

The Roadmap to Lifecycle BIM in the Canadian AECOO Community

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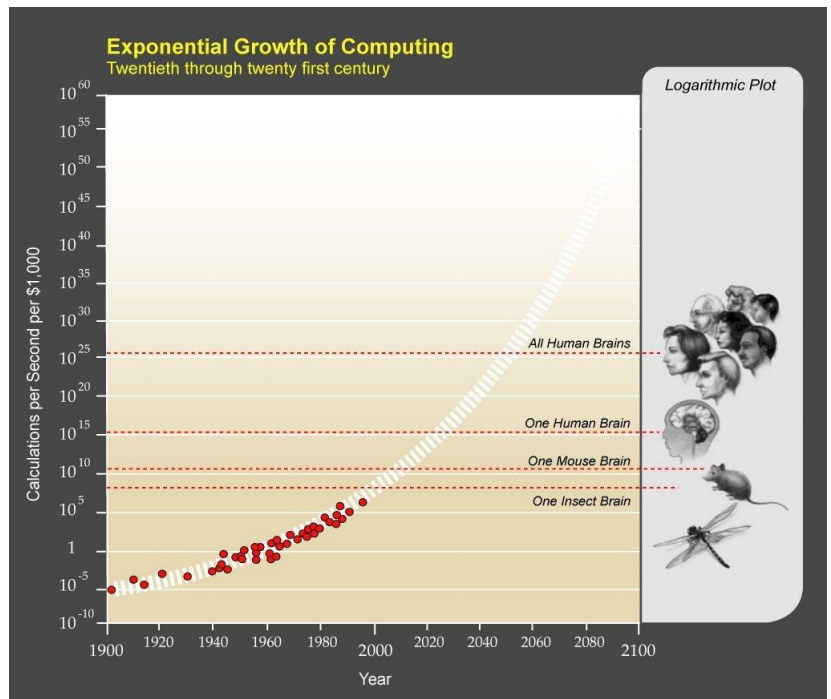
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Kurzweil's Law of Accelerating Returns

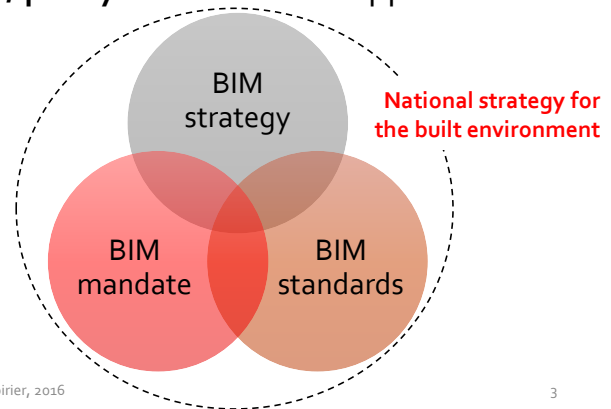


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Key takeaways

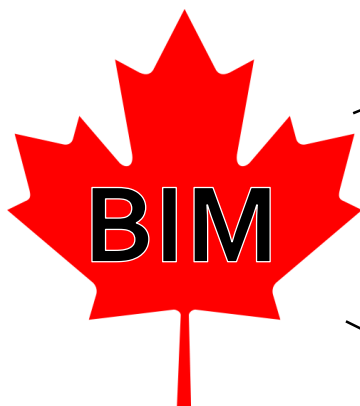
- BIM is a **catalyst** for change
- We need the appropriate **regulatory / policy** framework to support this change
- 3 key elements to this framework
 - National BIM **strategy**
 - National BIM **mandate**
 - National BIM **standards**
- The Roadmap is how we get there



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Where are we now?

Where are we headed?

How do we get there?

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- Established in 2010
- Joint national committee
- Objectives:
 - Define collaborative approaches
 - Develop and recommend consistent terminology & best practices
 - Endorse and Develop Open BIM Standards
 - Industry BIM education

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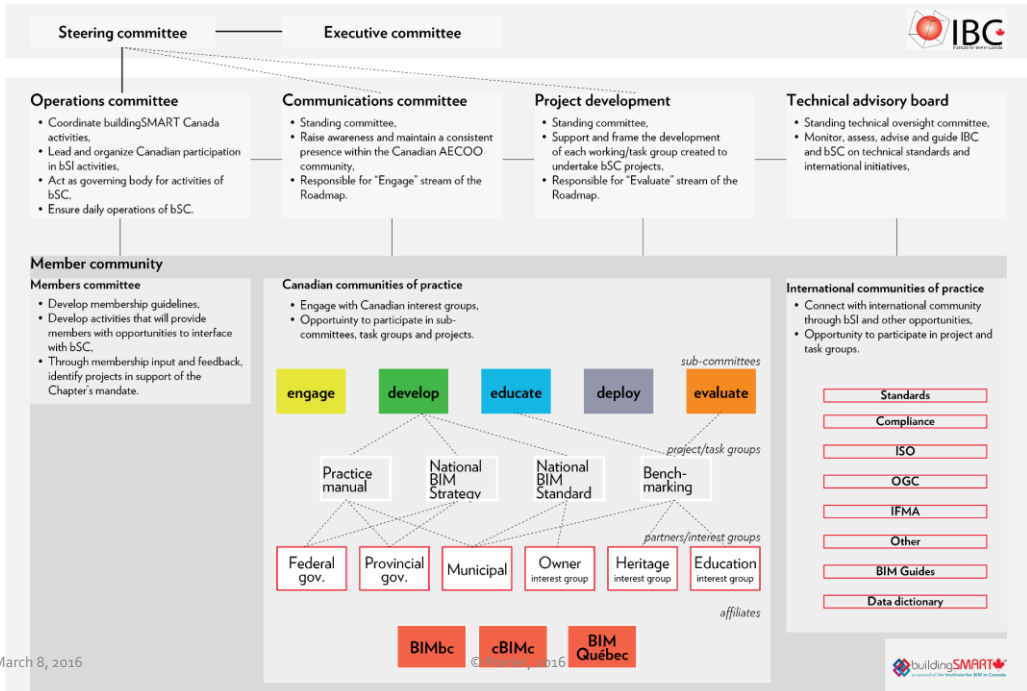
- Established in 2011
- Initiated and run by IBC
- provide the appropriate body and home for Canadian BIM Standards Development
- participation in the development of international BIM standards

