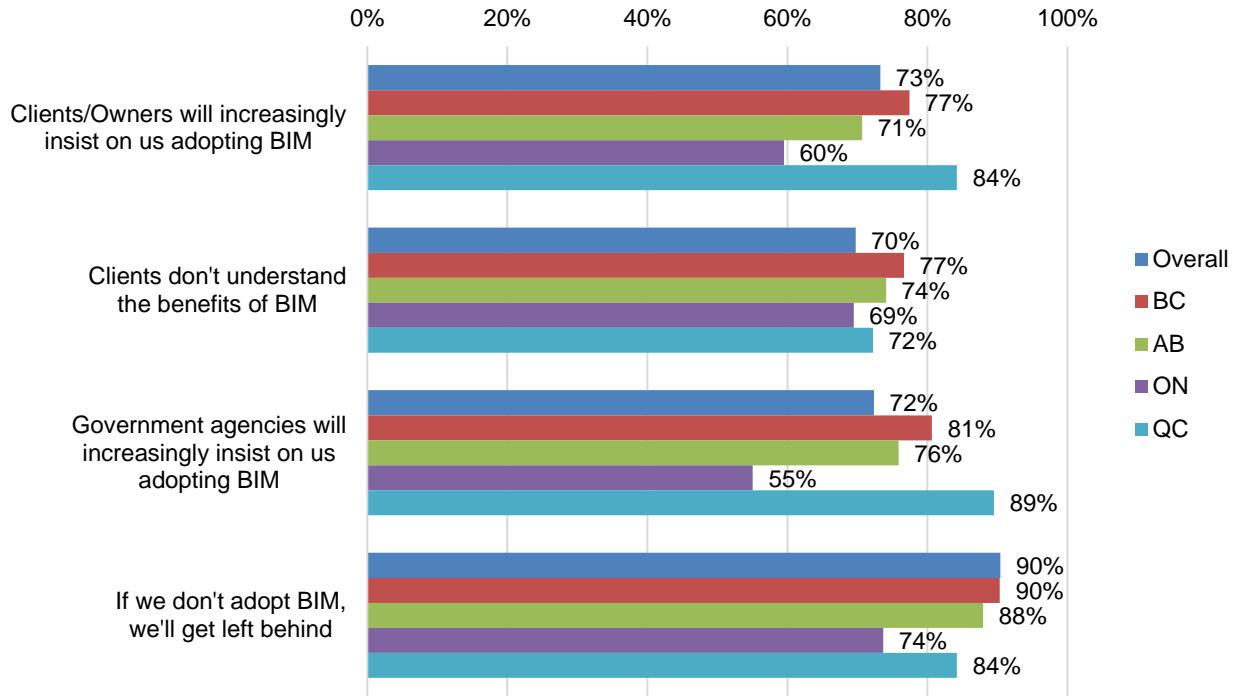


Figure 10: Cross Examination of BIM Beliefs for the G4P

3.5.2 BIM Beliefs in GTA

In addition to the cross-examination of the G4P, comparison analysis of the 2018 and 2019 GTA data was conducted. Figure 11 shows three BIM beliefs from the first and second survey. The statement – “if we don’t adopt BIM, we’ll get left behind” – is an addition to the second survey, hence no comparison could be made. Slight changes are shown for government’s and client’s demand for BIM (3% decrease and 6% increase, respectively). This may indicate an increase in demand for adopting BIM in the private sector rather than the public sector.

As for the third statement, a 10% increase was indicated by participants. Although clients do not fully understand the benefits of BIM, GTA professionals are starting to see the demand for BIM and tailoring their workflow to accommodate the BIM process. This shows a promising sign in the local industry. By providing information sessions and educational opportunities, clients would have better understanding for adopting BIM in their projects.

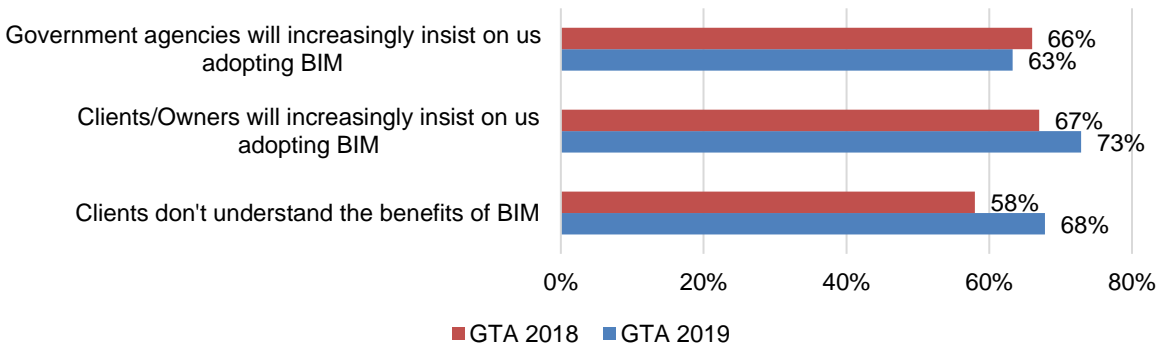


Figure 11: Comparison of BIM Beliefs in GTA

4 CONCLUSION AND FUTURE WORK

In conclusion, this paper introduced the 2018 and 2019 BIM surveys. Sample results and in-depth discussions on major aspects, including BIM awareness and usage, confidence in BIM knowledge and skills, BIM applications and BIM beliefs are presented. Cross-examinations for British Columbia, Alberta, Ontario, and Quebec were conducted, and BIM user and non-user groups were identified and justified. In addition, benchmark analyses between 2018 and 2019 GTA data were performed. The complete results and analyses for the Second Annual BIM Survey will be published online in May. This BIM initiative will be carried out on an annual basis and serve as invaluable documentation of the BIM transition process in Canada.

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