

**Macro Building
Information Modeling
(BIM) adoption in the
province of Quebec
Canada**

ANALYSIS REPORT
MARCH 2019

I Q C INITIATIVE
4.0 QUÉBÉCOISE POUR
LA CONSTRUCTION 4.0

EXECUTIVE SUMMARY

This report presents the findings of a targeted survey aimed at understanding the current state of macro BIM adoption in Canada, with a focus on the province of Quebec. The objectives of the study are to:

- Capture a clear portrait of the deployment of BIM in Quebec from the perspective of public owners and associations based on clear and internationally recognized indicators
- Identify the gaps in terms of macro BIM adoption in order to develop a comprehensive strategy for BIM deployment in Quebec

The survey and report are based on the **8 Maturity Components** of the **Macro BIM Adoption models** developed by Dr. Bilal Succar and Dr. Mohamed Kassem (Succar and Kassem, 2015; Kassem and Succar, 2017) in the context of the **BIM excellence initiative**. The survey was conducted in a targeted manner. Individuals representing the following types of organizations were targeted: public owners at the federal, provincial and municipal levels as well as representing public institutions (eg. Universities) and provincial associations. A total of 14 organisations were identified and contacted to conduct the survey of which 11 responses were logged. The survey was

conducted online between December 2018 and January 2019.

The findings show that there is increasing movement at all levels of government with respects to the deployment of BIM and digital project delivery from public organizations. While the trend is generally positive, a number of considerable risks are emerging. In particular, there is an increasing redundancy in the efforts to develop standards, guidelines and other documents to guide the BIM adoption process and the possibility of contradictions and incoherencies within these documents, which could seriously hinder industry the uptake of BIM causing both confusion and frustration. Furthermore, while some bodies have developed early BIM strategies and objectives, harmonizing these efforts would allow to focus on clarifying responsibilities and scopes for each level of government (e.g. Who does what; Who is best positioned to provide a primary/ supporting for each element of a strategy or action plan). Key takeaways from the survey highlight the need to focus on municipal and institutional bodies being the procurers and managers of considerable (if not a majority) of Canada's built environment.

Key recommendations from this study include:

- Develop a harmonized strategy for BIM deployment across Canada with clear objectives that can be adopted or adapted by all stakeholders, underpinned by a common framework (a collective why).
- Establish action items with clear responsibilities attributed to the various stakeholders involved in this transformation effort (a collective how and who)
- Define an action plan with clear milestones (a collective when)
- This action plan must clearly identify what is available and what is needed in terms of education and training, measurement and guidance (a collective what) by, for instance, addressing issues that have been identified as lacking in the survey, namely:
 - Standards and codes (to be adopted, adapted or created)
 - Contractual agreements and other regulatory requirements
 - Insurance policies

- Support systems such as classifications and information exchange protocols.
 - Develop standardized benchmarks and metrics for assessing organisations, teams and projects to drive continual performance improvement.
 - Develop or consolidate a platform for (a) sharing of information models and corresponding models; (b) digital submittals, and (3) other supporting systems such as standardised object libraries.
- Encourage multi-party cooperation between public bodies and other stakeholder groups by further enabling and empowering the champions and drivers that are already operating across Canada and in Quebec.

Next steps are to expand this survey across Canada to broaden input and support the development of this strategy and action plan. There is indeed a clear intent to extend the scope of the survey across Canada to include all other provinces and territories in the near future.

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INTRODUCTION

INTRODUCTION

The Quebec Construction 4.0 Initiative (IQC4.0), initiated by the Ministry of the Economy and Innovation in collaboration with the Group BIM du Québec, aims to support the Quebec construction industry in its digital transformation. The objectives of the initiative are (1) to engage and mobilize players in the Quebec construction industry in the digital shift and the transition to construction 4.0, (2) to structure efforts and develop measures to undertake in terms of digitizing the industry, (3) deploying measures in a consistent and consistent manner and (4) measuring and evaluating the progress of the initiative on the industry and its impact on the Québec economy. This is a long-term initiative that is part of a global movement to digitalize the built environment. The IQC4.0 currently has two measures: (1) the development of digital diagnostics and adapted BIM deployment plans and (2) the implementation of digital improvement projects under construction.

As part of IQC4.0, it is important to establish overall strategic directions for the large-scale deployment of BIM in the Quebec construction industry. This study aims to establish the current situation regarding BIM deployment in Quebec from a macro point of view. The following survey is based on the BIM macro deployment principles established by the BIM Excellence movement.

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The survey was conducted in a targeted manner. Individuals representing the following types of organizations were targeted: public owners at the federal, provincial and municipal levels as well as representing public institutions (eg. Universities) and provincial associations. A total of 14 organisations were identified and contacted to conduct the survey of which 11 responses were logged. The survey was conducted online between December 2018 and January 2019. The following table indicates the distribution of the respondents (Table 1)

TABLE 1
RESPONDENTS

Respondent	Number
Federal	3
Provincial	5
Municipal/Institutional	3

The following report presents the results of the survey based on the **8 Maturity Components** of the **Macro BIM Adoption models** developed by Dr. Bilal Succar and Dr. Mohamed Kassem in the context of the **BIM excellence initiative**. This particular model was used to structure the survey.

ABOUT THE BIM EXCELLENCE INITIATIVE AND THE MACRO BIM ADOPTION PROJECT

The BIM excellence (BIMe) initiative is a not-for-profit knowledge generation and sharing effort undertaken by volunteer researchers from both industry and academia. The BIMe Initiative provides a community-based, research-driven alternative to top-down, authority-led, and prescriptive BIM diffusion policies. Supported by clear **knowledge structures** a network of international subject matter experts, and an expanding modular language, the BIMe Initiative delivers an innovative, coherent and timely response to the opportunities and challenges brought-forward by **BIM adoption** at all **organisational scales**.

The Macro Adoption Project aims to assist policy makers in developing and/or assessing the macro BIM diffusion policies, strategies and plans within their respective markets¹. It is an ongoing project that was initiated by Dr. Bilal Succar (Australia) and Dr. Mohamad Kassem (UK) in 2013. The objectives of the studies undertaken under the macro BIM adoption project are to (1) identify the availability and maturity of common components necessary for enabling BIM adoption success at market scale; (2) identify the BIM adoption gaps in each studied market; (3) collate the lessons learned from different adoption approaches and then share these either publicly or privately; (4) monitor the diffusion of BIM over time through repeat assessments and data analytics; and most importantly (5) assist policy makers to develop, evaluate, or improve their BIM adoption strategies and roadmaps.

¹ Macro BIM Adoption projects and available reports are provided here: <https://bimexcellence.org/projects/macro-adoption/>

The macros adoption project relies on over 5 years of background research with multiple peer-reviewed papers published to date. The project is based on five main Macro Adoption Models depicted in Figure 1.

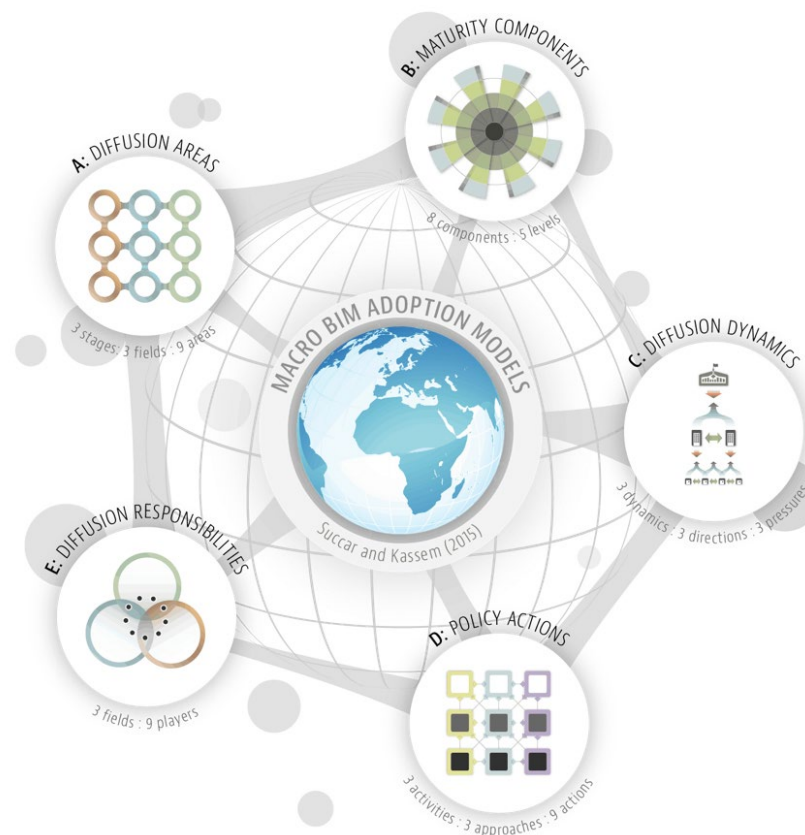
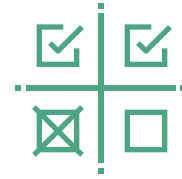


Figure 1 – Modèles d'adoption du BIM à l'échelle macro (Succar et Kassem, 2015)



OBJECTIVES, STAGES, AND MILESTONES

According to Succar and Kassem (2015): “the first component [of the macro BIM adoption maturity model] represents the availability of clear BIM-specific policy objectives, intermediate capability stages, and measurable maturity milestones separating current status from a quantifiable future target.”

The setting of objectives, stages and milestones, is typically captured within a strategy document be it specific to BIM or digital transformation or within a more global construction or built environment related strategy. To develop such a strategy, a first step is to instill an understanding of the overall benefits of BIM and digital project delivery within an organization or within an industry. This speaks to the need to clearly capture, formalise, articulate and communicate these benefits so that they are understood by the right people.

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When asked about the overall understanding of the benefits of BIM by policy makers in their respective organizations, a majority of respondents at the federal and municipal levels indicated that policy makers were only partially aware of the benefits of BIM. Conversely, respondents indicated a higher awareness at the provincial level (Figure 2). When asked to provide more information, all respondents indicated that more work was needed to engage and raise awareness amongst policy makers in their respective organizations or with their membership.

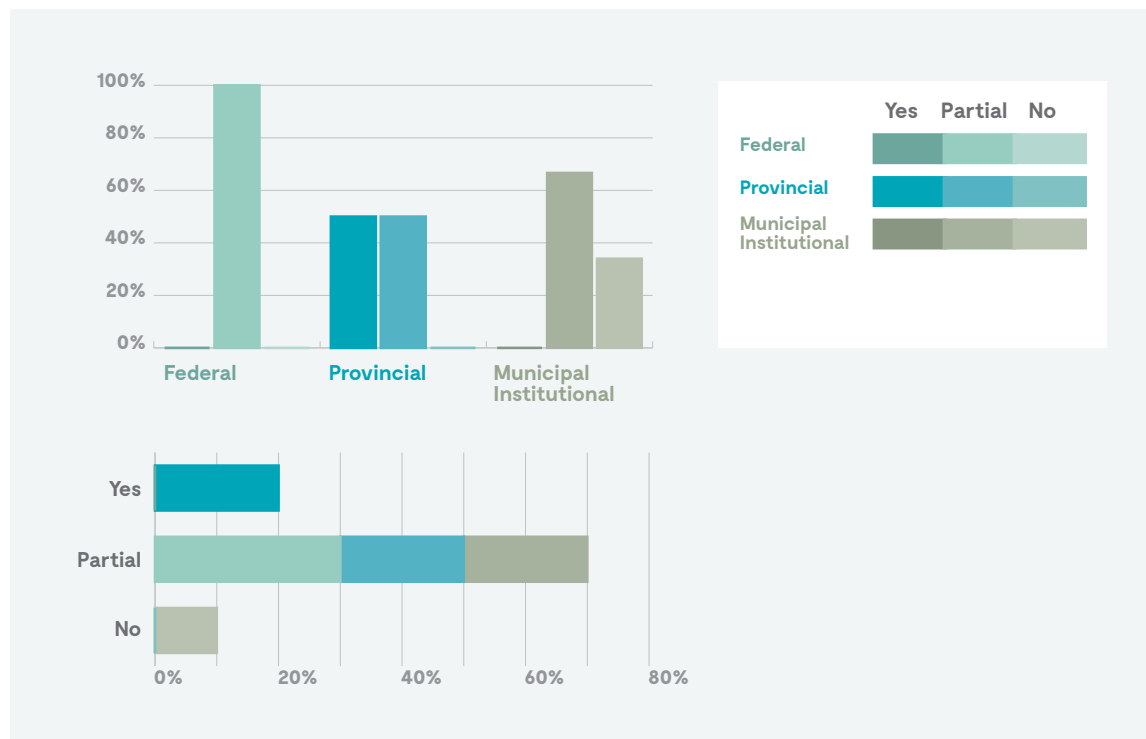


Figure 2 - Is there an overall understanding of the overall benefits of Building Information Modelling by Policy Makers in your organization?

With respects to the development and communication of objectives and strategy documents to guide and frame the BIM and digital transformation effort in Quebec and in Canada, such documents have been developed at both the federal and provincial levels, with most surveyed federal bodies indicating that they had developed objectives and some form of strategy. At the provincial and municipal levels, clear objectives and strategy documents seem less prevalent (Figure 3).

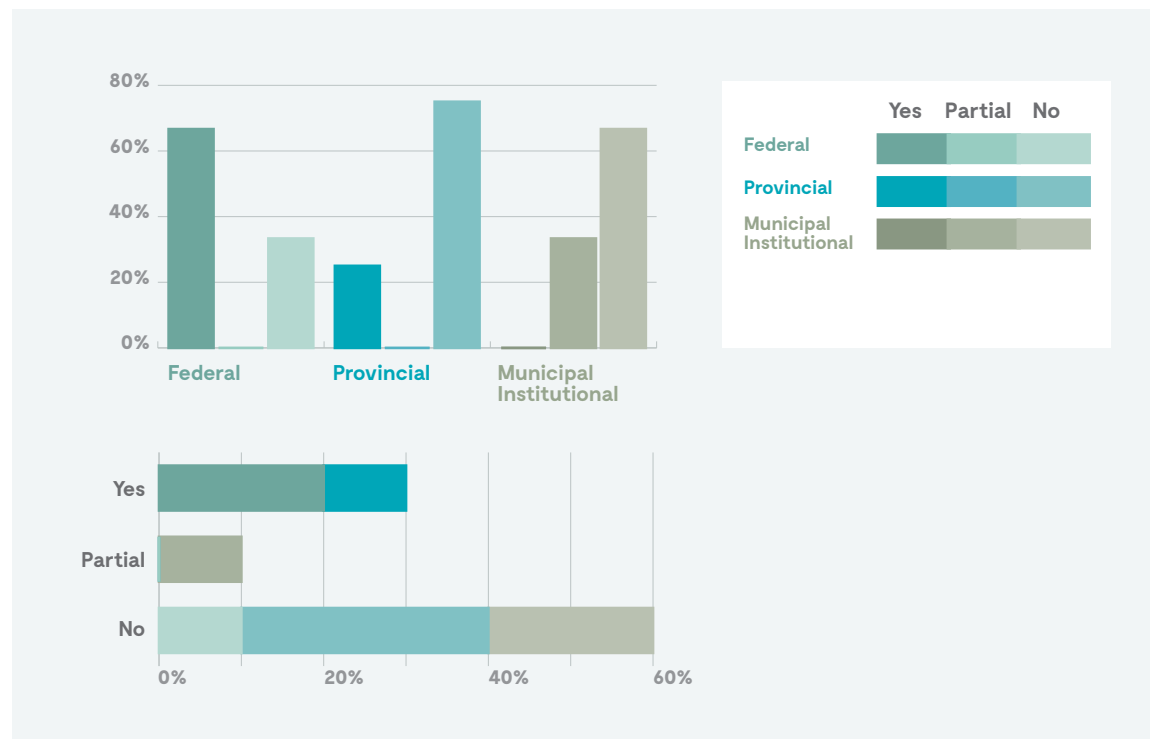


Figure 3 - Are there BIM Adoption Objectives publicly released by Policy Makers within a BIM-specific strategy or as part of an overall Construction Industry digitalisation plan in your organization?

BIM adoption levels or phases relate to established adoption targets within organisations (or across markets). Most respondents indicated that their organizations had established full or partial adoption levels or phases. Of all the respondents surveyed, only one provincial organization has published an organizational roadmap with phases being based on the deployment of specific uses (or dimensions) of BIM (Figure 4).