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<http://www.buildingsmart.org/chapters/chapter-directory/>

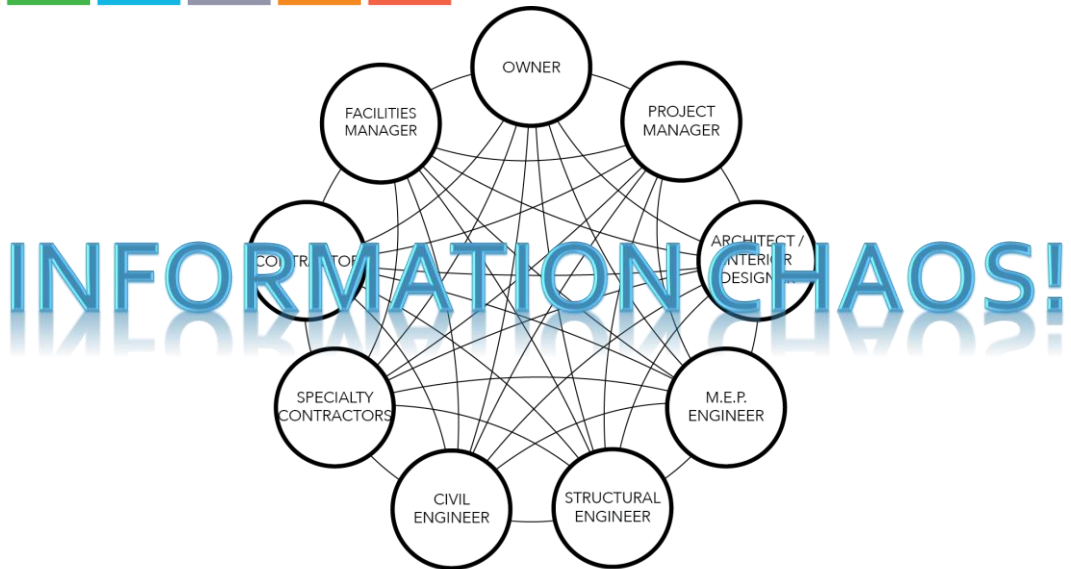


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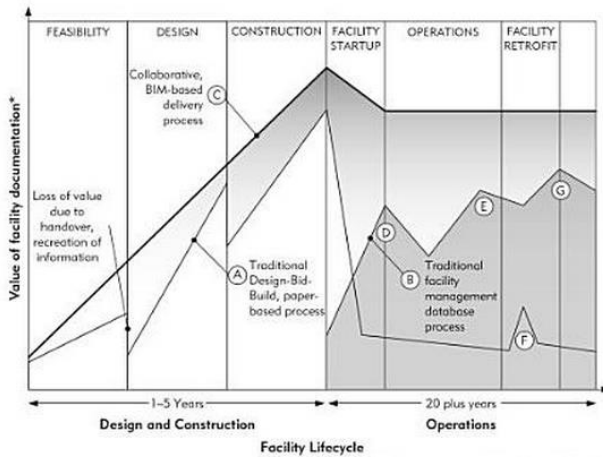
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Information loss



Cost of interoperability in the U.S.
\$15.8 G / year

(NIST, 2004)

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10-15%

increase to project cost due to poor documentation

(Engineers Australia, 2005)

5%

Cost of poor communication

(Haagenrud, 2007)

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25-30%

Cost of
fragmentation

(Haagenrud, 2007)

30%

of waste in
the field

(CURT, 2004)

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The bottom line

Capital Plan – Budget 2015

(millions of \$)	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	5 year
Schools	839	1287	1114	679	177	4,096
Healthcare	544	411	248	514	435	2,152
Municipal infrastructure	1,249	1,638	1,678	1,704	1,610	7,879
Capital Maintenance and Renewal	754	739	879	1,037	1,388	4,797
Roads and Bridges	1,305	780	908	776	814	4,583
Post-Secondary	163	187	163	21	46	580
Gov facilities, equip and others	10	10	20	20	10	70
						24,157

Total of **31,100 M\$** for 5 year plan

April 30, 2015

Presentation to ADM

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The bottom line: *potential* losses

Study	How that translates for the GOA
Cost of interoperability: deficient data and information management throughout an asset's lifecycle = 2.84 % of yearly capital expenditures (CapEX) (Gallaher et al., 2004)	Loss of 686 M\$ over the next 5 years
Cost of deficient project documentation: contributes 10 to 15 % to project costs (Engineers Australia, 2005)	Loss of between 2,415.7 M\$ and 3,623.6 M\$ over the next 5 years
Cost of lack of communication: Communication errors and loss of information on a project cost up to 5 % of investments (Haagenrud, 2007)	Loss of 1,207.9 M\$ over the next 5 years
Cost of fragmentation: 25-30 % of construction costs are incurred by the fractioning of the project delivery process (Haagenrud, 2007)	Represents between 6,039.3 M\$ and 7,247.1 M\$ that could be avoided over the next 5 years

At a minimum, the total loss on CapEX would be **4,309.6 M\$** over the next 5 years



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Where do we focus?

