Innovations in Canada
The Future of Construction

Presentation by:

Pierre Boucher
CCI President

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What is CCI?

CCI is a multi-stakeholder organization comprised of construction owners, architects, engineers, contractors, manufacturers and suppliers, and allied industries such as insurance, bonding, claims consultants, asset managers and financial institutions.

It would not be possible for CCI to deliver on its mandate without the full involvement of the construction value-chain. We do have some gaps in terms of membership, but we are working on it.
How do we define innovation

Improvement is such areas as procurement, construction management processes and procedures, HR, IT, product development, or anything else the industry needs to explore to increase its:

- productivity
- profitability
- market diversification
Industry Overview

While most other industries have undergone tremendous changes over the last few decades, and have reaped the benefits of process and product innovations, the Engineering & Construction sector has been hesitant about fully embracing the latest technological opportunities, and its labour productivity has stagnated accordingly.

This unimpressive track record can be attributed to various internal and external challenges: the persistent fragmentation of the industry, inadequate collaboration with suppliers and contractors, the difficulties in recruiting a talented workforce, and insufficient knowledge transfer from project to project, to name just a few.

**World Economic Forum - Shaping the Future of Construction**
Despite all this, and the fact that Canada is a G8 country, here is how Canada ranks in areas that impact on its ability to reach much higher levels of economic performance. According to the World Economic Forum, Canada:

- Ranks 15th out of 144 countries for business competitiveness
- Ranks 17th in venture-capital availability
- Ranks 23rd in business sophistication
- Ranks 27th in corporate R&D spending
- Ranks 26th in its capacity to innovate (LEED)
- Ranks 30th in being an early adopter of technologies and processes (BIM)
What are the fact?

Statistical data indicates that, today, one hour of work in Canada produces $13 less than in the United States, and $29 less than Norway.

According to the U.S. Bureau of Labor Statistics, the construction industry is the only sector that has decreased in productivity since 1964.

The Chief Economist of the Conference Board of Canada states the following: “If we continue to discount or dismiss the productivity issue, Canadians future incomes will be threatened, particularly if there is a sustained downward adjustment in the price of key natural resources. If there was ever a time to take poor productivity growth seriously, that time has arrived.”
Figure 3: US Industry Productivity and Performance, 1964-2012

Index of US labour productivity

Non-farm business labour productivity

CAGR +1.9%

Relative improvement

+153%

Construction labour productivity

CAGR -0.4%

-19%
In May 2016, the World Economic Forum published a Document titled: Shaping the Future of Construction.

The report involved input from a great many companies from many regions of the world active along the construction value chain: suppliers of building materials, chemicals and construction equipment; contractors; and engineering, architecture and planning firms – as well as project owners and developers, academics, and leaders from government, civil society, and industry organizations.
Two Canadians were members of the WEF Steering Committee:

John Beck
Executive Chairman
Aecon

Neil Alexander Bruce
President and Chief Executive Officer
SNC-Lavalin
This report provides assessment of the state of the industry state and the global trends that will impact on the industry. It introduces a conceptual framework transforming the industry, listing a number of measures, grouped in eight areas. They are:

- Technology, materials and tools
- Processes and operations
- Strategy and business model innovation
- People, organization and culture
- Industry collaboration
- Joint industry marketing
- Regulation and policies
- Public procurement
These measures are classified into three groups:

- Measures taken by private companies on their own;
- Measures taken by companies in collaboration with their peers – or by the industry as a whole;
- Measures taken by the government, acting both as the regulator and as a major project owner.

For each of the areas, the report identifies current best practices, and provides illustrative case studies of innovative approaches, to prepare for the industry’s transformation.
### Importance of Different Transformation Areas

Scale from 1-unimportant to 5-important

- People: 4.6
- Adoption of new technologies: 4.5
  - materials and tools
- Industry collaboration: 4.2
- Business models: 4.1
- Corporate strategies: 4.0
- Maturity of business processes: 4.0
- Maturity of construction operation: 4.0
- Corporate cultures: 3.8
- Corporate organizations: 3.7
- Creation of intellectual properties: 3.6
WEF – Global Trends with E&C