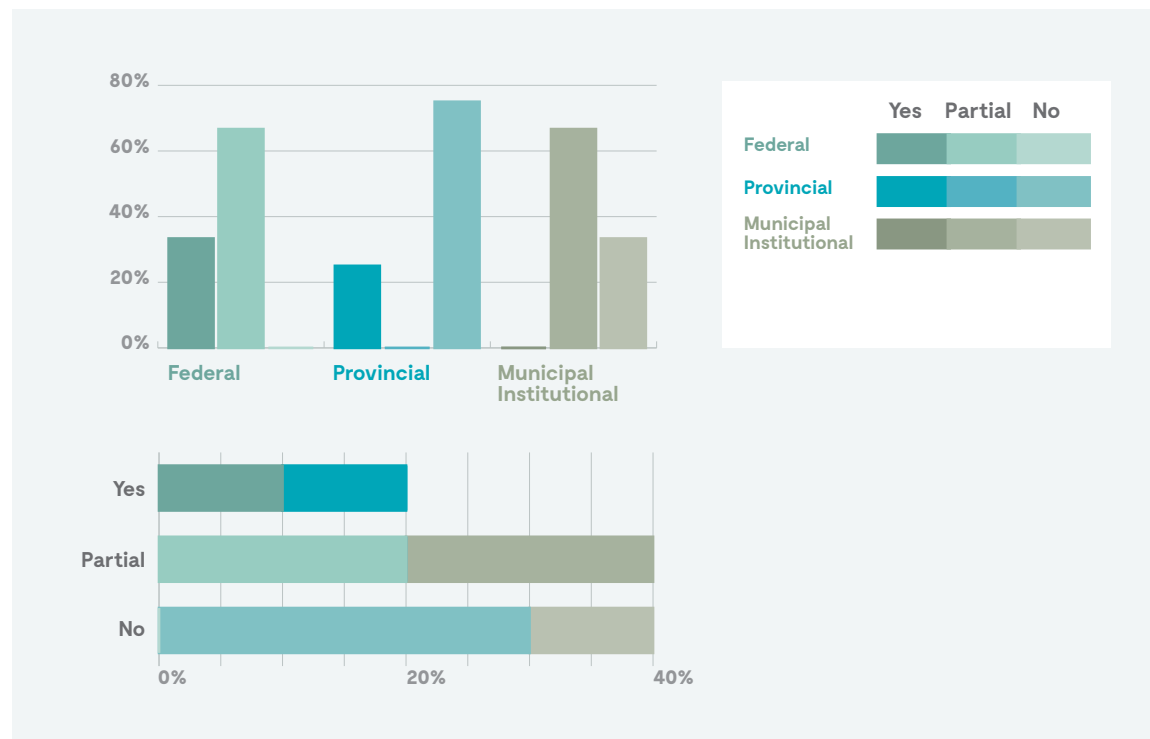


Figure 4 - Are there well-defined organizational BIM Adoption Levels or Phases?

In parallel to the development of BIM deployment strategy, objectives and phases, action items need to be identified, sequenced, coordinated and tied to a timeline in order to ensure a successful BIM adoption process. A majority of respondents indicated that there weren't any BIM adoption milestones identified within their organisations (Figure 5).

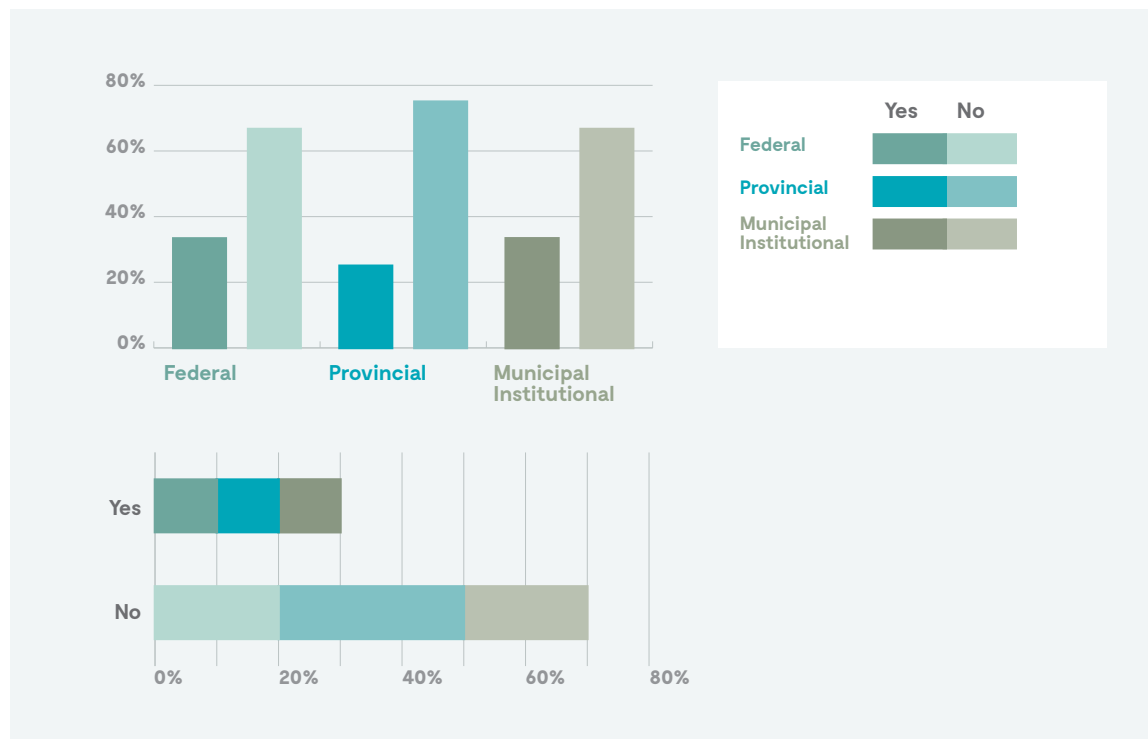
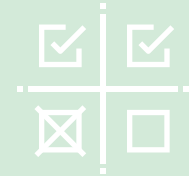
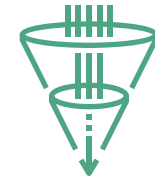


Figure 5 - Are there clear BIM Adoption Milestones (target dates) to meet these objectives?

Discussion

The findings of this section highlight the need for more awareness and engagement on the part of policy makers to share learning and clearly establish the importance and value proposition from BIM as part of an overall digital transformation of the construction industry and built environment. Moreover, there is a clear need for a well-defined strategy that lays out clear objectives, stages and milestones of such a digital transformation. It is imperative that this strategy be integrated into policies which are monitored and maintained. Ultimately, even considering regional differences and the fact that construction is of provincial jurisdiction, there is a need for a common way forward that is adhered to at all levels. Its manifestation can take on different forms, however the purpose should be aligned. To deploy misaligned or incoherent strategies could potentially result in significant waste and redundancy.





DRIVERS AND CHAMPIONS

According to Succar and Kassem (2015): “the second component [of the macro BIM adoption maturity model] represents the individuals, groups and organizations undertaking the task of *demonstrating the efficacy* of an innovative system/process to potential adopters.” Champions are early adopters of BIM who promote new tools, technologies, processes or standards, usually on a volunteer basis. Champions can be individuals, groups, such as communities of practice, or organisations, such as industry associations. Drivers are mandated or enabled to stimulate the deployment of BIM through communication, encouragement and monitoring. Similarly to champions, drivers refer to motivated and empowered individuals, groups or organizations. Drivers can also refer to external or internal pressures driving BIM deployment.

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When asked whether such empowered groups had been mobilized within their organizations, respondents were split evenly, with a majority of municipal and federal respondents indicating that they their organisation had put a BIM adoption task group in place (Figure 6). Moreover, when asked to provide more information on these task groups within their organization, a majority of respondents indicated that they were officially set up and recognized by upper management. However, for the most part, these groups were composed on an ad-hoc basis, with one exception being the creation of an entire department whose responsibility is BIM deployment (provincial organization). The other exception was a federal body who had mobilized three core working groups dedicated to the deployment of BIM and lifecycle management practices.

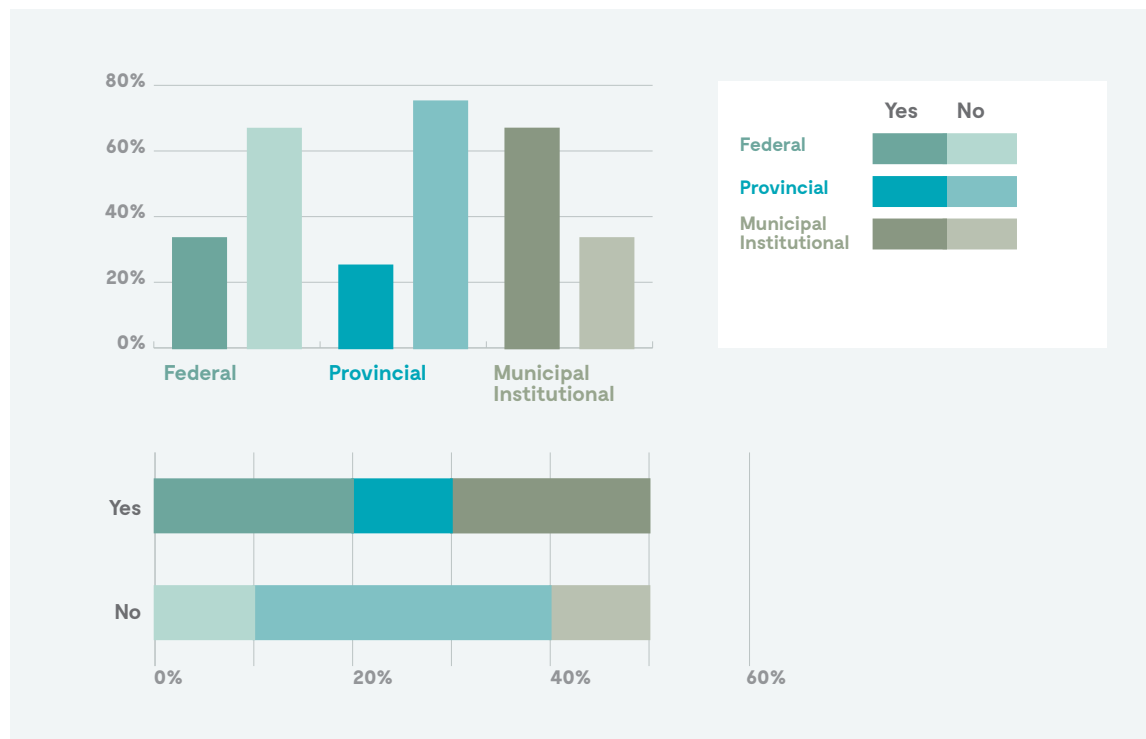


Figure 6 - Is there a BIM Adoption Task Group or committee driving BIM implementation/diffusion across your organization?

In parallel to the task groups discussed above, respondents were split in indicating whether there were BIM adoption drivers within their respective organizations. All federal respondents indicated that there were such drivers, while the majority of provincial and municipal respondents indicated that there weren't (Figure 7).

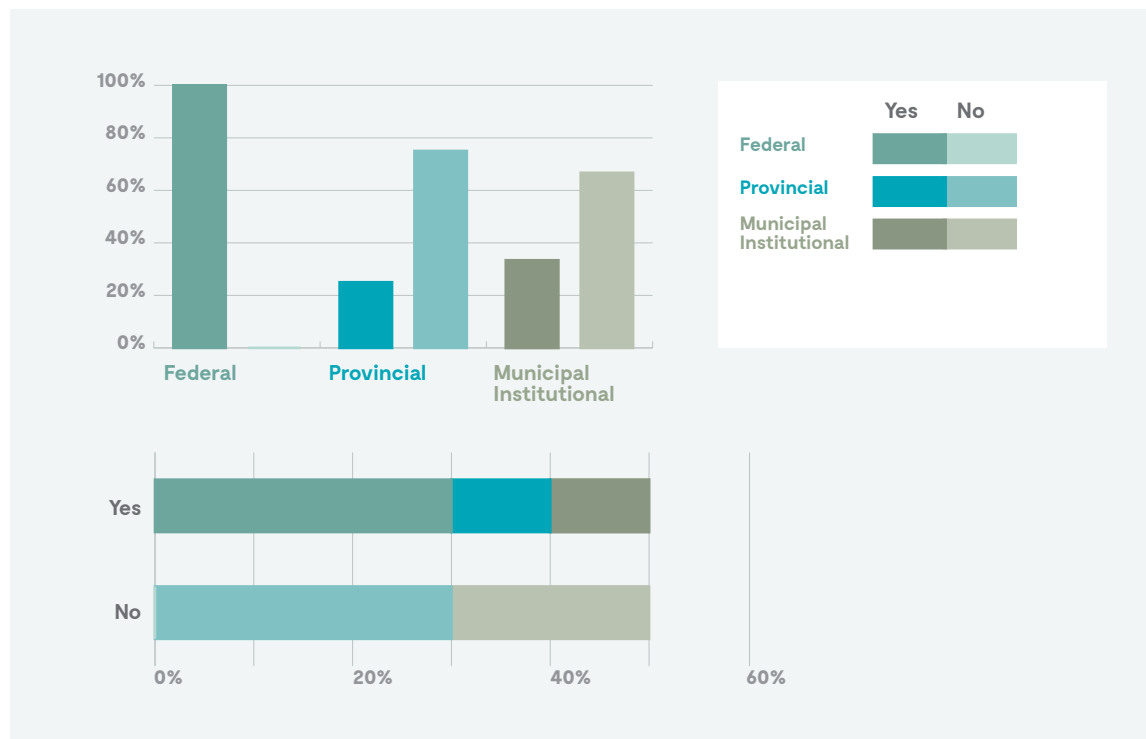


Figure 7 - Are there assigned BIM Adoption Drivers within your organization?

When asked if their organizations were involved with external BIM adoption champions or drivers, a strong majority of respondents, at all levels, indicated that they were (Figure 8). Below is a non-exhaustive list of these external BIM champions identified in the survey (Table 2):

TABLE 2
EXTERNAL BIM CHAMPIONS

Federal / national level	Provincial level
<ul style="list-style-type: none"> → buildingSMART Canada → Canada BIM Council → Federal Industry Real Property Advisory Committee (FIRPAC) → Major associations <ul style="list-style-type: none"> - RAIC - ACEC - CCA - CSC - CIQC → Academic institutions 	<ul style="list-style-type: none"> → BIM-IDP Multisectoral Table → Groupe BIM du Québec → Research chairs → Academic institutions → BIM Consultants

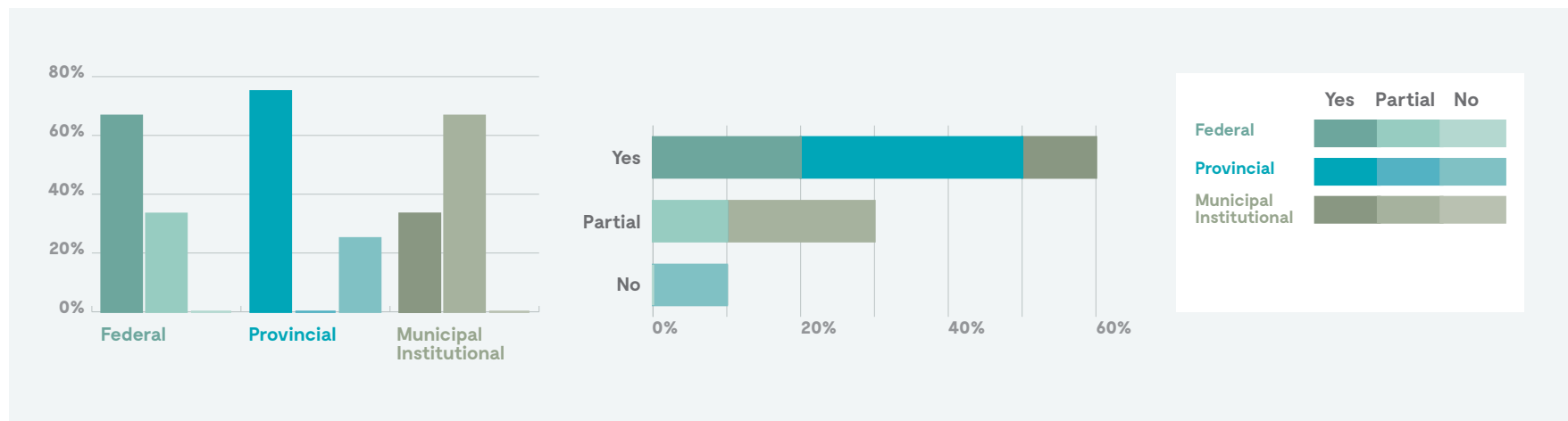
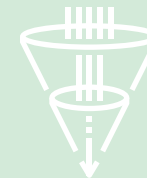
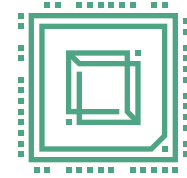


Figure 8 - Is your organization engaged with external BIM Adoption Champions?

Discussion

The findings of this section identified the availability of a number of drivers/champions and several bodies dedicated to BIM deployment in Quebec and Canada. However, there is no single or unified task group that coordinates and monitors BIM adoption and implementation efforts across Canada. At the provincial level, Quebec have strong drivers in the Groupe BIM du Quebec and the governmental mandate for digital transformation and the BIM-IDP multisectoral table. It should be noted that this unified group will be difficult to achieve given the regional differences of the Architecture, Engineering, Construction, Owner and Operators (AECOO) community across Canada, however a tight coordination between local, provincial and national groups is essential and efforts are currently underway to align these groups. In addition, another positive aspect highlighted in the findings is that major provincial and national associations are well on their way to communicating and supporting their members with BIM (for instance the Royal Architecture Institute of Canada and the updated Canadian Handbook of Practice for Architects).





REGULATORY FRAMEWORK

According to Succar and Kassem (2015): “the third component [of the macro BIM adoption maturity model] describes the contractual environment, intellectual property rights, and professional indemnity insurance underlying collaborative BIM projects.” It points to the mechanisms and resources that are available to frame and support BIM-enabled project delivery processes, including resources addressing : “responsibilities specific to shared models (e.g. elemental authorship and model ownership), collaborative processes (e.g. overlapping project phases and early involvement of subcontractors), and prescriptive protocols (e.g. data exchange structures and information delivery standards) [...] clarifying the rights, responsibilities and liabilities of varied project stakeholders [...]” throughout asset lifecycle phases.

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The majority of respondents indicated that no procurement directives or regulations had been developed to encourage or facilitate the use of information models and digital workflows within their organization. For those respondents who did indicate that there were specific directives within their procurement documents, they were referring to specific language and guidelines had been developed to be included in such documents (Figure 9).