Improve performance



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Generate value



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Where do we focus?

Planning for a Sustainable Future
The 2016-2019 Federal Sustainable Development Strategy

	Taking Action on Climate Change	<p>5 Goals</p> <p>36 Measurable Targets</p>
	Clean Technology, Jobs and Innovation	
	National Parks, Protected Areas and Ecosystems	
	Freshwater and Oceans	
	Human Health, Well Being and Quality of Life	

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Where do we focus?

- UK Construction 2025 strategy

Lower costs

33%

reduction in the initial cost of construction and the whole life cost of built assets

Faster delivery

50%

reduction in the overall time, from inception to completion, for newbuild and refurbished assets

Lower emissions

50%

reduction in greenhouse gas emissions in the built environment

Improvement in exports

50%

reduction in the trade gap between total exports and total imports for construction products and materials

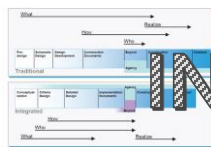
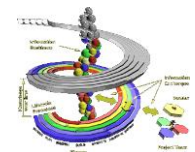
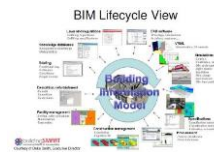
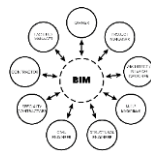
5/12/2016

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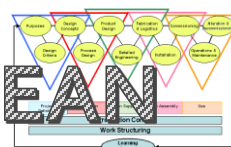
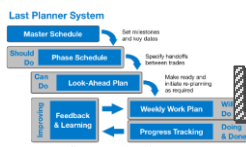
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The road forward



INTEGRATION



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The road forward



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The bottom line: *potential* gains

Study	How that translates for the GOA
Implementation of project delivery which foster better collaboration could save, at a minimum, 10% of Cap EX (doesn't include BIM) (National Audit Office, 2005)	Potential gains of 1,424.1 M\$ between 2017 and 2020
Systematic reduction of construction costs between 8 % and 10 % for projects having implemented BIM (BIM Task Group, 2011)	Potential gains between 1,139.3M\$ and 1,424.1 M\$ between 2017 and 2020
Better precision in estimating costs (less than 3% of variation with actual costs) (Gao and Fischer, 2008b)	Better project predictability
7%-19% reduction in project schedule (Gao and Fischer, 2008b , U.S. General Services Agency, 2014)	Avg. Length of project = 36 months Between 2 ½ and 7 month reduction Financing costs = 4% / year = 0.3 % / month of project costs Represents between 106.8 M\$ and 299 M\$ between 2017 and 2020

At a minimum, the potential gain on Cap EX could be **2,670.2 M\$** over the next 5 years

April 30, 2015

Presentation to ADM

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The bottom line

- At a minimum, the total loss on Cap EX would be **4,309.6 M\$** over the next 5 years
- At a minimum, the potential gain on Cap EX could be **2,670.2 M\$** over the next 5 years

$\Delta = 6,979.8 \text{ M\$}$
22% of total CapEx

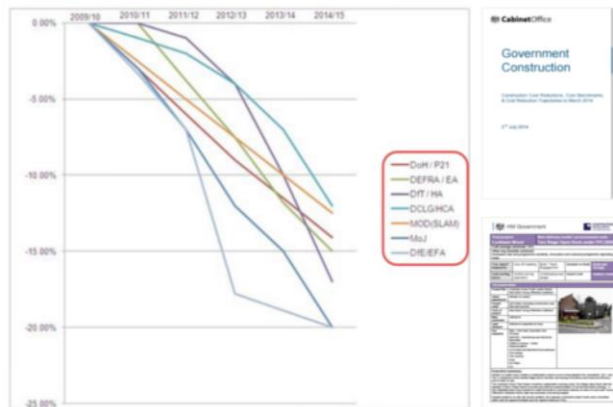
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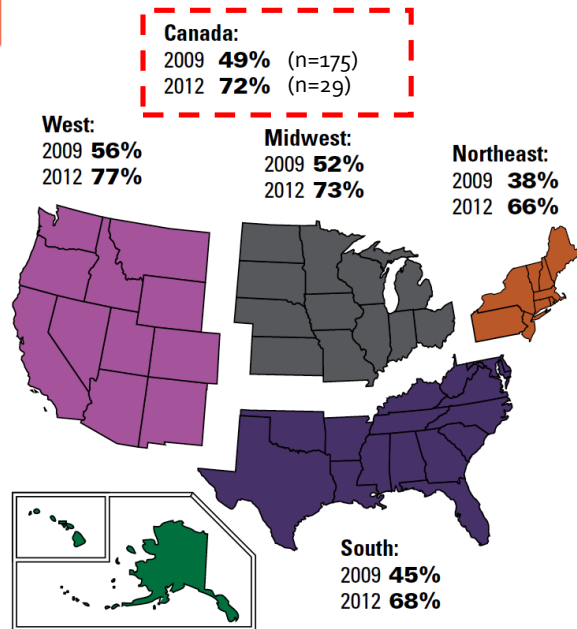


