

2016

# Innovation in the Construction Sector: A Survey of Infrastructure Owners



This study was made possible with financial support from Natural Resources Canada through the Canadian Industry Program for Energy Conservation (CIPEC) – an industry-government partnership that supports industrial energy efficiency. For more information about CIPEC go to [www.cipec.ca](http://www.cipec.ca)

2016-03-17 version 2.

L.M. Waugh, University of New Brunswick,  
T.M. Froese, University of British Columbia,  
F. Sadeghpour, University of Calgary  
(assisted by A. Horosko, Beau-Bay Consulting)

© 2016 Canadian Construction Innovations Inc.

## EXECUTIVE SUMMARY

International and Canadian reports indicate an urgent need to improve innovation in the Canadian construction sector.

Between September and December of 2015, 30 executives from large infrastructure owner organizations were interviewed about the current state and future potential of innovation in Canada's construction sector. These executives are collectively responsible for spending over \$25 billion annually. Their organizations are distributed across most provinces of Canada and represent a balance of public and private organizations, as well as 7 industry sectors.

The survey began with profile questions regarding individual respondents and their organizations followed by a request for respondents' initial thoughts on innovation problems and processes. Next the respondents were probed for their views on innovation from a variety of perspectives: motivations, opportunities, emerging technologies, trends, impediments, importance, and performance. The final section of the survey obtained feedback on who has the greatest potential to improve innovation, what methods best encourage innovation, and how innovation relates to measures of success for the respondents' organization.

The respondents' organizations predominantly use the traditional project delivery approach of completing design documents before selecting a contractor and proceeding with the construction phase; the remaining organizations typically use design-build or EPC (Engineering/Procure/Construct) procurement processes. In their typical designer selection process, the majority of the respondents' organizations use both prequalification and proposals, with most of the remaining using a proposals-only selection process. In their typical contractor selection process, one-third use low-bid only, one-quarter use both prequalification and proposals, and one-fifth use both prequalification and low-bids, with the remaining using either proposal-only or prequalification-only.

Most respondents chose "to improve services to clients/end-users" as one of the most important motivations for innovating. Further insight was gained from two questions regarding the project phase (project time) with the greatest opportunity for innovation. The first question asked whether "the planning and design phase," "the on-site construction phase," or "the operation and maintenance phase" has the greatest opportunity for innovation; most chose the planning and design phase. In a (second) complementary question identifying which of the 9 Project Management Institute management processes had the greatest opportunity for innovation, approximately 1/2 of respondents chose scope management, integration management, risk management, and procurement management; approximately 1/4 chose communications management, time management, and cost management; very few chose human resource management and quality management. Corroborating the first of these two questions, the management processes chosen most frequently, are related to the early stages of the project and more importantly to contract strategy decisions – scope, risk, and procurement. Both questions

point to the planning and design phase of a project having the greatest opportunity for innovation.

In response to the opened-ended questions within the “initial thoughts” section of the survey, the three most frequently named innovation problem/need categories were: contract strategy, collaboration, and lifecycle thinking; or more descriptively, we interpret the respondents to have told us that a fractured contract delivery model contributes to, or exacerbates a lack of collaboration and a lack of lifecycle thinking. In particular, respondents pointed to the low-bid system and poor risk allocation as problems within traditional contract strategies and characterized the result as a fractured delivery system in which claims are expected.

The identification of a need for collaboration and lifecycle thinking that arose from open-ended questions, was reinforced in a multiple-choice question in which 4 of 5 respondents chose “short-term rather than lifecycle decision making” as the most constraining impediment to innovation. Reference to lifecycle, clearly indicates that respondents see opportunities for innovation through collaboration across the design, construction, and operations phases. These phases are seen as silos that obstruct the flow of information across their boundaries and therefore obstruct collaboration that would result in innovation. The message is also clear that they see opportunities for innovation across disciplines or participants between and within these phases. The most obvious participants being the owner, designer, and contractor.

The second most frequently chosen option as a constraining impediment to innovation was “low-bid selection criteria for construction or design.” Extending the issue of low-bid selection, respondents generally referred to traditional delivery models (contract strategies) as having fragmented or fractured the construction sector. We were told that in some quarters of the construction sector, competition within traditional contractual arrangements has created incentives to exploit project risks that leave individual project participants seeking success through means that detract from the overall project goal. Moreover, these incentives create adversarial relationships between the participants that preclude the possibility of innovation. Respondents are calling for alternative contract strategies that align with different project sizes and risk allocation needs.

Respondents identified a variety of innovation opportunities. The emerging technology that was most frequently identified as promising was “modular prefabrication and on-site automation,” followed by “building information modeling.”

“Minimizing environmental impact and maximizing sustainability” and “improving energy efficiency and reducing carbon emissions” were the first and third (respectively) most frequently selected trends originating outside the construction sector that are likely to have the greatest impact on construction sector innovation, while the second most frequently selected trend was “responding to the aging workforce and scarcity of skilled workers.”

As methods that best encourage innovation, “changes to regulations and codes” and “government grants and tax incentive programs directly with industry” were selected by 60% and 50% of the respondents, respectively.

Respondents indicated that the most important measures of success within their organizations were “reputation” and “client/end-user satisfaction” (chosen by almost 70% and 60% respectively over other options including “profit,” “market share,” and “efficiency”). Almost 90% of those who responded to this question saw innovation as an enabler or contributor to the measures of success that they had selected.

Although 100% of respondents agreed that innovation is important to the future of the Canadian construction sector, on average they rated “the Canadian construction sector’s performance at innovation” between “poor” and “acceptable.”

Respondents indicated that the parties with the greatest potential to improve sector-wide innovation, are:

- sector-wide organizations that represent one specific type of participant
- universities and research institutes
- sector-wide organizations that represent multiple participant types.

Correspondingly, when respondents were asked about their organizations’ role in sector-wide innovation, the most frequent response was through their involvement in industry organizations.

We conclude the following.

1. Innovation means different things to different people.
2. Innovation in the construction sector is of high importance and has an integral role, but innovation performance is marginal.
3. Short-term rather than lifecycle decision making is the most constraining impediment to innovation in the construction sector.
4. The biggest structural issue constraining innovation in the Canadian construction sector is the fractured delivery model.
5. Specific opportunities for innovation include: modular construction and on-site automation, building information modeling, minimizing environmental impact and maximizing sustainability, improving energy efficiency and reducing carbon emissions, and responding to the aging workforce.
6. Sector-wide organizations (such as Canadian Construction Innovations Inc.), universities, and colleges are the parties with the greatest potential to improve sector-wide innovation.

We highly recommend Canadian Construction Innovations’ continued work mobilizing people who will help to improve the level of innovation in the Canadian construction sector. To generate collaboration opportunities among construction sector participants, we recommend use of clusters, task groups, and other means to develop information dissemination events and mechanisms, as well continuing to identify best practices and promote the use of promising emerging technologies and processes.

[Specific recommendations are currently under review by CCI and are therefore confidential.]

Finally, we recommend that longer term strategies be developed to address structural and systemic fragmentation in the Canadian construction sector that has created barriers which impede collaboration and therefore innovation.