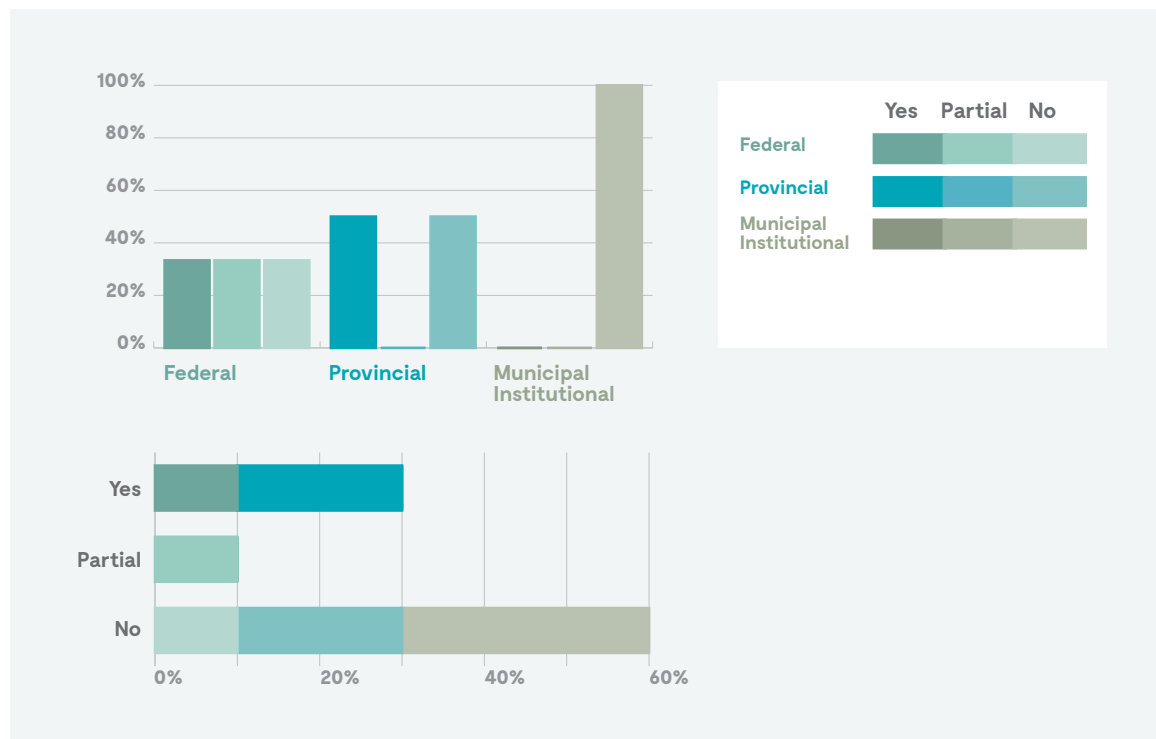


Figure 9 - Are there any Procurement Directives or Regulations encouraging or facilitating the use of information models and digital workflows in your organization?

The intent for adapting procurement directives is to support BIM-enabled project delivery across the design and construction phases by embodying specific contractual agreements that should also dictate the minimum BIM requirements for commissioning and handover. Other contractual aspects include, intellectual property rights, licencing and model authorship as well as authorized uses of models and their components. A minority of survey respondents indicated that there were updated contractual agreements to reflect BIM-enabled project delivery within their organizations (Figure 10).

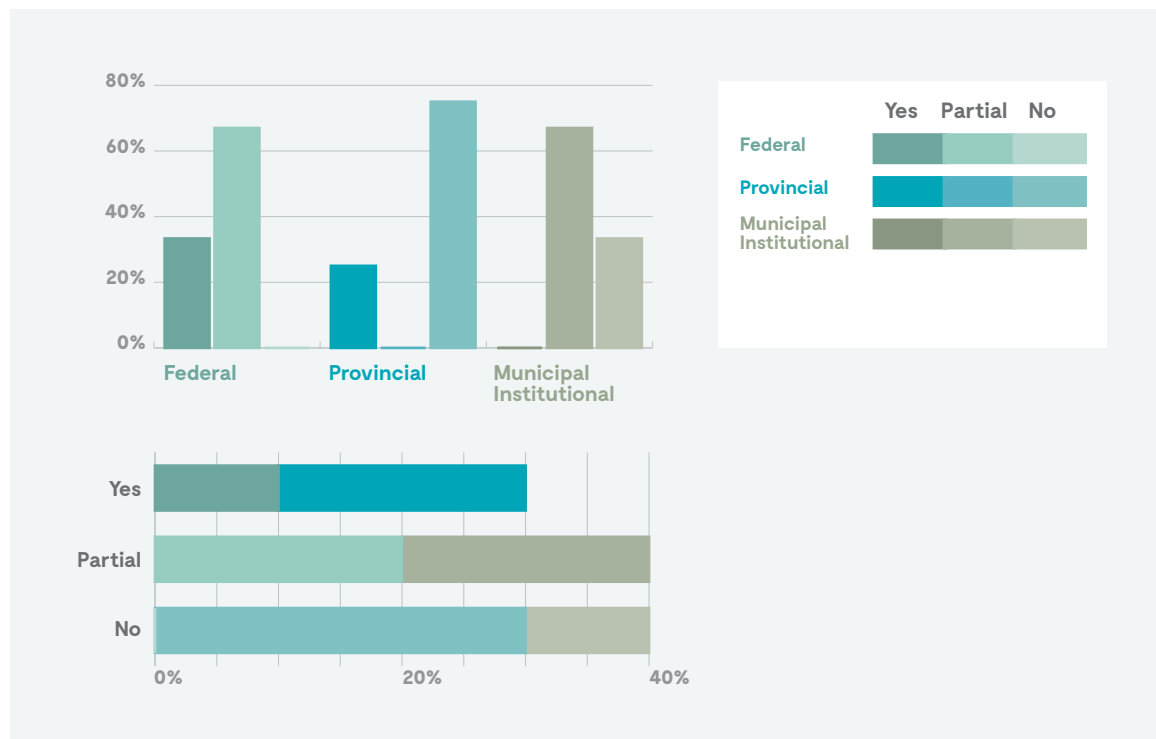


Figure 10 - Are there new and updated Contractual Agreements or Documents with embedded BIM requirements?

Out of respondents who indicated that they have developed full or partial updated contractual agreements, a minority have addressed digital rights and intellectual property (Figure 11) and none have addressed contractual clauses related to information exchanges through common data environments (Figure 12).

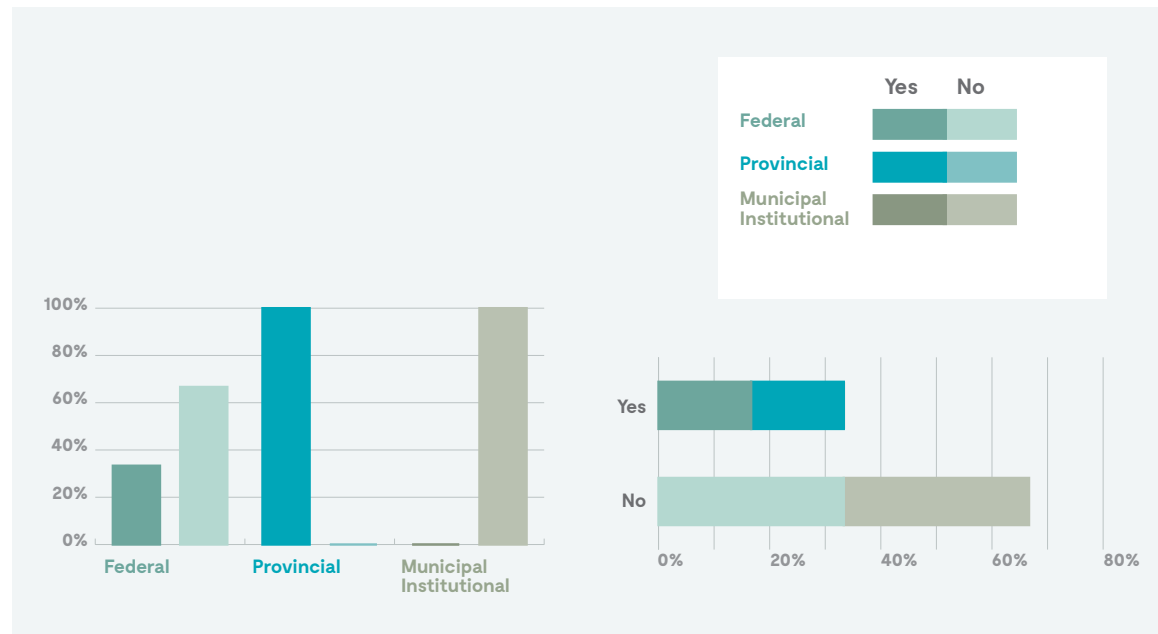


Figure 11 - Are there any new or updated Contractual Clauses covering the Digital Rights of information models or information shared through digital means?

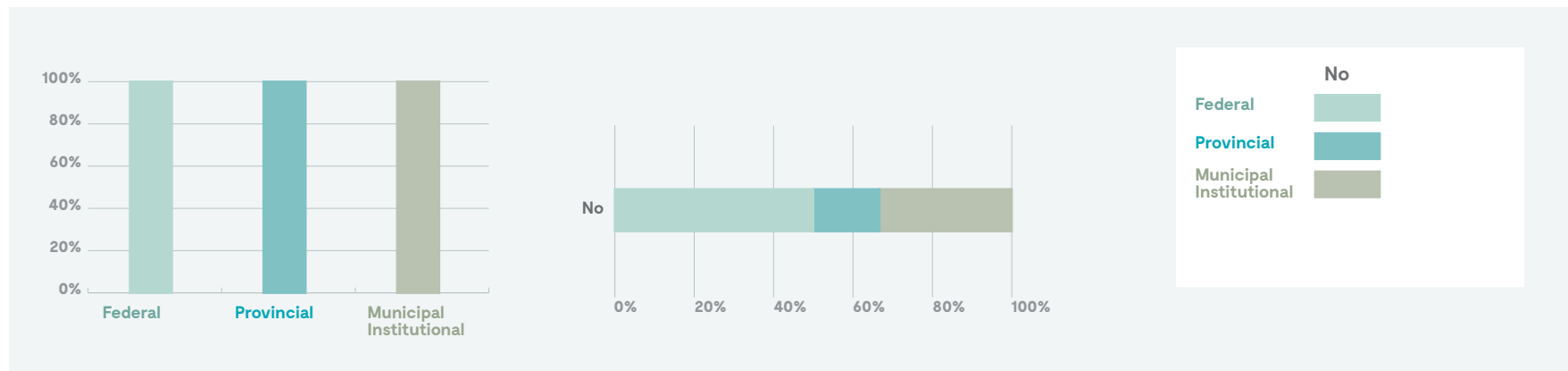


Figure 12 - Are there any new or updated Contractual Clauses for the exchange of information through Common Data Environments?

In parallel, none of the survey respondents indicated the availability of new or updated insurance policies covering the use of information models and digital workflows (Figure 13).

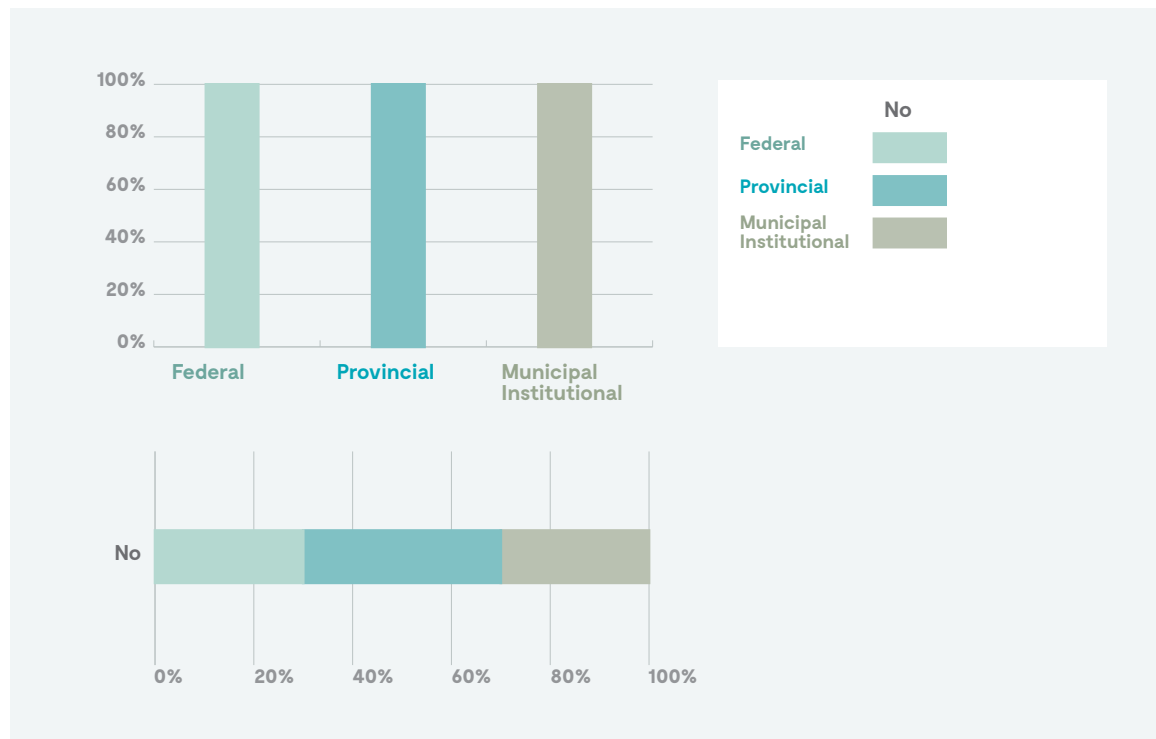


Figure 13 - Are there new or updated Insurance Policies covering the use of information models and digital workflows?

Lastly, all respondents indicated that there were no local (be they national or provincial) standards or regulatory directives that were obligatory (such as the Canadian National Building Code or Canadian National Energy Code) (Figure 14).

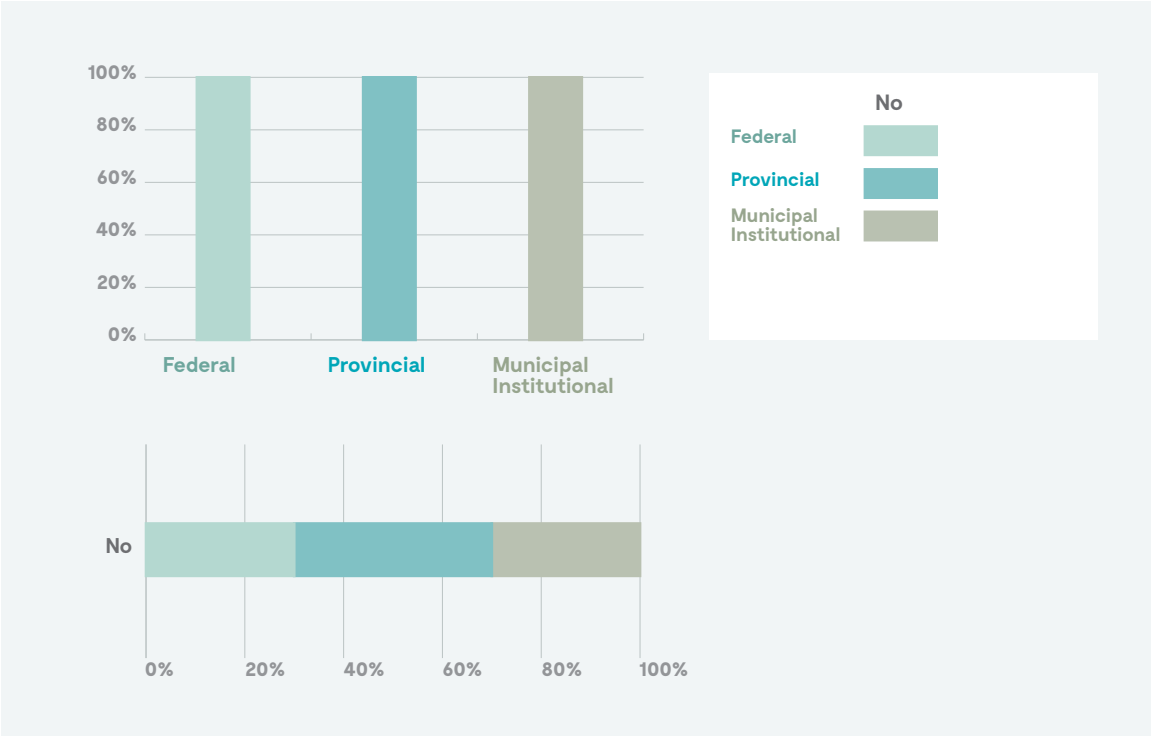
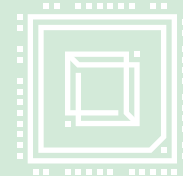


Figure 14 - Are there any Local Standards or Regulatory Directives (from Government) focusing on BIM that need to be adhered to in your organization?

Discussion

The findings of this section indicate that the regulatory framework is still in flux in Quebec and in Canada and that it is not optimized for collaborative BIM project-delivery environments. For instance, there is a notable lack of updated contractual mechanisms that address these new collaborative environments (CDEs). Moreover, respondents seem to indicate that current Insurance policies don't reflect the new realities of BIM-enabled project delivery. An exception to this is the IBC 100-2014 contract appendix that addresses contractual issues of BIM such as copyright and intellectual property. Ideally, the regulatory framework that is developed becomes an integral part of all project requirements, including processes, roles and deliverables.





NOTEWORTHY PUBLICATIONS

According to Succar and Kassem (2015): “the fourth component [of the macro BIM adoption maturity model] represents publicly-available documents of relevance, developed by influential industry stakeholders, and intended for a market-wide audience. [...] Noteworthy BIM publications (NBP)s represent include three main types of publications (guides, protocols and mandates) representing eighteen subtypes (e.g. report, standard, and case study).” NBPs can also represent a telling metric in that they indicate, to a certain extent, the level of interest and willingness to formalize lessons learned, “best” practices, guidelines, case studies, etc.