The road forward The Savings are Real



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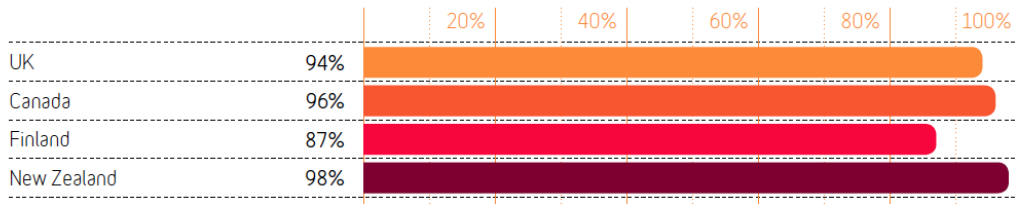
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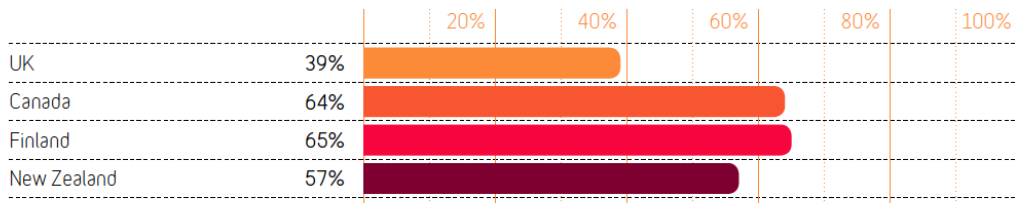
(McGraw-Hill, 2012) 25



Awareness of BIM



Respondents aware of and currently using BIM



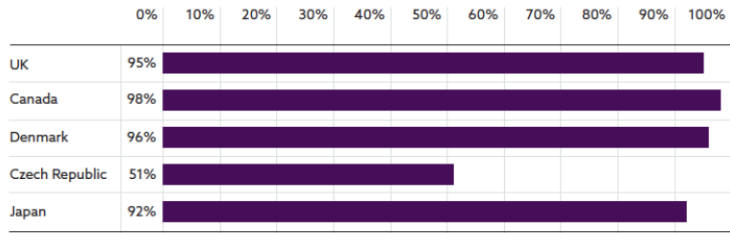
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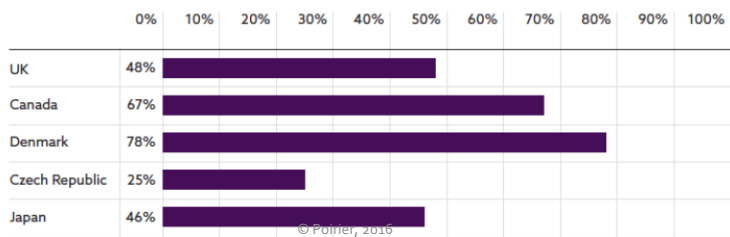
(NBS, 2013) (n=72) 26



Awareness



Respondents aware of and currently using BIM



(NBS, 2015)
(n=127)

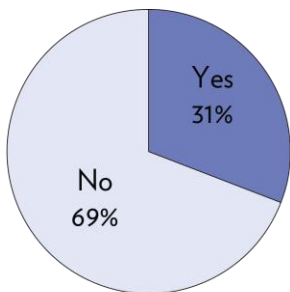
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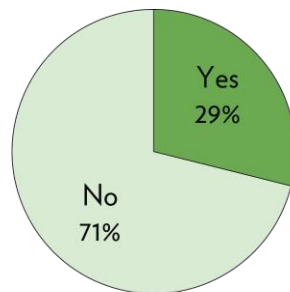
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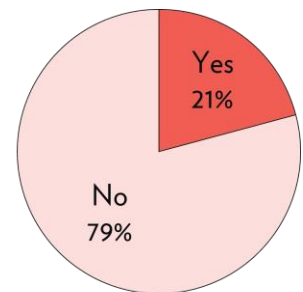
BIM & integrated approaches in Quebec



Building Information Modeling (BIM)



Integrated approaches



Lean design & construction

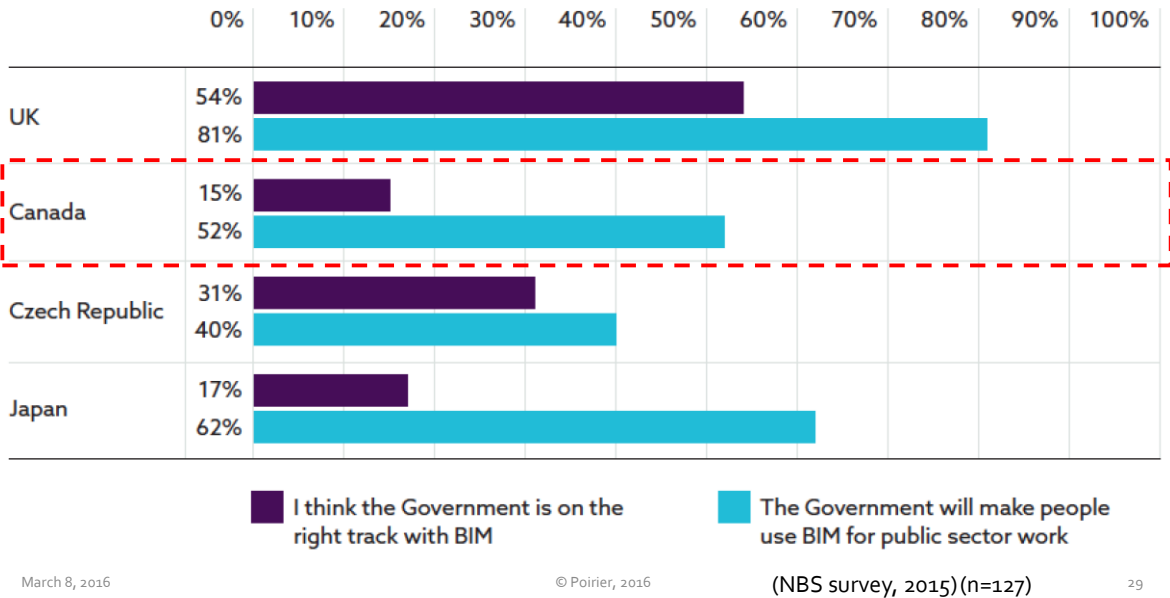
(Tahrani, Poirier & Forgues, 2015)
(n=521)

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Agreement with statements...