Mega Trends

Best Practices

Technology

Incremental Innovation
# Megatrends driving change

## Figure 2: Megatrends Shaping the Construction Industry’s Future

<table>
<thead>
<tr>
<th>Market and customers</th>
<th>Sustainability and resilience</th>
<th>Society and workforce</th>
<th>Politics and regulation</th>
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<tbody>
<tr>
<td><strong>Demand in developing countries</strong>&lt;br&gt;65% of the next decade’s growth in construction will happen in emerging countries</td>
<td><strong>Resource scarcity</strong>&lt;br&gt;No. 1 consumer of global raw materials is the construction industry</td>
<td><strong>Urbanization and housing crisis</strong>&lt;br&gt;200k people are added daily to urban areas and need affordable and healthy housing</td>
<td><strong>Complex regulatory requirements</strong>&lt;br&gt;25 different procedures are required for a typical warehouse construction permit in India</td>
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<td><strong>Globalized markets</strong>&lt;br&gt;1 in 2 E&amp;C companies plan to move into new geographies</td>
<td><strong>Sustainability requirements</strong>&lt;br&gt;50% of the solid waste in the United States is produced by the construction industry</td>
<td><strong>Health/comfort needs of citizens</strong>&lt;br&gt;2-5x higher than outside are the levels of volatile organic compounds found inside US homes</td>
<td><strong>Stricter HSE and labour laws</strong>&lt;br&gt;10% of the workforce in a public project in California had to come from the “otherwise unemployed”</td>
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<td><strong>Bigger, more complex projects</strong>&lt;br&gt;123km (76 miles) is the length of the Undersea tunnel that will connect Dalian and Yantai in China</td>
<td><strong>Energy and climate change</strong>&lt;br&gt;30% of global greenhouse gas emissions are attributable to buildings</td>
<td><strong>Talent and ageing workforce</strong>&lt;br&gt;50% of general contractors are concerned about finding experienced crafts workers for their workforce</td>
<td><strong>Slow permit and approval process</strong>&lt;br&gt;$1.2tn of infrastructure could be added by 2030 if all countries committed to specific time limits for approvals</td>
</tr>
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<td><strong>Aging infrastructure</strong>&lt;br&gt;1 in 3 German railway bridges are more than 100 years old</td>
<td><strong>Resilience challenges</strong>&lt;br&gt;3x as many disasters were reported last year as in 1980</td>
<td><strong>Stakeholder pressure and organization</strong>&lt;br&gt;67k signatures were collected opposing the construction of the Stuttgart train station</td>
<td><strong>Geopolitical uncertainty</strong>&lt;br&gt;18 Turkish construction workers were kidnapped by militants in Baghdad in September 2015</td>
</tr>
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<td><strong>Massive financing need</strong>&lt;br&gt;$1tn annual investments are needed to close the global infrastructure gap</td>
<td><strong>Cyberthreats</strong>&lt;br&gt;90% of firms agree that information controls have an impact on front-line employees</td>
<td><strong>Politicization of construction decisions</strong>&lt;br&gt;In 2011 the Portuguese government cancelled a 165km (103 mile) high-speed train line project as an austerity measure</td>
<td><strong>Corruption</strong>&lt;br&gt;49% of survey respondents believe corruption is common in a Western European construction market</td>
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Global trends importance matrix

Figure 21: Global Trends – Their Importance for and Impact on the E&C Industry
## Figure 1: Industry Transformation Framework

### (Future) Best practices

<table>
<thead>
<tr>
<th>2.1 Technology, materials and tools</th>
<th>2.2 Processes and operations</th>
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<tbody>
<tr>
<td>Advanced building and finishing materials</td>
<td>Front-loaded and cost-conscious design and project planning</td>
</tr>
<tr>
<td>Standardized, modularized and prefabricated components</td>
<td>Innovative contracting models with balanced risk-sharing</td>
</tr>
<tr>
<td>(Semi-)automated construction equipment</td>
<td>A common and appropriate framework for project management</td>
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<tr>
<td>New construction technologies, e.g. 3D printing</td>
<td>Digital technologies and big data along the value chain</td>
</tr>
<tr>
<td>Smart and life-cycle-optimizing equipment</td>
<td>Enhanced management of subcontractors and suppliers</td>
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<td>Digital technologies and big data along the value chain</td>
<td>Lean and safe construction management and operations</td>
</tr>
<tr>
<td></td>
<td>Rigorous project monitoring (scope, time, cost)</td>
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### 2.3 Strategy and business model innovation

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<th>2.4 People, organization and culture</th>
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<tr>
<td>Differentiated business model and targeted consolidation and partnerships</td>
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<tr>
<td>Sustainable products with optimal life-cycle value</td>
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<td>Internationalization strategy to increase scale</td>
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<td>Strategic workforce planning, smart hiring, enhanced retention</td>
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<td>Continuous training and knowledge management</td>
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<td>High-performance organization, culture and incentive schemes</td>
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### 3.1 Industry collaboration

<table>
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<th>3.2 Joint industry marketing</th>
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<tr>
<td>Mutual consent on standards across the industry</td>
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<tr>
<td>More data exchange, benchmarking and best-practice sharing</td>
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<tr>
<td>Cross-industry collaboration along the value chain</td>
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<tr>
<td>Industry-wide collaboration on employer marketing</td>
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<tr>
<td>Coordinated communication with civil society</td>
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<tr>
<td>Effective interaction with the public sector</td>
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### 4.1 Regulation and policies