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According to a compilation of all responses there are a total of 39 NBP available from public bodies and associations in Quebec and at the federal level in Canada across the surveyed organizations. (NOTE: this is not a total of all NBP available in Canada). Federal bodies account for more than half the available NBPs according to the data (Figure 15).



Figure 15 - Total number of Noteworthy BIM Publications

Of note in the distribution of NBPs is the absence of BIM standards or codes and BIM sensitive insurance policies at all levels as highlighted above (Figure 13 and Figure 14). Moreover, there are very little classifications, metrics and contractual agreements. There are a good number of case studies and strategy or vision NBPs. There is also a fair distribution of project delivery plans and process maps according to the survey (Figure 16).

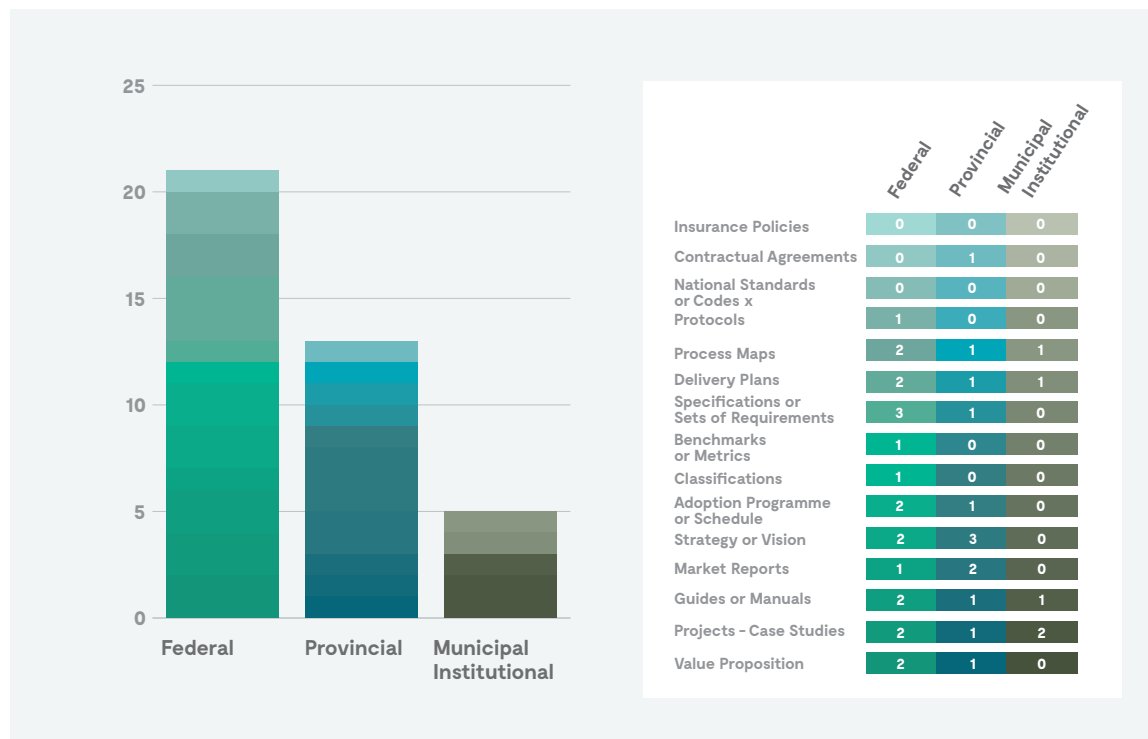


Figure 16 - NBPs available by type

For the organizations that indicated having developed NBPs, a majority indicated that they were issued by single departments. The organizations that indicated coordinating the development of NBPs across multiple departments were either federal or provincial bodies (Figure 17).

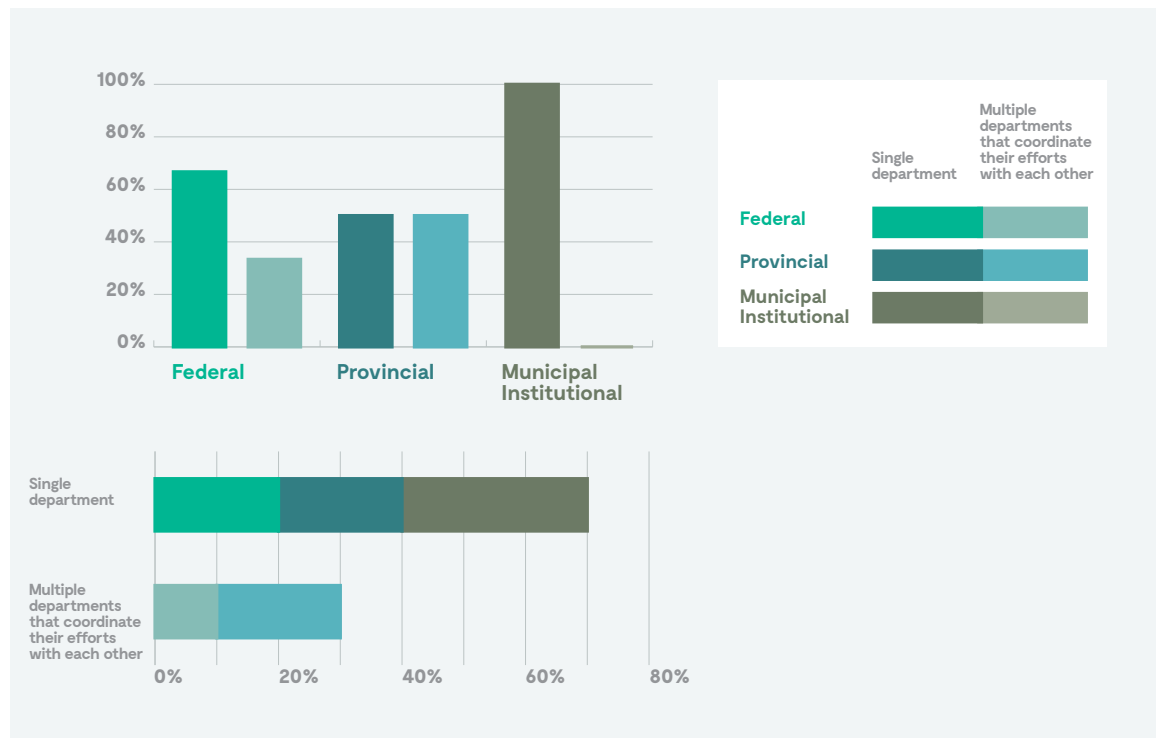


Figure 17 - Are these Noteworthy BIM Publication developed and/or coordinated by a single department/section or multiple departments/sections?

When asked whether there were any redundancies or overlaps, or conversely gaps in the NBPs, a strong majority indicated that there were not identifiable gaps (Figure 18). It is important to note that the respondents were asked about redundancies, overlaps or gaps between NBPs within their organizations and not between NBPs developed by different organizations.

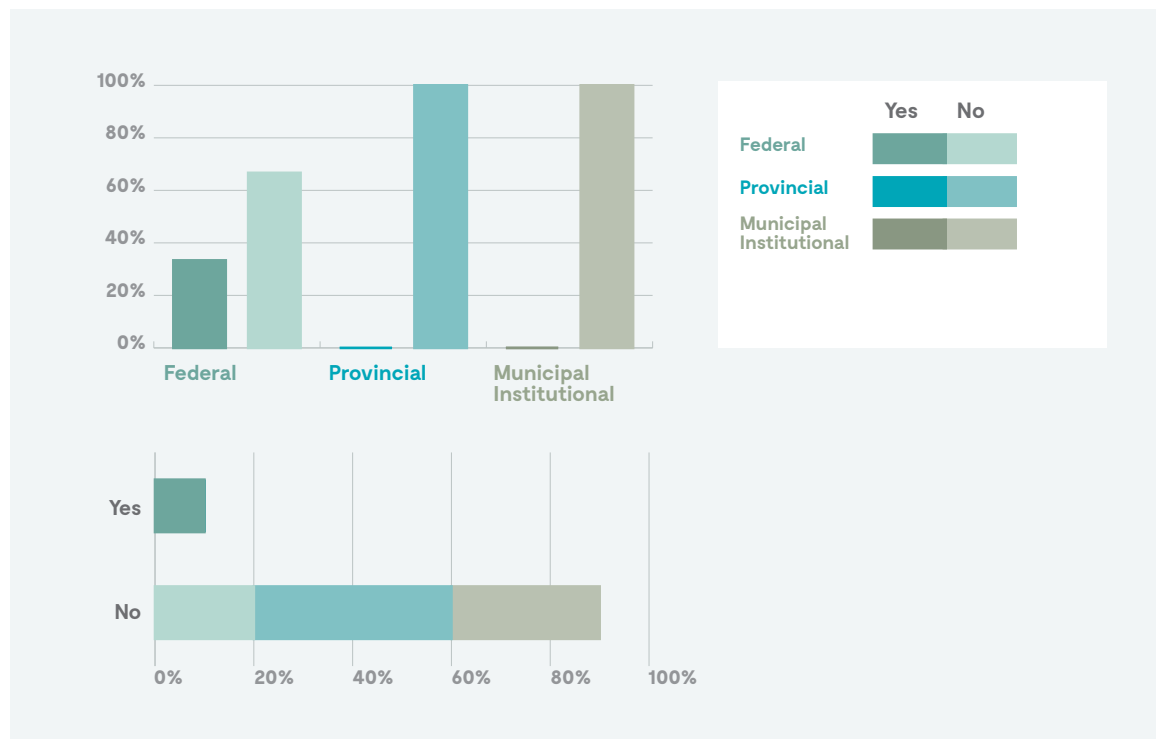


Figure 18 - Are there any redundancies, gaps, or overlaps in the Noteworthy BIM Publications developed in your organization?

Finally, respondents were asked whether these NBPs were hosted in a centralized repository for easy access. Most respondents indicated that such a repository was not available or that the NBPs they had developed were easily accessible (Figure 19).

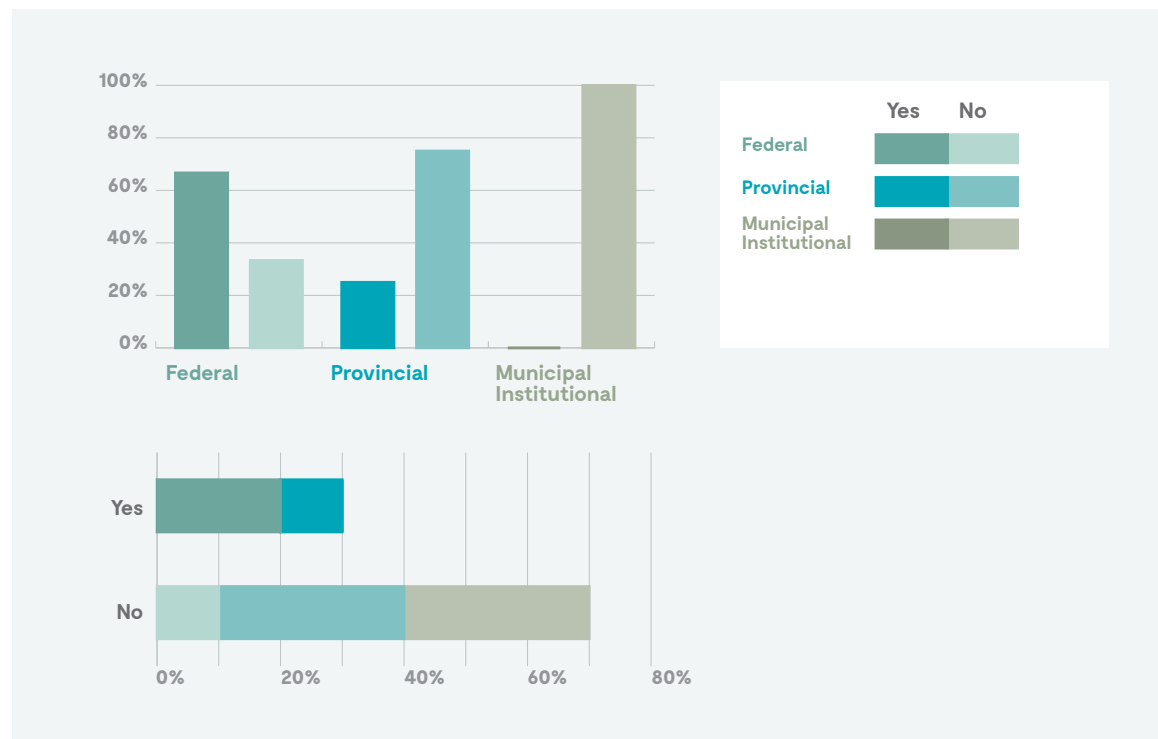


Figure 19 - Is there a central repository for relevant Noteworthy BIM Publications (e.g.an official web portal) that provide access to these materials?

Discussion

The findings of this section indicate that there is an increasing number of NBPs that have been or are being developed at all levels. However, these NBPs do not seem to be freely available and / or centralized and coordinated. These challenges combined with the difficulty in accessing these documents – except a few documents that were accessible – could lead to significant issues such as redundancy, overlap and, evenb worse, contradictions. At this point, it is not possible to tell whether these potential issues have arisen. An in-depth review of these NBPs should be undertaken to highlight such issues. Ideally, the goal is to reach a state where NBPs are authoritative and interconnected, managed and optimized by a single entity, reflect international best practices and cover the entire project lifecycle and project supply chain.





LEARNING AND EDUCATION

According to Succar and Kassem (2015): “the fifth component [of the macro BIM adoption maturity model] represents market-wide educational activities covering BIM concepts, tools and workflows. These educational activities are either delivered through tertiary education, vocational training or professional development; either as competency-based or course-based learning models.”

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Respondents were first asked whether their respective organizations had developed a BIM education framework of learning strategy. In this regard, a large majority indicated that no such framework or strategy had been developed (Figure 20).



Figure 20 - Has your organization developed a BIM Education Framework or Learning Strategy?

It is therefore unsurprising that a strong majority of organisations did not offer learning units within their organisations (Figure 21) nor were any CPD programmes offered (Figure 22).

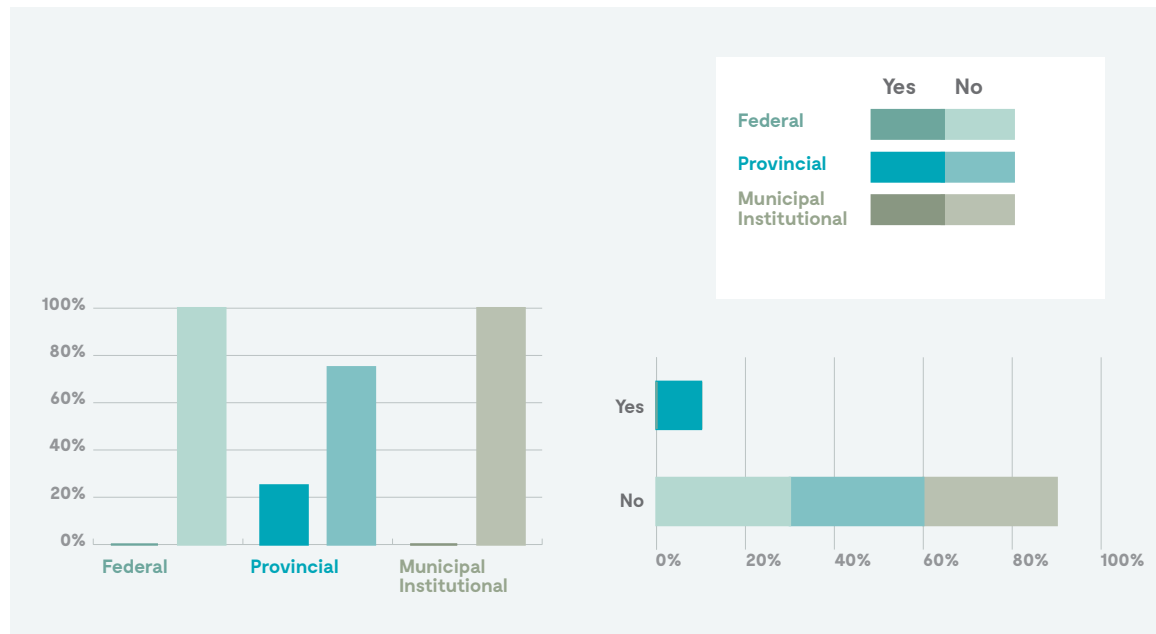


Figure 21 - Are there BIM-focused Learning Units offered within your organization?

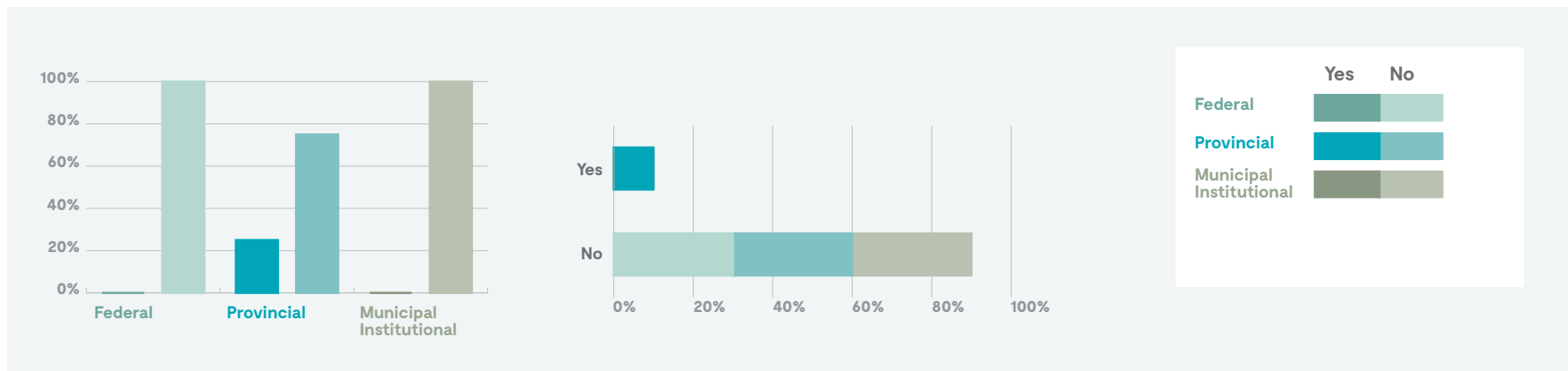


Figure 22 - Are there BIM-focused Continual Professional Development (CPD) programmes offered by your organization?