Some observations

- Limited rate of **adoption**
- Limited to **specific portions** of the supply chain
- **Inconsistent** use of BIM across Canada
- Variable level of **maturity** and **capability**
- Hinders **potential value** to Canada



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How can the Canadian AECO industry:

1. **learn from other countries' experiences** in the transition to innovative project delivery approaches?
2. develop a comprehensive **reform strategy in order to improve its performance and efficiency** to ensure its sustainability and competitiveness?

Source: (Tahrani et al. 2015)

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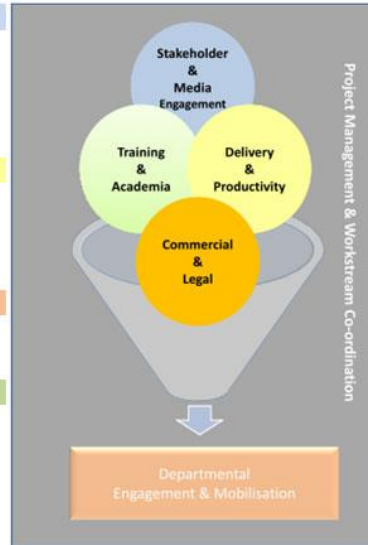
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UK

- 1.) Stakeholder and Media Engagement:**
 - BIM vision and value
 - Departmental and GCS co-ordination
 - SME / Regional Awareness
 - Stakeholder engagement and management
 - Communication
 - Guidance and publications
- 2.) Delivery and Productivity**
 - COBie UK:2012
 - PAS1192:2 and 3
 - Plans of work
 - Level of Detail (LOD)
 - Data Management
- 3.) Commercial and Legal**
 - Contracts
 - Copyright
 - IP / PI
- 4.) Training and Academia**
 - Academic Forum
 - Construction Skills
 - Technical training
 - APM
 - Accreditation
 - Supply strategies

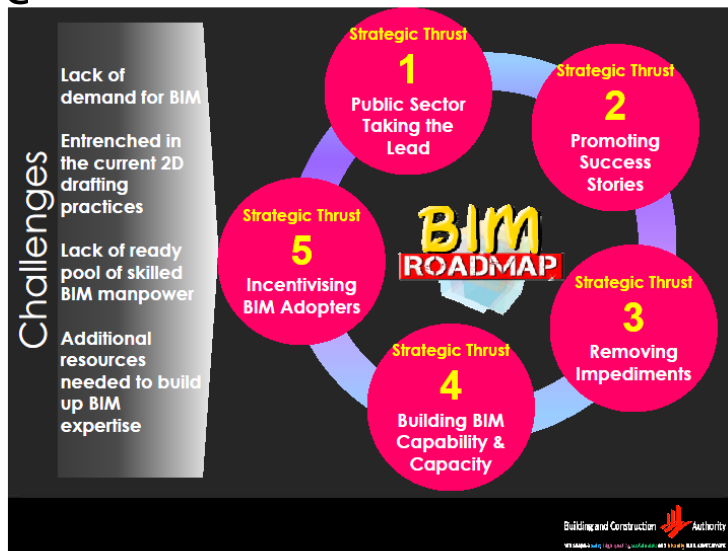


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Singapore

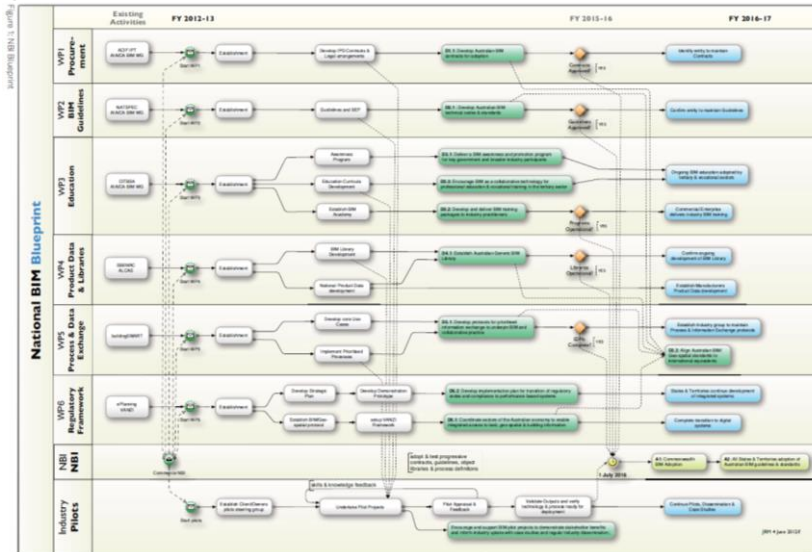


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Australia



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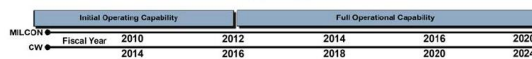
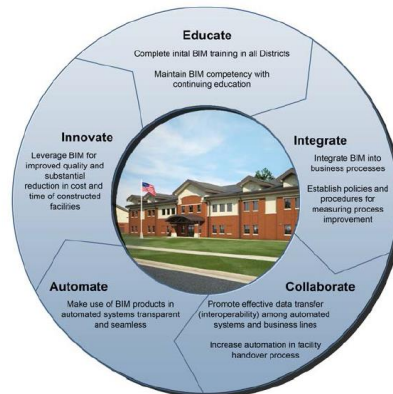
USACE