<table>
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<th>4.2 Public procurement</th>
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<tbody>
<tr>
<td>Harmonized building codes/standards and efficient permit processes</td>
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<tr>
<td>Market openness to international firms and SMEs</td>
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<tr>
<td>Promotion and funding of R&amp;D, technol. adoption and education</td>
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<tr>
<td>Actively managed and staged project pipelines with reliable funding</td>
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<tr>
<td>Strict implementation of transparency and anti-corruption standards</td>
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<tr>
<td>Innovation-friendly and whole-life-cycle-oriented procurement</td>
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Potential impact of new technologies

Figure 20: Future Impact and Likelihood of New Technologies

Impact-likelihood matrix of new technologies
The Value of other IT Enablers

Figure 8: Digital Technologies Applied in the E&C Value Chain

Planning

Design and engineering

Construction

Operations

Life-cycle integration

Big data and analytics

Simulation and virtual reality

Mobile interfaces and augmented reality

Building Information Modelling (in the cloud)

Ubiquitous connectivity and tracking

3D scanning

Unmanned aerial vehicles

Embedded sensors

Technology integration

Cybersecurity

User interfaces and applications

Software platform and control

Digital/physical integration layer
The Full Lifecycle Value of BIM

Figure 9: Applications of BIM along the E&C Value Chain

- **Operations**: Building information support for renovation and termination
  - Data platform for condition monitoring and predictive maintenance
  - Data repository for facility- and asset-management systems
  - Platform for virtual handover and commissioning

- **Construction**: Real-time data sharing, integration and coordination
  - Data exchange with construction-monitoring and surveillance tools
  - Model input to automated and autonomous equipment

- **Design and engineering**: Integration of field data from laser scans
  - Data repository for analytics-optimized design
  - Model input to simulation and rapid prototyping
  - Data delivery/integration for performance analyses

- **BIM**: Lifecycle BIM
  - Parametric modelling and object libraries
  - Constructability and clash analysis
  - Coordination of design disciplines
  - Integrated design-construction process

- **Integration of data and processes**
## Value of Advanced Building Materials (ABM)

### Figure 6: Examples of Advanced Building and Finishing Materials

<table>
<thead>
<tr>
<th>Incremental innovation</th>
<th>Radical innovation</th>
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<tbody>
<tr>
<td><strong>Advances on traditional materials and existing characteristics</strong></td>
<td><strong>New material combinations and multi-functional characteristics</strong></td>
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<tr>
<td>— <em>iQ Natural</em>, an advanced vinyl flooring, is 100% recyclable, using a bio-based plasticizer. The product has TVOC values 100 times below the strictest European standards.</td>
<td>— <em>Lixil</em>’s super-lightweight ceramic sidings combine fast-hardening cement with organic fibre to meet the required performance at half the weight</td>
</tr>
<tr>
<td>— <em>Neopor</em> is an enhanced styrofoam, offering up to 20% efficiency improvement in insulation</td>
<td>— Self-healing concrete, generated through the addition of bacterial spores, is estimated to reduce lifetime costs by up to 50%</td>
</tr>
<tr>
<td>— <em>ArcelorMittal</em> has launched organically coated steel that achieves 30-year guaranteed durability and does not contain genotoxic, hexavalent chromium</td>
<td>— Concrete admixed with special construction chemicals achieves 50% faster curing times</td>
</tr>
</tbody>
</table>

- Higher recyclability/reusability
- Reduced life-cycle costs
- Reduced material costs
- Faster construction process
- Higher energy efficiency
- Improved health/well-being

- Early development/pilot phase
- Market-ready
Final world from The world Economic Forum...

The industry as a whole should enhance coordination and cooperation across the value chain, and agree on common goals and standards. And to gain the support of society at large, the industry needs to work collectively with all stakeholders, along multiple dimensions.

The recommendations contained in our report - “Shaping the Future of Construction” - require the commitment and encouragement of many active participants in the industry – people who believe in a modern E&C industry that will benefit all.
Former President and CEO of Mitacs and former president of the University of British Columbia Arvind Gupta states the following:

- Our ecosystem is not as developed as other countries.
- In some countries, we see cluster development where companies support one another.
- In other countries, we have seen an innovation supply chain develop, where companies farm things out to smaller companies.
- In some countries, we see much richer connections with government labs.
Solutions!

Former President and CEO of Mitacs and former president of the University of British Columbia states the following:

- Other countries have adopted different strategies.
- We need to link academia with business and increase the success rate well above what it is today
- We want to just get people working together so than help one another.
Our strategy: Three pillars!

- Idea Generation Pillar: Smart, Targeted Networks
- Pre-Commercialization Pillar: Pilot Projects Fund
- Commercialization Pillar: Procurement Set Aside
Thank you!