Discussion

The findings of this section indicate that BIM specific education and training is still very marginal within organisations and that there is very little in the way of formalized learning strategies across the organizations surveyed. While there exists specific programs in colleges and universities across Quebec and Canada, there does not seem to be a concerted or coherent offer across Quebec, highlighting the need for more work in this regard. That being said, there are a number of efforts underway to offer a harmonized approach to BIM education such as the Learning Outcomes Framework for BIM currently being developed by buildingSMART International and adapted by buildingSMART Canada. Ideally, the target would be to integrated BIM and digital practices seamlessly into education, training and professional development programs across Quebec and Canada.





MEASUREMENTS & BENCHMARKS

According to Succar and Kassem (2015): “the sixth component [of the macro BIM adoption maturity model] represents market-wide metrics for benchmarking project outcomes and assessing the capabilities of individuals, organizations and teams.” The development of such measurements and benchmarks signal a more mature market which is capable of supporting performance assessment and improvement.

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When asked about measurement of BIM-diffusion within their respective organisations, a strong majority indicated the absence of such metrics or approaches. Only 50% of respondents at the provincial level indicated the presence of some progress in this area (Figure 23).

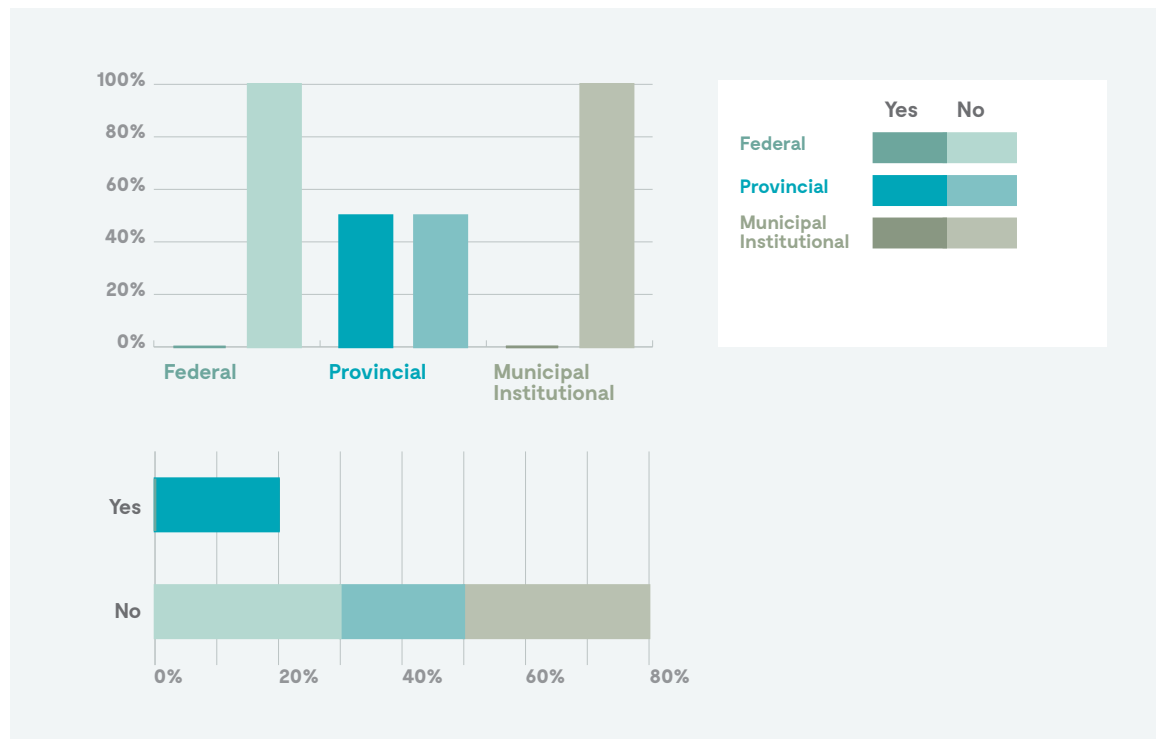


Figure 23 - Has there been any organization-wide measurement of BIM Diffusion?

In addition, aside from measuring BIM diffusion, respondents were asked about the availability of metrics for assessing organizational BIM capability and/or maturity. All of the respondents indicated the lack of such metrics (Figure 24).

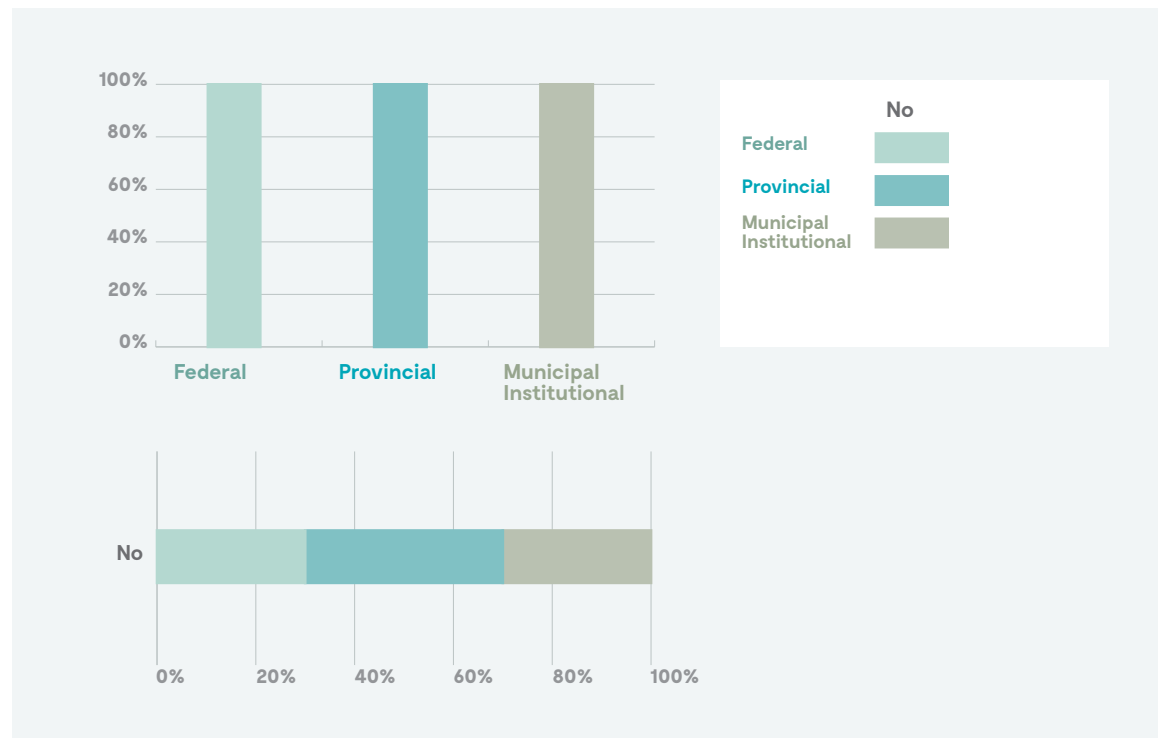


Figure 24 - Are there any officially-sanctioned metrics to measure organizational BIM Capability/Maturity?

Moreover, none of the respondents indicated that their organizations had developed and applied metrics to measure BIM performance and BIM-related outcomes of complete projects (Figure 25).

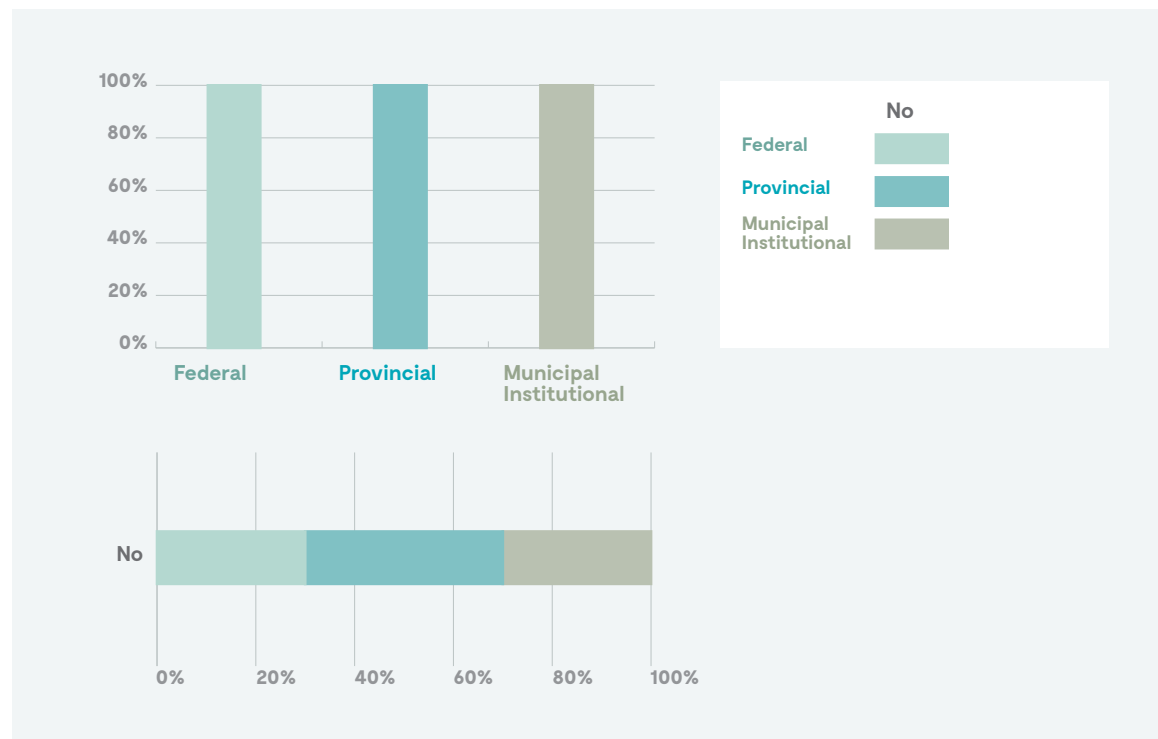


Figure 25 - Are there any metrics applied by your organization to measure the BIM Performance and BIM-related Outcomes of completed projects?

When asked about pre-qualifying organizations on tenders with regards to BIM, 30% of respondents, operating at the federal and provincial levels, indicated that there were indeed mechanisms to evaluate and score project participants (Figure 26).

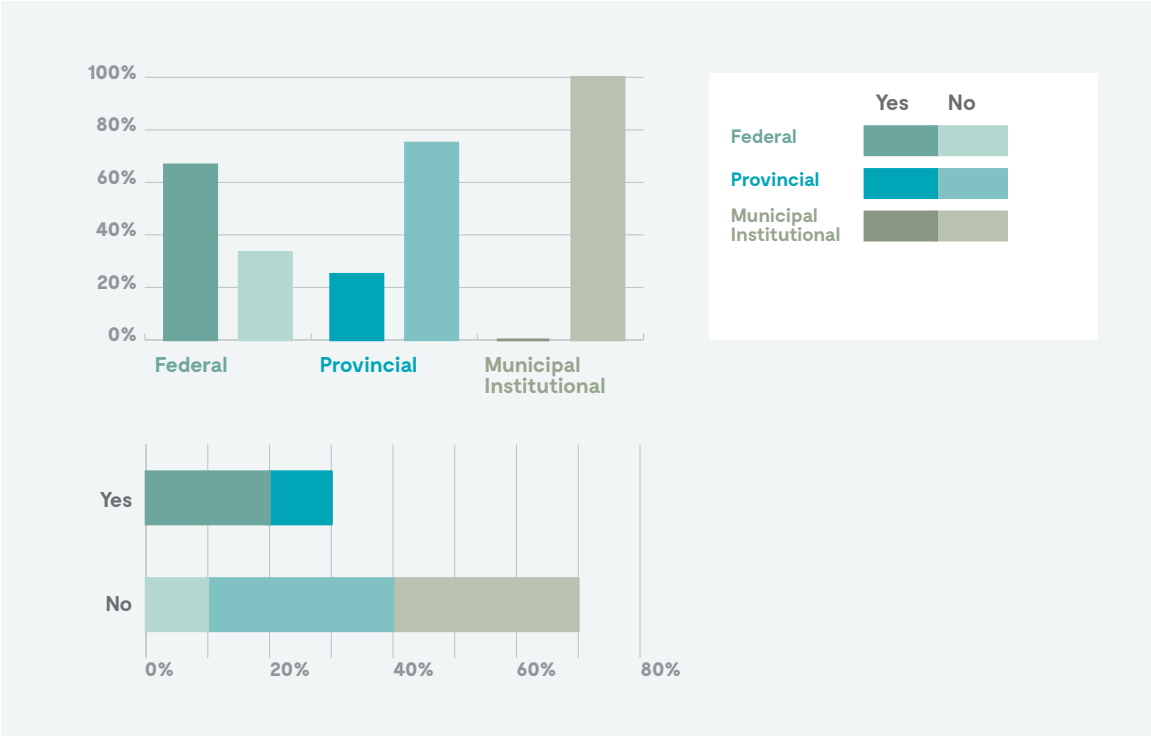


Figure 26 - Are there any metrics or mechanisms applied to Pre-qualify the BIM Abilities of participants in your tenders?

In terms of certification, a strong majority of respondents indicated that there weren't any certified individuals within their organizations (Figure 27).

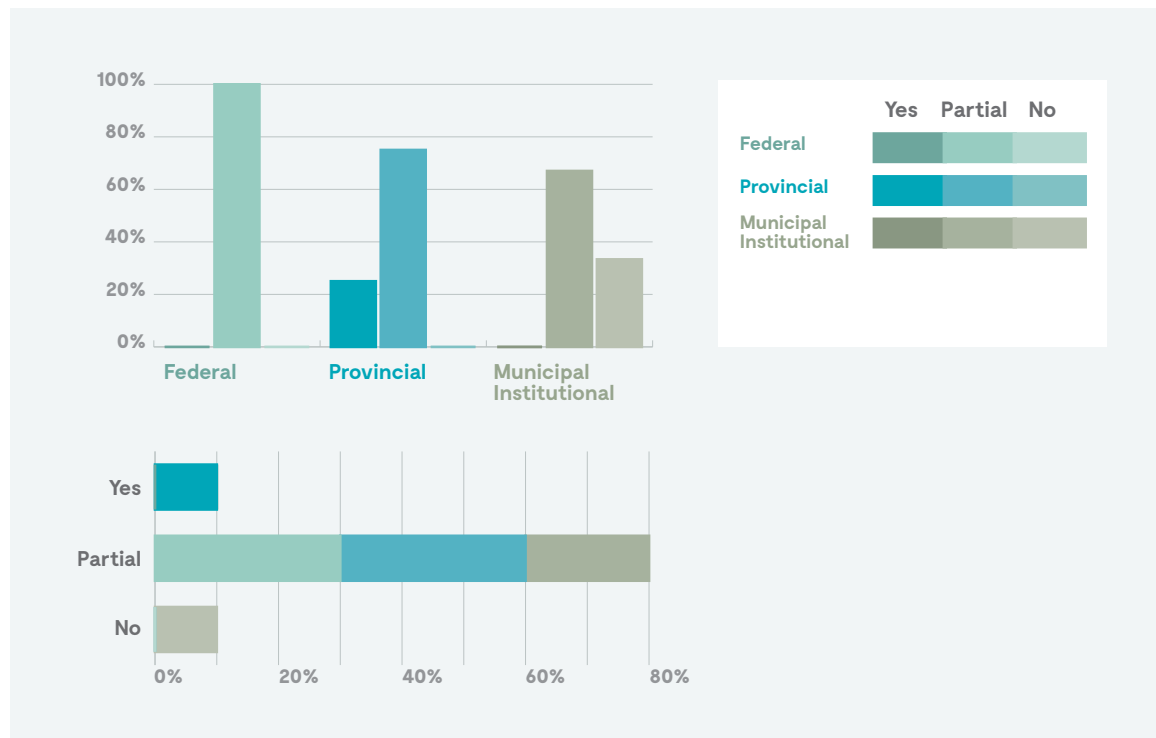


Figure 27 - Do any individuals within your organization possess BIM Certification from a recognized national or international program?

None of the respondents indicated that their organizations had implemented a BIM training programme that was certified by a national or international body (Figure 28).