The US Army Corps of Engineers Roadmap for Life-Cycle Building Information Modeling (BIM)

US Army Corps of Engineers

November 2012

Directorate of Civil Works
Engineering and Construction Branch
Washington, DC 20314-1000



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Governmental policy

No formal policy mandating BIM implementation on all public projects in Canada

Four separate initiatives



Space management and open BIM
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Royal Alberta Museum pilot project
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Several small pilot projects



Moose Jaw Hospital
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Source: (Tahrani et al. 2015)



Governmental policy

No formal policy mandating BIM implementation on all public projects in Canada

Four separate initiatives

Fragmented initiatives across the county



Space management and open BIM
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Royal Alberta Museum pilot project
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Several small pilot projects



Moose Jaw Hospital
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Source: (Tahrani et al. 2015)


A leader in the buildingSMART community

A Roadmap to Lifecycle Building Information Modeling in the Canadian AECOO Community

a call to action!

To lead the transformation to a better performing Canadian AECOO community through the implementation of collaborative, open BIM-based project delivery and lifecycle processes.

A clear transformation is needed for the Canadian Architecture, Engineering, Construction, Owners and Operations (AECOO) community to improve its performance and contribute more effectively to the social, environmental and economic development of Canada. The Canadian chapter (ISC) of buildingSMART International (BSI), a council of the Institute for BIM in Canada (IBC), firmly believes that this transformation should be supported by more collaborative approaches to project delivery based on building information modeling (BIM) tools, technologies and processes that are aligned with other similar initiatives currently under way around the globe. Furthermore, we believe that this must be achieved through a National BIM mandate. In light of this, ISC has developed a roadmap to prompt, guide and sustain this transformation.

We strongly believe that a transformation to collaborative BIM-based project delivery and lifecycle processes in the Canadian AECOO community must be founded on six principles:

1. All Canadian AECOO community stakeholders, at all levels, must be actively **engaged** in the transformation;
2. The technologies, processes and standards supporting the transformation must be rigorously, consistently and continually **developed** and maintained;
3. All Canadian AECOO community stakeholders must be **educated** and trained to ensure the transformation be successful and maintained;
4. The tools, technology and processes that are developed must be **deployed** and adopted within a conducive environment across the Canadian AECOO community;
5. The progression of this transformation must be continuously monitored and **evaluated** for effectiveness;
6. The transformation must be **sustained** by all Canadian AECOO community stakeholders well beyond the initial transformation cycle.

The roadmap articulates these six principles and develops them by setting clear intentions aimed towards a verifiable desired state. ISC is convinced that the roadmap will facilitate the transformation to a better performing industry through the collective participation of all its stakeholders. We challenge the Canadian AECOO community to get involved and support this roadmap, participate in its implementation, and put its outcomes into practice.

Roadmap Statement of Intent v1.0 | 26.11.2016

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↑] the average growth in Canadian infrastructure construction is expected to be 3.1% p.a. through 2025 [↓
Source: Infrastructure Economics and Construction Industry to 2025



The Canadian AECOO community accounts for more than \$190 billion in capital expenditures or 18.2% of the Canadian GDP. The construction industry alone employs 1.5 million people or 7.5% of the total workforce¹. This industry is one of the pillars of the Canadian economy; however, it is hindered by several issues that render it inefficient, wasteful and unsatisfactory. The AECOO community is fragmented, complex, slow to change and has an inconsistent notion of value. It is also a community that has to deal with the uniqueness of its project-based context, which requires the cooperation and collaboration of several specialized individuals and organizations to deliver products within a strict and complex regulatory framework.

There is growing consensus both nationally and globally among community stakeholders that systemic change is necessary. Other countries have come to this conclusion and put forth national frameworks to support the transformation towards a more efficient and better performing construction industry. These countries have invested in the development and adoption of innovative approaches to project delivery and facility maintenance. It is time for the Canadian AECOO community to follow suit and transform for the sake of not only industry, but for its society, its environment and its economy as a whole.

Emerging trends in the global AECOO community are an alleviating barrier to performance. Of these trends, BIM is increasingly being recognized all over the world as powerful processes and technologies that enable and support better collaboration between project team members and in turn lead to more efficient and effective planning, design, construction and maintenance of built assets. Indeed, the movement to BIM is motivated by increased value, safety, productivity and sustainability.

This transformation is, however, rife with challenges and needs to be undertaken in a strategic and structured way. It must happen at multiple levels (industry, organization, project) and be supported by the government, the client base and by the community itself. It is therefore essential that a clear path be set out that informs this transformation to better practice in the Canadian AECOO community. The buildingSMART Canada Roadmap to Lifecycle Building Information Modeling in the Canadian AECOO community aims to set out this path.

The roadmap is a call to action to engage the AECOO community, foster consensus, and move towards open BIM-based collaborative project delivery and building lifecycle processes. It is a living document with the following outcomes:

- a National BIM mandate that sets out the framework (technological, organizational and procedural) for the deployment of collaborative BIM-based project delivery environments in the Canadian AECOO community;
- an alignment between all stakeholders with regards to roles and impact in supporting and sustaining this collective transformation; and
- a clear scope and sequence of activities that must be carried out in order to support and sustain this collective transformation and progress towards a desired state.