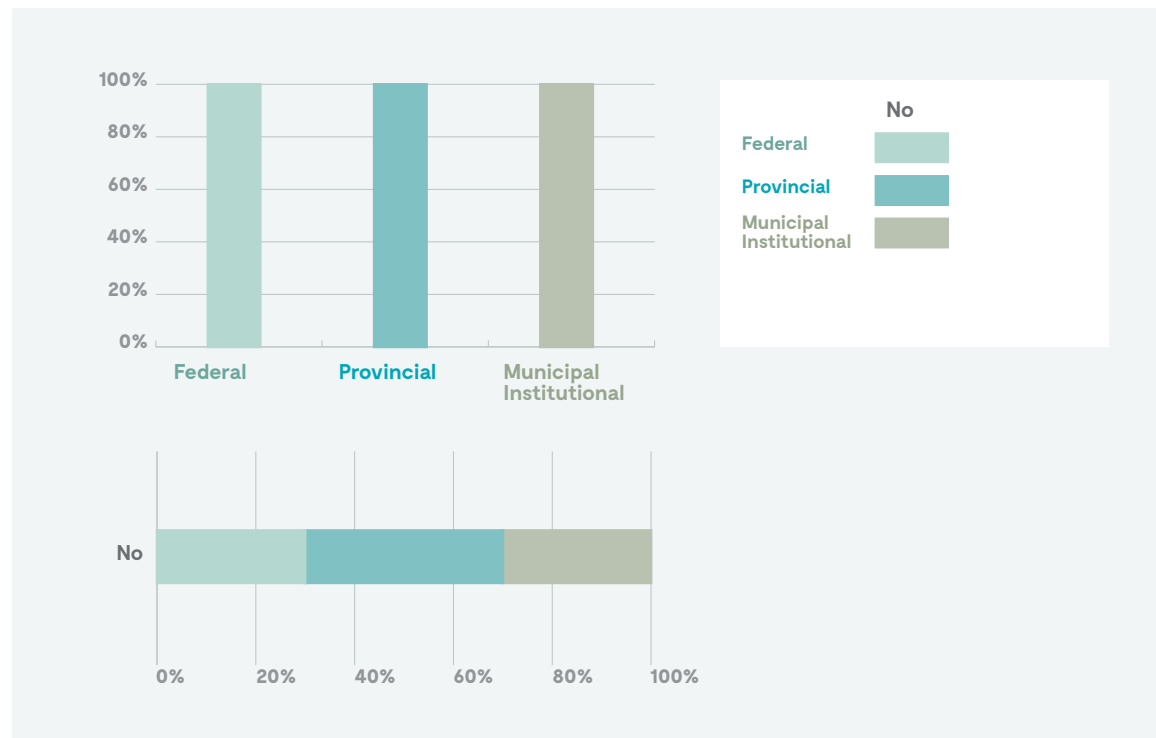
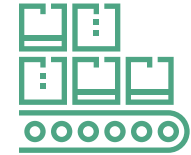


Figure 28 - If your organization has implemented a BIM Training Programme, has this programme received formal Accreditation from a national or international authority?

Discussion

The findings of this section indicate that there have not been any efforts to assess either BIM diffusion or BIM capability or BIM maturity. Moreover, there has been very little done in the way of measurement of BIM performance, BIM certification and accreditation. One explanation is the lack of metrics and tools to perform such measurement. This is currently being addressed through the IQC4.0 which is developing a benchmarking and assessment platform for BIM capability and maturity. Ideally, the goal would be to develop a set of standardised metrics and benchmarks, that are continuously revised to suit evolving practices, and that are integrated into project requirements, workflows and deliverables.





STANDARDISED PARTS & DELIVERABLES

According to Succar and Kassem (2015): “the seventh component [of the macro BIM adoption maturity model] represents the *standardised, data-rich model parts* (e.g. walls, beams, HVAC units, doors and furniture) which populate object-based models [as well as the] *model uses*, the standardisable deliverables from generating, collaborating-on and linking object-based models to external databases.”

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A majority of respondents indicated that there were no (or were not aware of any) standardized object libraries available for use (Figure 29). The only respondent who indicated that there were object libraries, mentioned that they were internally developed and based on legacy 2D CAD libraries.

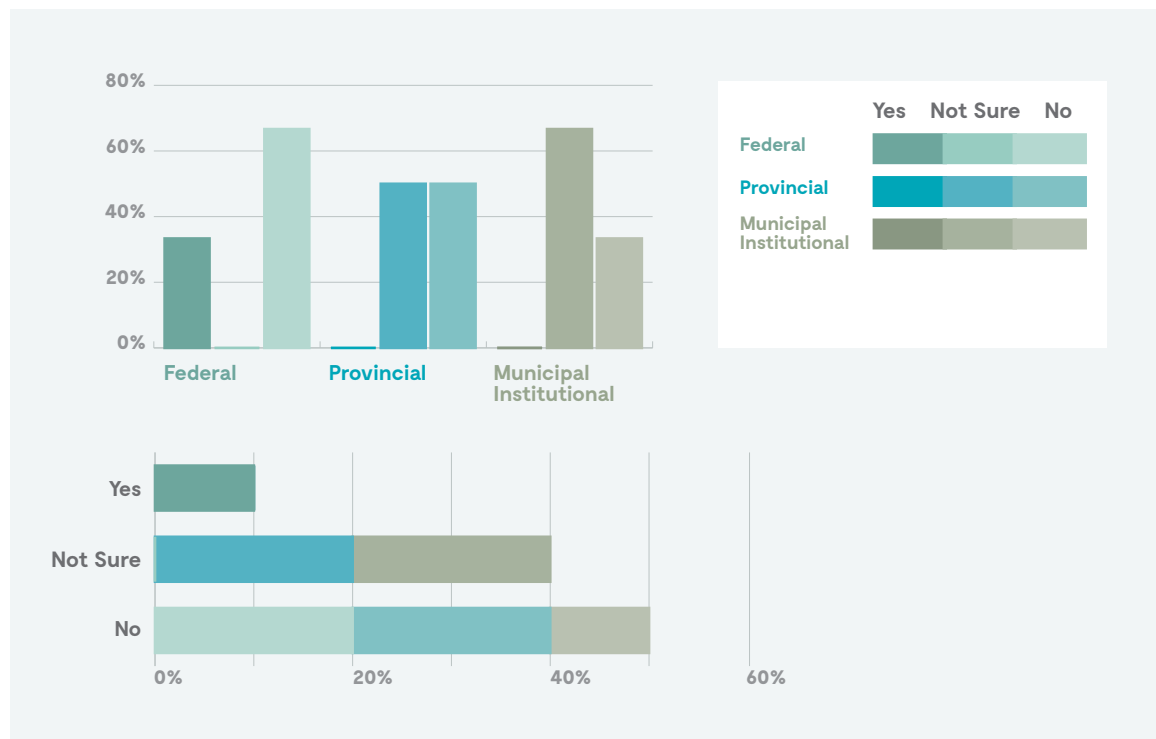


Figure 29 - Are there standardised Object Libraries available for use by the local industry (e.g. doors, structural beams, and mechanical equipment)?

Moreover, none of the respondents indicated that their organizations had developed or adopted standardized templates for information exchanges at specific asset lifecycle phases (Figure 30).

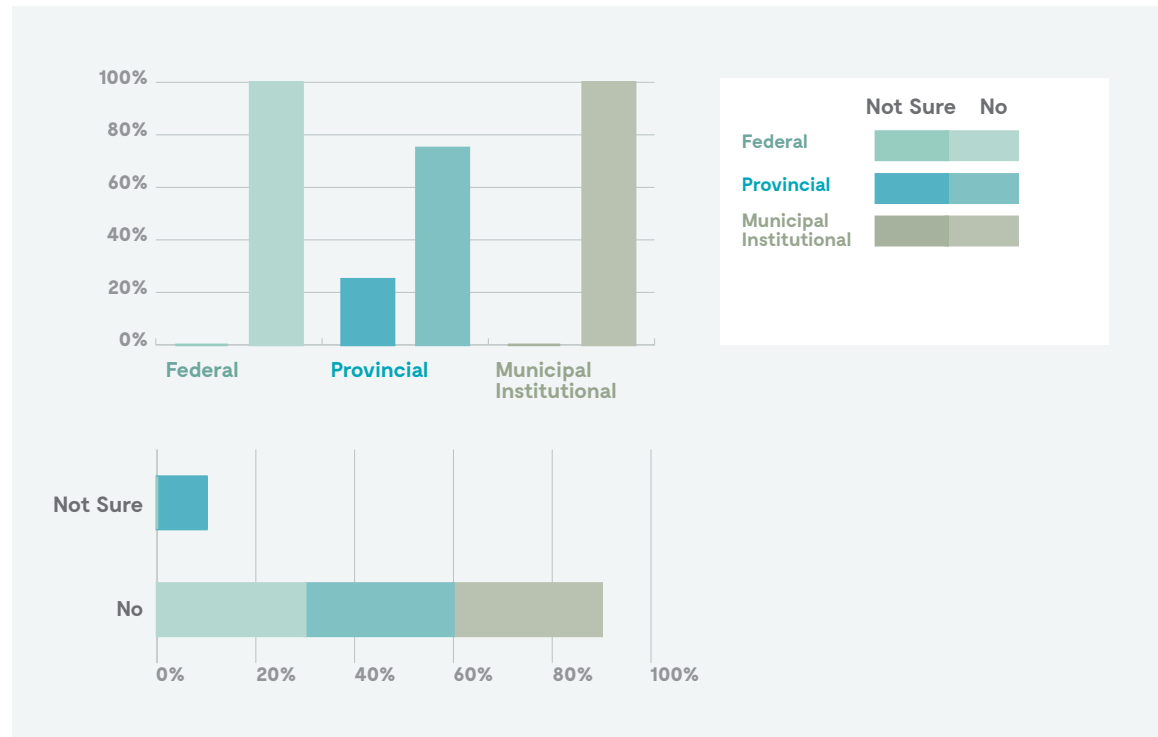


Figure 30 - Are there standardised templates - mandated by the Public Procurer - for collecting information covering a facility's maintainable assets (e.g. COBie)?

A majority of respondents indicated that there were no (or were not aware of) formalized process maps guiding digital workflows and deliverables for project participants (Figure 31).

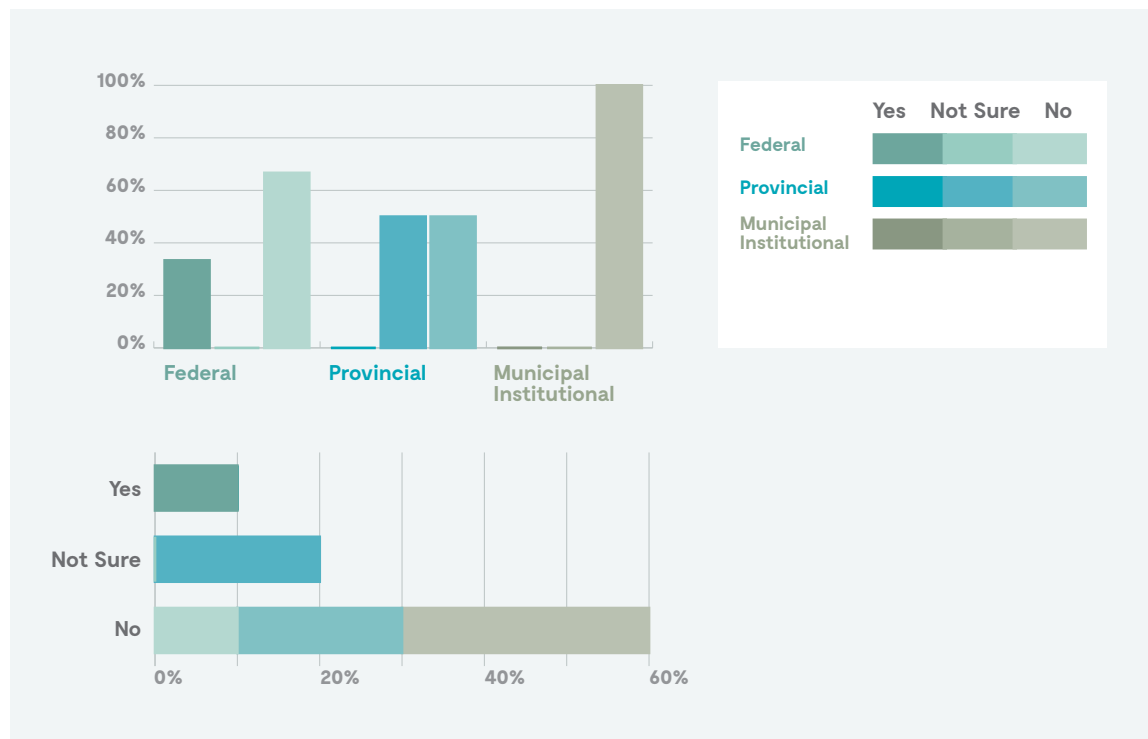


Figure 31 - Are there well-documented Process Maps to guide the digital workflows and deliverables of the local industry?

Respondents from federal organizations were the only ones who indicated to have a centrally managed list of model uses. All other respondents indicated that they did not have such a list (or weren't aware) (Figure 32).

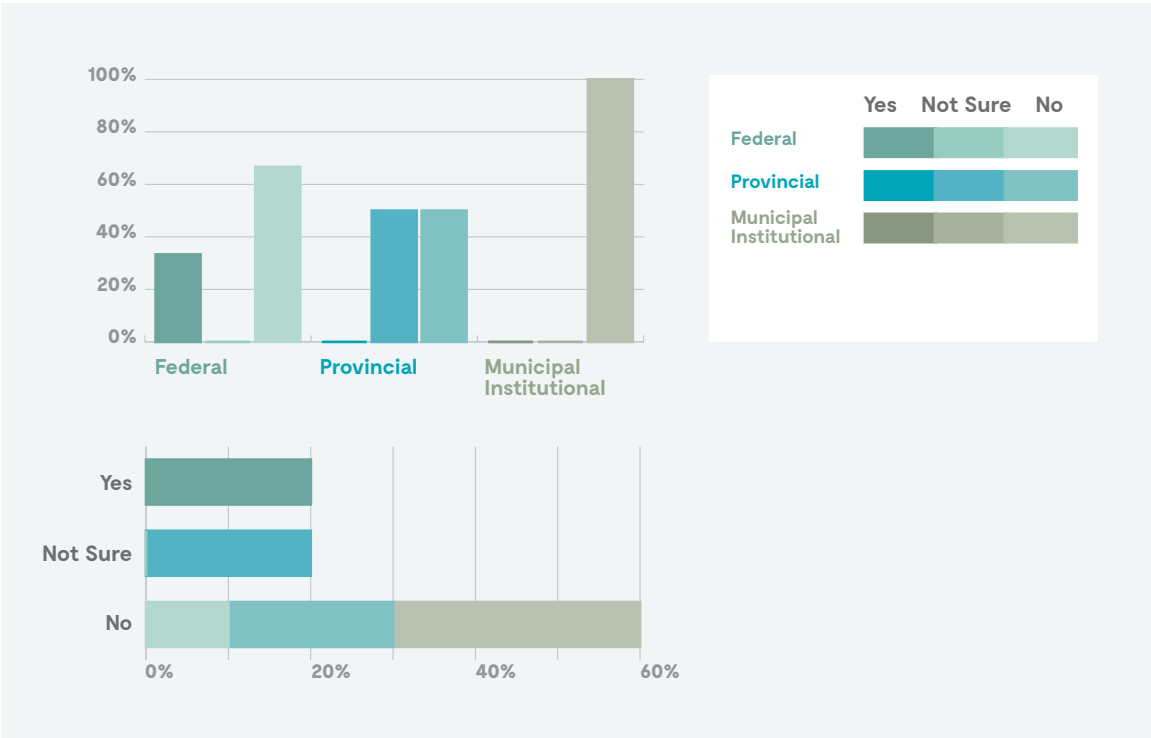


Figure 32 - Is there a centrally-managed list of BIM/Model Uses (e.g. Clash Detection, Construction Logistics, or Asset Maintenance) for use by facility designers, builders, and operators?

When asked whether their organizations had implemented a standardized classification system, all respondents involved with federal organizations and some organizations at the provincial levels indicated that they had (Figure 33). All respondents who had implemented a classification, had implemented one or more of the omniclass tables (21, 22, or 23).

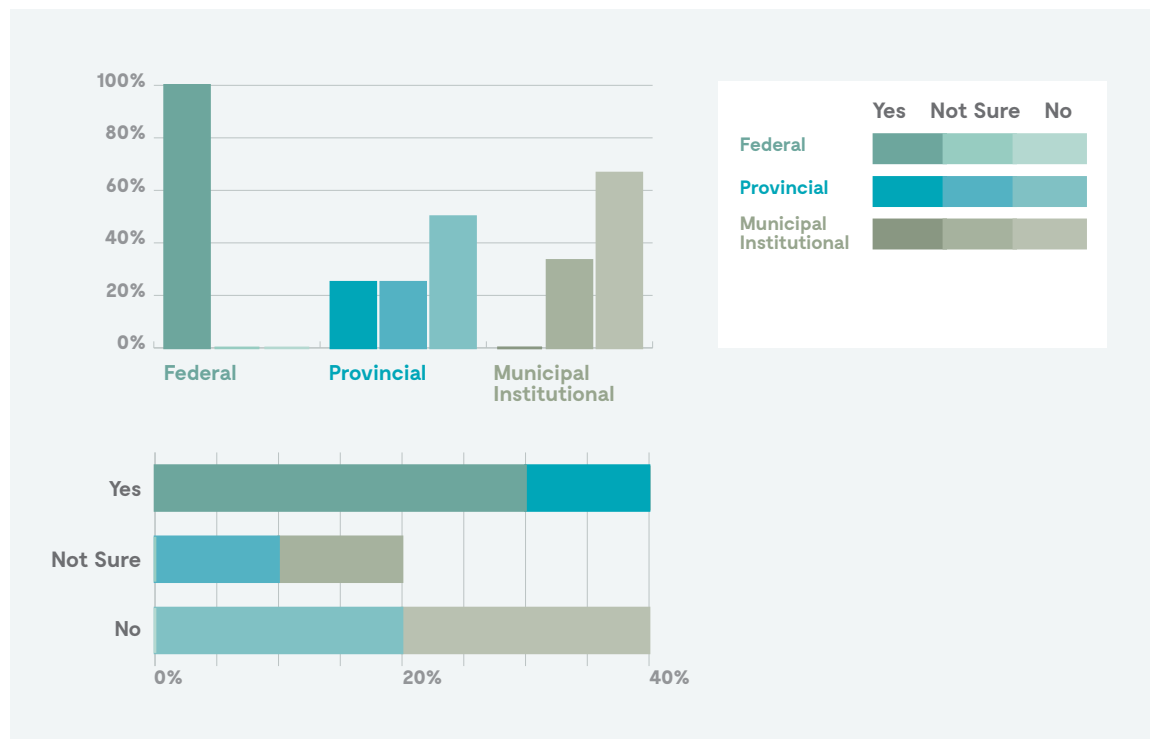


Figure 33 - Does your organization use a nationally accepted Classification System for organising the naming of modelled elements, systems, and activities (similar to OmniClass or Uniclass)?

Finally, respondents were asked whether they used or had developed a level of X (LoX) definition to support model-based exchanges (Figure 34). The responses were varied across respondent types, being either developed locally, adopted or adapted from international standards.

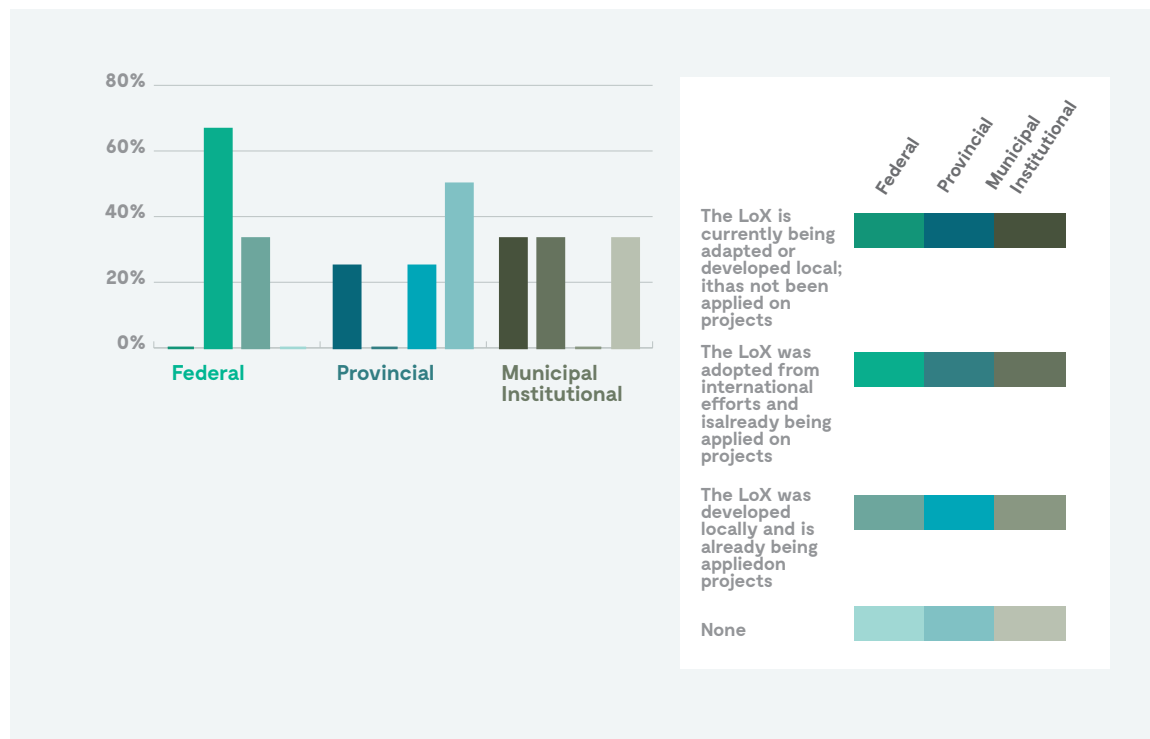
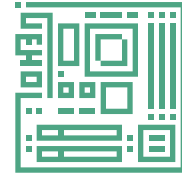


Figure 34 - Is an internationally adopted or nationally developed Level of X (LoX) applied when specifying model-based exchanges?

Discussion

The findings of this section indicate that there is still a lot of work with regards to standardizing parts and deliverables to support BIM-enabled project delivery. Indeed, object libraries or standardized parts as well as standardized deliverables are a key element in maximising efficiencies in developing object-oriented models. The findings also suggest there is little in the way of development of formal process maps to guide digital workflows and deliverables for project participants. To this effect, there are a number of international standards that have been developed, such as LoX definitions, object classifications schemas (eg. omniclass), model use taxonomies (eg. BIME model use list) and information exchange standards and protocols (eg. COBie and other official MVDs). Ideally, the goal is to develop standardized object libraries, model uses supporting delivery of services and operational data requirements that are optimized and integrated into procurement mechanisms, project workflows and asset lifecycle practices.





TECHNOLOGY INFRASTRUCTURE

According to Succar and Kassem (2015): “the eighth and final component [of the macro BIM adoption maturity model] refers to the availability, accessibility and affordability of hardware, software and network systems [as well as] the availability, usability, connectivity and openness of information systems hosting data-rich three-dimensional models”

In general, accessibility and affordability of hardware and software in Quebec and Canada, while seen as a barrier to adoption, is not an unsurmountable obstacle to BIM. Likewise, connectivity in most towns and cities across Canada is adequate. Therefore, basic technological barriers to BIM, while present, are not generally conceived to have a significant role in determining the rate of adoption in Quebec and Canada.

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For the survey, respondents were asked about cloud-based environments and hosting of project data. For instance, a strong majority of organizations surveyed have not developed web-portals for accepting submittals by project teams (Figure 35). The organizations that did, they deploy industry standard document exchange platforms (e.g. Sharepoint).

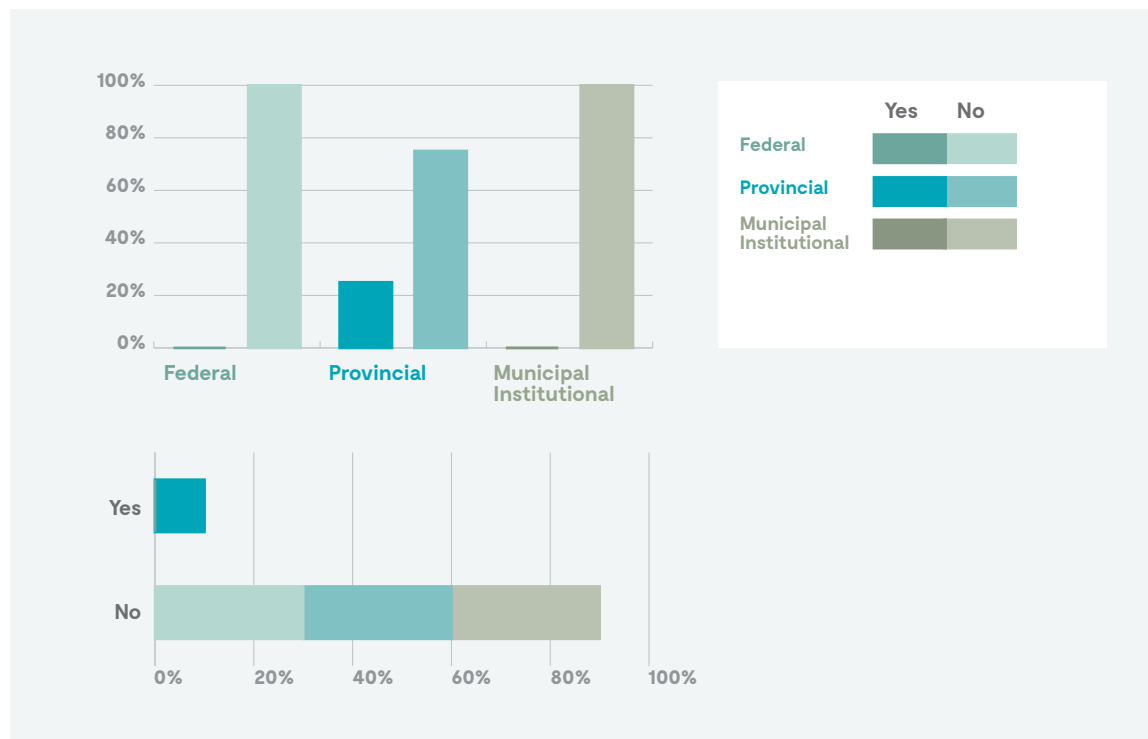


Figure 35 - Has your organization developed a web portal for accepting model-based submittal by industry stakeholders?

Moreover, a majority of respondents indicated that they did have information security obstacles which prevented the exchange of information models and data sets. In this regard, all organizations at the federal level indicated such constraints while at municipal/institutional level, the majority of organizations indicated either to have faced or are unsure of said issues (Figure 36).

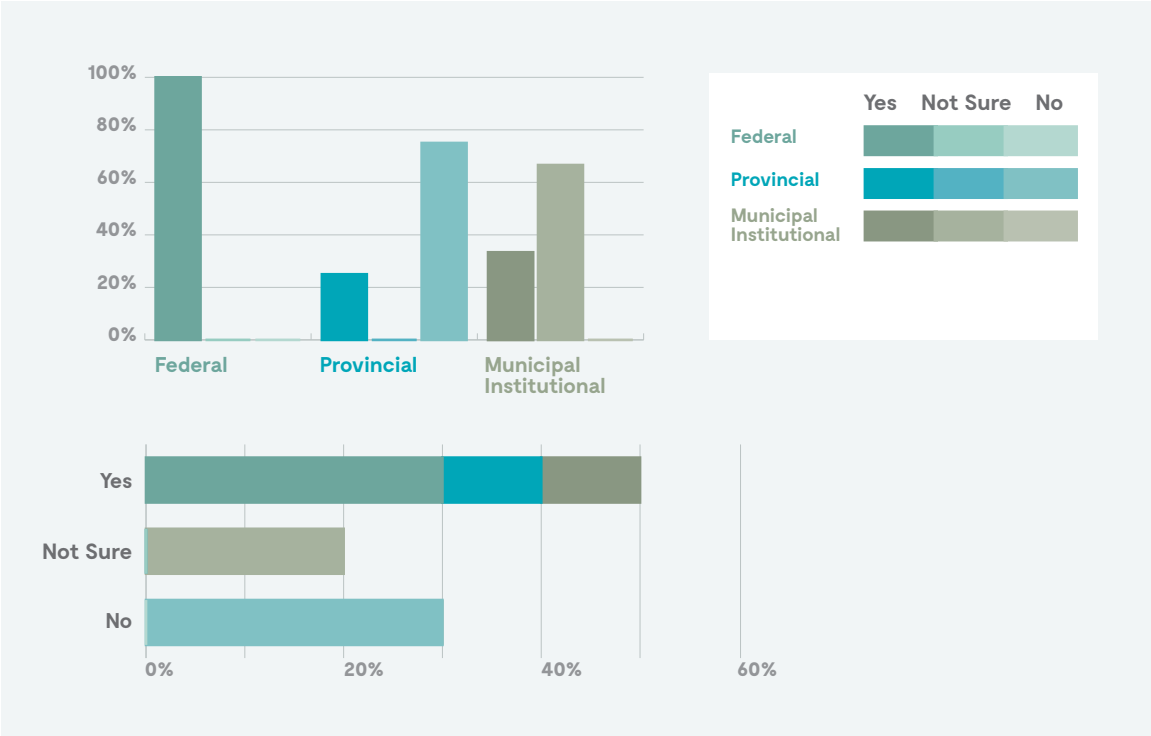


Figure 36 - Are there Information Security obstacles (e.g. departmental regulations or network-access firewalls) preventing the exchange of information models and data sets within your organization or with other organizations?

Finally, a majority of respondents indicated that they were not using locally developed BIM software solutions (Figure 37). The respondents who indicated that they were using locally developed solutions referred to solutions developed through partnerships with local organizations that were often supported through government programs such as the Build in Canada Innovation Program (BCIP).

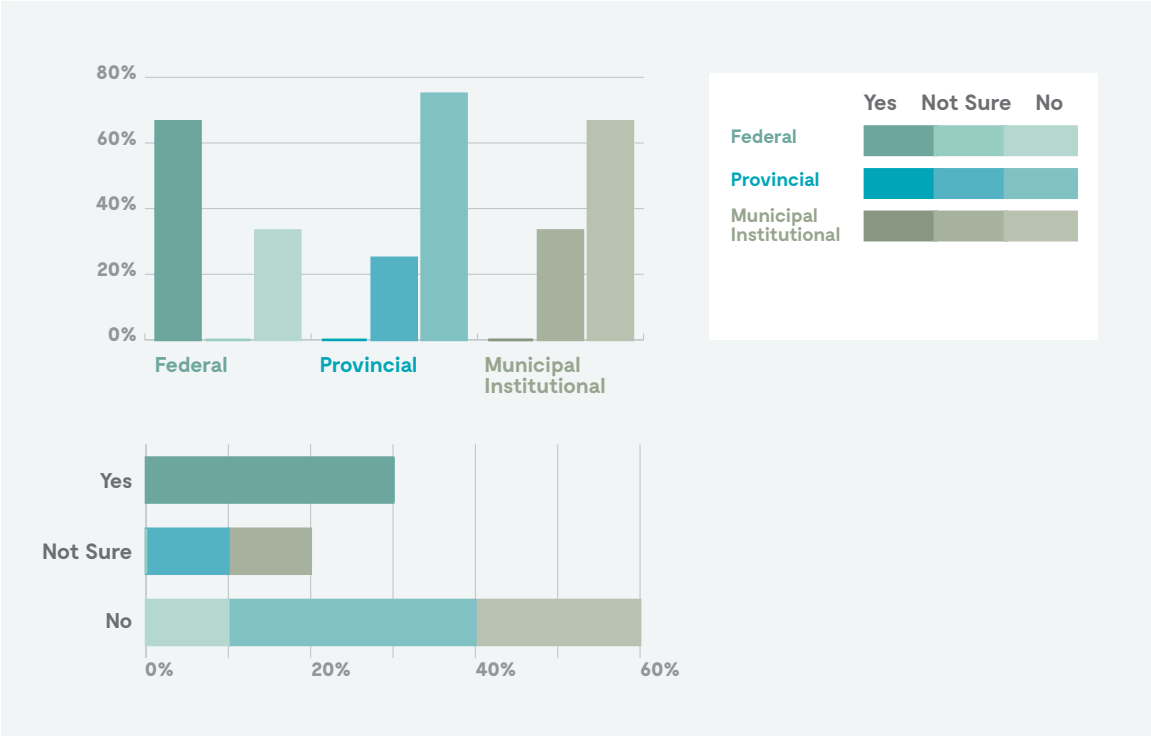
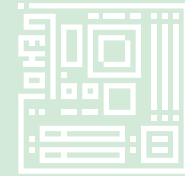


Figure 37 - Are there locally-developed BIM software solutions adapted to the organization's specific requirements and standards?

Discussion

The findings of this section indicate that while affordability of technology was not a key issue in influencing large scale BIM adoption rates, technological issues, such as cloud-based computing and file exchange as well as data security concerns are still prevalent and require attention. This is reflected by the fact that, for instance, there are no NBPs that cover data security issues. However, there seems to be potential to develop local solutions and develop local markets for the development of BIM tools. Ideally, the goal is to ensure an intuitive and ubiquitously accessible technology infrastructure which allows seamless interchange between all users, virtual systems and physical objects across the whole lifecycle.





ADOPTION POLICIES

With regards to adoption policies as well as formalization and engagement exercises, respondents were asked, among other things, whether there was an enforceable BIM mandate in their organizations. 20% of respondents at the provincial and municipal levels indicated that there were, and 20% of respondents indicated a partial mandate, at the federal and municipal/institutional level (Figure 38).

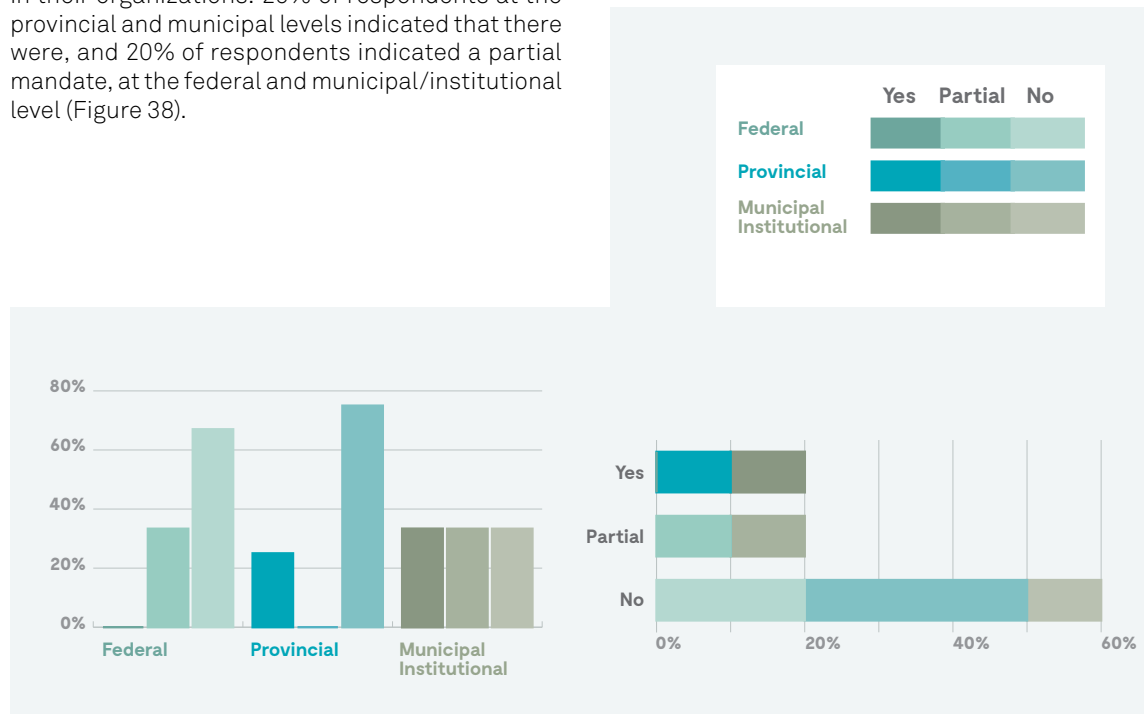


Figure 38 - Is there an enforceable BIM Mandate in your organization?