1. Statistics Canada (2015). <http://www5120.cma.ca/indicators/infrastructure-construction/infrastructure-construction> (Accessed on November 23, 2014)
2. OECD (2014). [Transforming the industry \(document\) \(en\) \(03/10/14\)](http://www.oecd.org/infrastructure/infrastructure-investment/)
3. Industry Canada (2014). <http://www5120.cma.ca/indicators/infrastructure-construction/infrastructure-construction> (Accessed on 30 July 2014)

Roadmap Statement of Intent v1.0 | 26.11.2016

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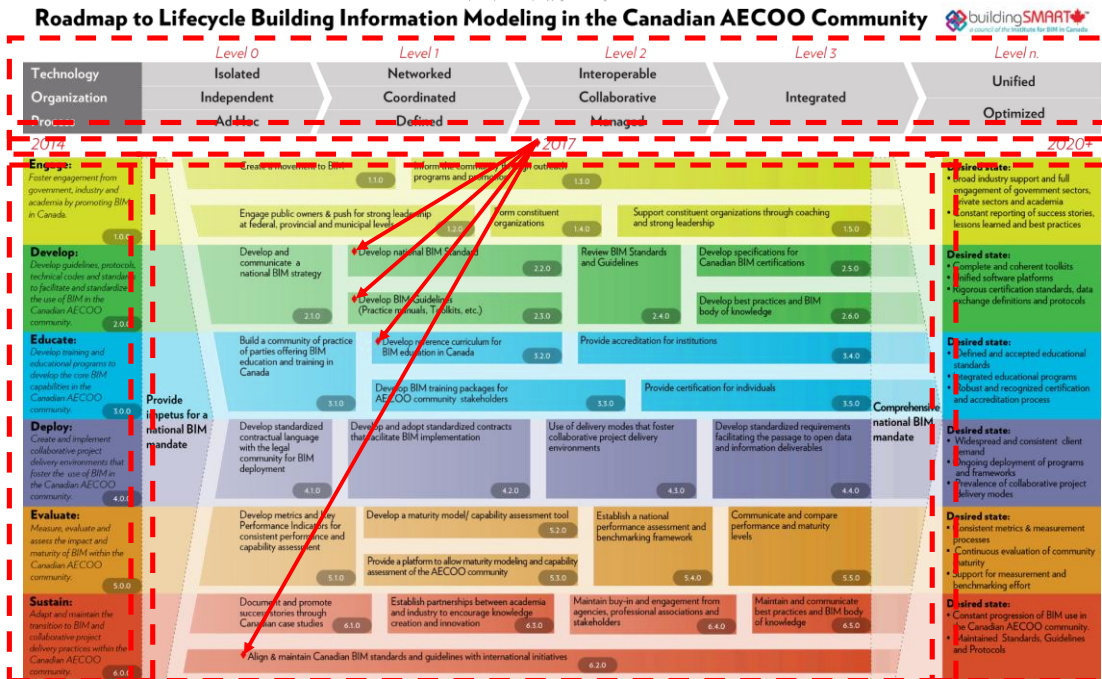
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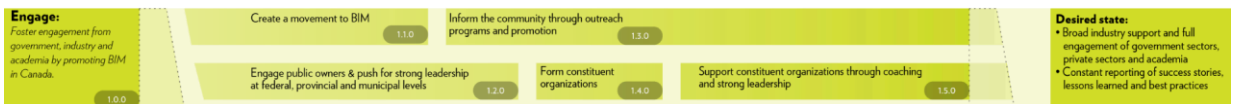
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Roadmap v.1.0 | 26.11.2014 | Copyright © buildingSMART Canada 2014



Engage *To foster engagement from government, industry and academia by promoting open standards for BIM in Canada.*

- **Desired state**
 - Broad industry support and full engagement of government sectors, private sectors and academia
 - Constant reporting of success stories, lessons learned and best practices
- **Activities:**
 - Create a movement to BIM.
 - Engage public owners and push for strong leadership at federal, provincial and municipal levels
 - Inform the community through outreach programs and promotion.
 - Form constituent organizations.
 - Support constituent organizations through coaching and strong leadership





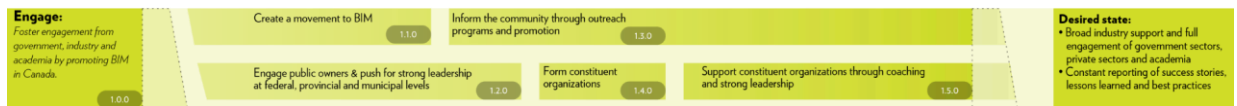
Engage *To foster engagement from government, industry and academia by promoting open standards for BIM in Canada.*

• 2015

- Free membership
- Affiliates Initiative

• 2016

- Monthly Members' community meetings
- Develop case study database



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Engage

- Benefits of BIM for Owners Report
 - Overview of BIM from Owners Perspective
 - Non-technical
 - Case Studies which attempt to measure the impact of BIM



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Develop *To develop guidelines, protocols, technical codes and standards to facilitate and standardize the use of BIM in the Canadian AECOO community.*

• Desired state:

- Complete and coherent toolkits
- Unified software platforms
- Rigorous certification standards, data exchange definitions and protocols

• Activities:

- Develop and communicate a national BIM strategy.
- Develop national BIM Standard
- Develop BIM guidelines (practice manuals, toolkits, etc.)
- Review BIM Standards and guidelines.
- Develop specifications for Canadian BIM certifications.
- Develop best practices and BIM body of knowledge.



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Develop *To develop guidelines, protocols, technical codes and standards to facilitate and standardize the use of BIM in the Canadian AECOO community.*

• 2015

- Canadian Practice Manual for BIM
- Acknowledge release of NBIMS-US V3

• 2016

- Develop a comprehensive national BIM Strategy to help steer the elaboration of the BIM mandate.