A majority of respondents indicated that their organizations had conducted one or more pilot studies for BIM, with all respondents at the federal level indicating such pilots had been completed (Figure 39).

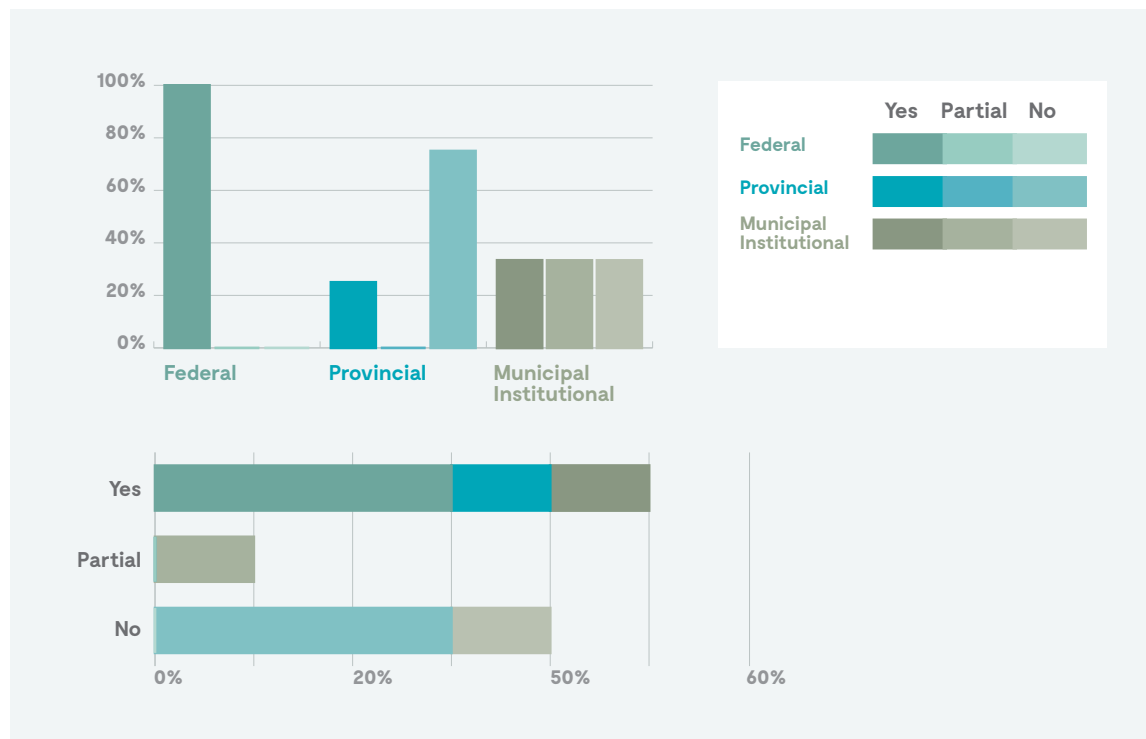


Figure 39 – Did your organization conduct and complete one or more BIM Pilot Studies or commission the delivery of BIM Case Studies?

A majority of respondents indicated that there was an active effort, either full or partial, by their respective organizations to enable BIM adoption and digital transformation at all three levels (Figure 40).

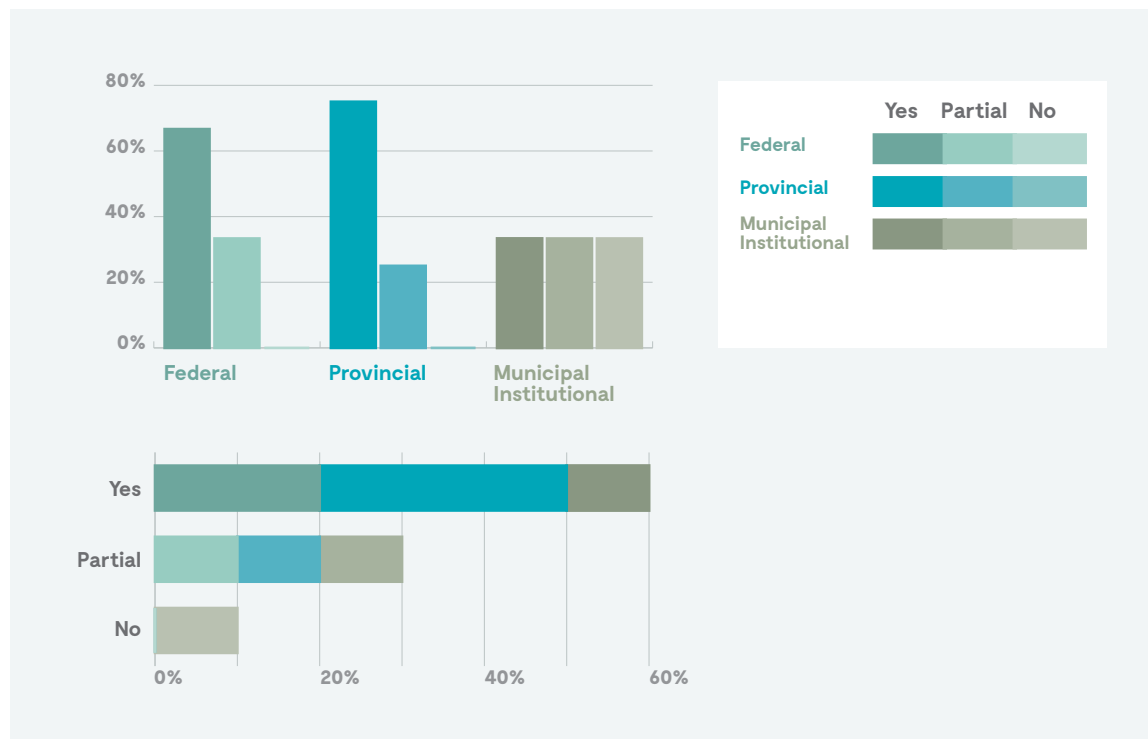


Figure 40 - Is there an active effort by your organization to enable BIM Adoption and Digital Transformation in general?

Finally, a majority of respondents indicated that their organizations supported or organized national (or regional) BIM events.

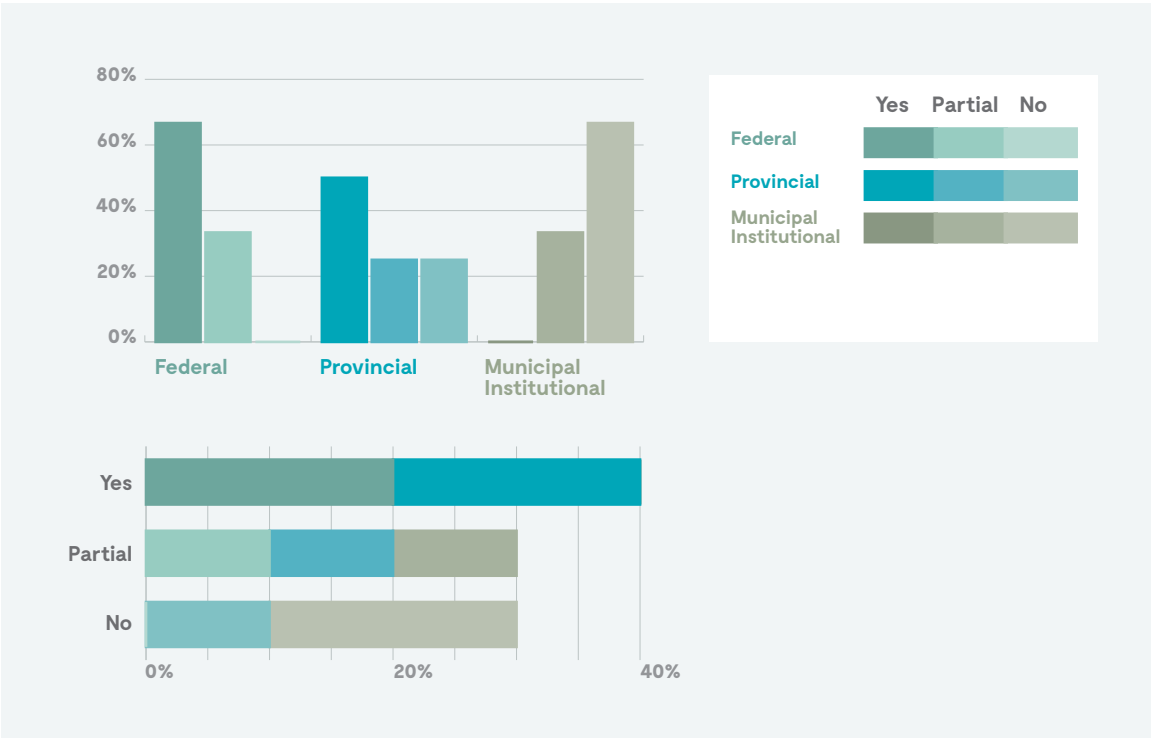
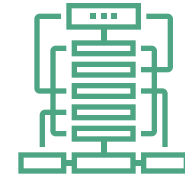


Figure 41 - Does your organization support or organize National BIM Events (e.g. conferences, seminars, or workshops)?

Discussion

The findings of this section indicate that BIM mandates are still sparse across Quebec and at the federal level. However, there is active engagement and widespread support by most respondents in the digital transformation agenda. Interestingly, only a small majority of respondents indicated that their organisation had developed pilot projects. Indeed, as highlighted in the report on principals of BIM adoption, developed by Groupe BIM du Québec, piloting is one of the key elements in the BIM deployment process.





RESPONSIBILITY MATRIX

Lastly, respondents were asked to rate the involvement of various stakeholder groups in the facilitation or encouragement of BIM diffusion in Quebec and Canada. Table 3 is a heat-map of respondents' answers across the five scales of involvement, ranging from low to high involvement. The stakeholder groups represented are the following:

- **Policy Makers:** governmental bodies, ministries, and departments
- **Educational Institutions:** universities, vocational colleges, and schools
- **Construction Organisations:** companies involved in the design, construction, and operation of built facilities
- **Technology Developers:** software, hardware and network solution providers (e.g. Autodesk or Bentley)
- **Technology Service Providers:** Commercial companies bridging the sales/services gap between technology providers and end users
- **Industry or Professional Associations:** associations representing the interests of their individual/organisational members within a specific industry, sector, discipline or specialty (e.g. Association of Architects)
- **Communities of Practice:** an informal grouping of individual practitioners with a common interest in a specific software, hardware or network solution (e.g. BIM User Group)
- **Technology Advocates:** a formal grouping of individuals and organisations focused on the development/ promotion of technology-centric standards and policies (e.g. buildingSMART)

TABLE 3
RESPONSIBILITY MATRIX

		Low	Medium-low	Medium	Medium-high	High
	Policy Makers	40 %	40 %	20 %	0 %	0 %
	Educational Institutions	0 %	50 %	30 %	20 %	0 %
	Construction organisations	0 %	50 %	30 %	10 %	10 %
	Technology developers	0 %	0 %	60 %	30 %	10 %
	Technology Service Providers	0 %	0 %	40 %	40 %	20 %
	Industry and Professional Associations	20 %	20 %	30 %	20 %	10 %
	Communities of practice	0 %	10 %	30 %	40 %	20 %
	Technology Advocates	0 %	10 %	20 %	40 %	30 %

Figure 42 shows a weighted average for each stakeholder group. Respondents identified the following four groups, in order, as being the most involved in facilitation and encouragement of BIM diffusion:

- Technology Advocates
- Technology Service Providers
- Communities of Practice
- Technology Developers

It is interesting to note that all four stakeholder groups are focused around the technological aspects of BIM, reflecting a predominant view of BIM as a technology which seems to be consistent across many markets in the world (as seen in Kassem and Succar, 2017).

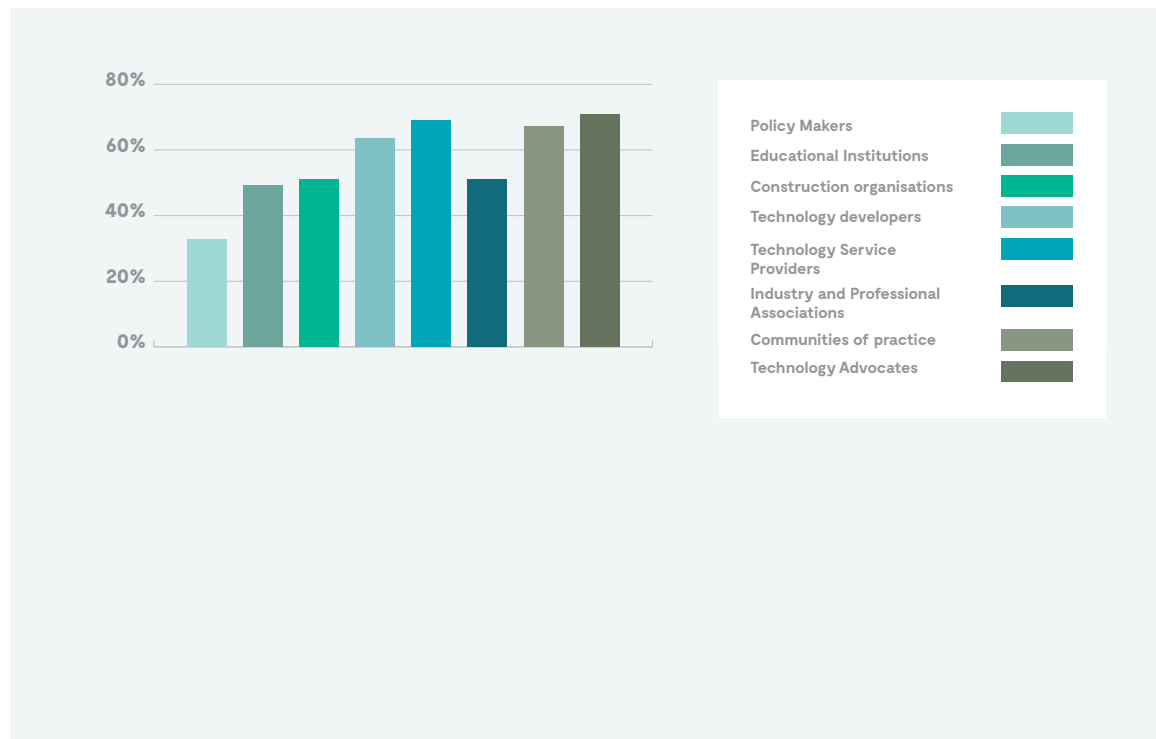


Figure 42 - Please rate the involvement of the below identified Stakeholder Groups in facilitating or encouraging BIM diffusion in your country

CONCLUSION

This report presents the findings of a targeted survey aimed at understanding the current state of macro BIM adoption in Canada, with a focus on the province of Quebec. The objectives of the study are to:

- Capture a clear portrait of the deployment of BIM in Quebec from the perspective of public owners and associations based on clear and internationally recognized indicators
- Identify the gaps in terms of macro BIM adoption in order to develop a comprehensive strategy for BIM deployment in Quebec

The findings show that there is increasing movement at all levels of government with respects to the deployment of BIM and digital project delivery from public organizations. While the trend is generally positive, a number of considerable risks are emerging. In particular, there is an increasing redundancy in the efforts to develop standards, guidelines and other documents to guide the BIM adoption process and the possibility of contradictions and incoherencies within these documents, which could seriously hinder industry the uptake of BIM causing both confusion and frustration. Furthermore, while some bodies have developed early BIM strategies and objectives, harmonizing these efforts would allow to focus on clarifying responsibilities and scopes for each level of government (e.g. Who does what; Who is best positioned to provide a primary/ supporting for each element of a strategy or action plan). Key takeaways from the survey highlight the need to focus on municipal and institutional bodies being the procurers and managers of considerable (if not a majority) of Canada's built environment.

Key recommendations from this study include:

- Develop a harmonized strategy for BIM deployment across Canada with clear objectives that can be adopted or adapted by all stakeholders, underpinned by a common framework (a collective why).
- Establish action items with clear responsibilities attributed to the various stakeholders involved in this transformation effort (a collective how and who)
- Define an action plan with clear milestones (a collective when)

→ This action plan must clearly identify what is available and what is needed in terms of education and training, measurement and guidance (a collective what) by, for instance, addressing issues that have been identified as lacking in the survey, namely:

- Standards and codes (to be adopted, adapted or created)
- Contractual agreements and other regulatory requirements
- Insurance policies
- Support systems such as classifications and information exchange protocols.
- Develop standardized benchmarks and metrics for assessing organisations, teams and projects to drive continual performance improvement.
- Develop or consolidate a platform for (a) sharing of information models and corresponding models; (b) digital submittals, and (3) other supporting systems such as standardised object libraries.

→ Encourage multi-party cooperation between public bodies and other stakeholder groups by further enabling and empowering the champions and drivers that are already operating across Canada and in Quebec.

Next steps are to expand this survey across Canada to broaden input and support the development of this strategy and action plan. There is indeed a clear intent to extend the scope of the survey across Canada to include all other provinces and territories in the near future.

ACKNOWLEDGMENTS

A special thank you to all the respondents who took the time to fill out the survey. Many thanks go to Dr.Mohamad Kassem and Dr.Bilal Succar for their feedback and collaboration.

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