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Develop

- Toolkits
 - Design Development Phase Toolkit
 - Construction Phase Toolkit
 - FM Handover & Operations Toolkit



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Educate *To develop training and educational programs to develop the core BIM capabilities in the Canadian AECOO community.*

- **Desired state:**
 - Defined and accepted educational standards
 - Integrated educational programs
 - Robust and recognized certification and accreditation process
- **Activities:**
 - Build a community of parties offering BIM education and training in Canada.
 - Develop reference curriculum for BIM education in Canada.
 - Develop BIM training packages for AECOO community stakeholders.
 - Provide accreditation for institutions.
 - Provide certification for individuals.



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Educate *To develop training and educational programs to develop the core BIM capabilities in the Canadian AECOO community.*

• 2015

- Established the 'BIM in Education' committee,
- Conducted an environmental scan of BIM education in Canada

• 2016

- Develop the 'BIM in Education' Strategy
- Develop a reference curriculum for BIM education in Canada.
- 2-day seminars to help industry get started with BIM.



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Deploy *To create and implement collaborative project delivery environments that foster the use of BIM in the Canadian AECOO community.*

• Desired state:

- Widespread and consistent client demand
- Ongoing deployment of programs and frameworks
- Prevalence of collaborative project delivery modes

• Activities:

- Develop standardized contractual language with the legal community for BIM deployment
- Develop and adopt standardized contracts that facilitate BIM implementation
- Use of delivery modes that foster collaborative project delivery environments
- Develop standardized requirements facilitating the passage to open data and information deliverables



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Deploy *To create and implement collaborative project delivery environments that foster the use of BIM in the Canadian AECOO community.*

• 2015

- Promotion of IBC's BIM Contract Addendum

• 2016

- Continue to promote of IBC's BIM Contract Addendum.
- Push for the standardization of contractual language that facilitates the implementation of BIM and open BIM standards.



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Deploy

- IBC Contract Appendix for BIM projects
 - IBC 100-2014 – IBC BIM Contract Appendix
 - IBC 201-2014 – IBC LOD, Authorized Uses and Model Elements Table



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Evaluate *To measure, evaluate and assess the impact and maturity of BIM within the Canadian AECOO community.*

• Desired state:

- Consistent metrics & measurement processes
- Continuous evaluation of community maturity
- Support for measurement and benchmarking effort

• Activities:

- Develop metrics and Key Performance Indicators for consistent performance and capability assessment
- Develop a maturity model/ capability assessment tool
- Provide a platform to allow maturity modeling and capability assessment of the AECOO community
- Establish a national performance assessment and benchmarking framework
- Communicate and compare performance and maturity levels



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Evaluate *To measure, evaluate and assess the impact and maturity of BIM within the Canadian AECOO community.*

• 2015

- Develop metrics and KPIs

• 2016

- Develop strategies to measure, evaluate and assess the impact and maturity of BIM in Canada.
- Conduct a national BIM survey.



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Sustain *To adapt and maintain the transition to BIM and collaborative project delivery practices within the Canadian AECOO community.*

• Desired state:

- Constant progression of BIM use in the Canadian AECOO community.
- Maintained Standards, Guidelines and Protocols

• Activities:

- Document and promote success stories through Canadian case studies
- Align & maintain Canadian BIM standards and guidelines with international initiatives
- Establish partnerships between academia and industry to encourage knowledge creation and innovation
- Maintain buy-in and engagement from agencies, professional associations and stakeholders
- Maintain and communicate best practices and BIM body of knowledge



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Sustain *To adapt and maintain the transition to BIM and collaborative project delivery practices within the Canadian AECOO community.*

• 2015

- BIM guidelines environmental scan

• 2016

- Develop a strategy to publish and broadcast case studies of BIM and open BIM adoption and implementation in Canada.



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Some observations

- **Innovative approaches** improve the performance and value generated
- **Governments** around the world are **driving the reform**
- Canadian mandate can rely on **international efforts** to inform its initiatives
- Canadian initiative must share a **single vision**

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Source: (Tahrani et al. 2015)

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Next Steps:

Need for reliable Canadian data

- At the core of any **change / continuous improvement** effort
- If we want to **inform decisions**
- If we want to **develop policy**
- If we want to **move forward**

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Next Steps:

Need for a national strategy for the built environment

- Aimed at **improving the performance** of the industry
- Aimed at **generating more value** for Canada
- Aimed at delivering a **better and more sustainable** built environment

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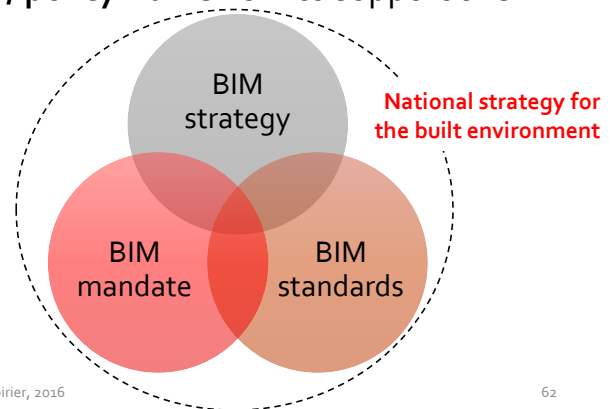
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Key takeaways

- BIM is a **catalyst** for change
- We need the appropriate **regulatory / policy** framework to support this change
- 3 key elements to this framework
 - National BIM **strategy**
 - National BIM **mandate**
 - National BIM **standards**
- The Roadmap is how we get there



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Roadmap to Lifecycle Building Information Modeling in the Canadian AECOO Community

