

# AI: Engineering & Construction Forum

Harry Sambells

Engineer-in-Residence

Centre for Project Management Excellence

Schulich School of Engineering

18-June-2019



UNIVERSITY OF  
CALGARY

# AGENDA

1. Opening Remarks
2. Engineering and Construction Perspectives in AI
3. University of Calgary R&D in AI
4. Round Table Discussions
5. Summary Remarks
6. Lunch and Networking



Photo credit: Getty Images

# But First a Safety Moment



- Safety or Security Concern
  - Please exit safely from the building
  - Proceed to MSC (MacEwan Student Centre North Courtyard)
  - Call Security: 403-220-5333

- Health Emergency:
  - Dial 911
  - Contact Security: 403-220-5333
  - AEDs are located near ENG 230 out the door to the right



# Objectives for today's forum

- Sharing of consulting engineering and construction perspectives of AI in their industry
- Sharing Schulich School of Engineering (SSE) and Faculty of Science research and advancement in the AI and Digital Engineering area
- Determining some mutually beneficial R&D opportunities for the SSE and other faculties and to potentially advance AI development in the E&C industry
- Identify AI Synergies between the University and Industry
- Provide some networking opportunities



# Some thoughts...

- The world's second largest industry is construction, which is projected to reach \$10 trillion by 2020 according to market reports based on data released by the Construction Intelligence Center (Andrew Rink, *ENR*, September 2018).

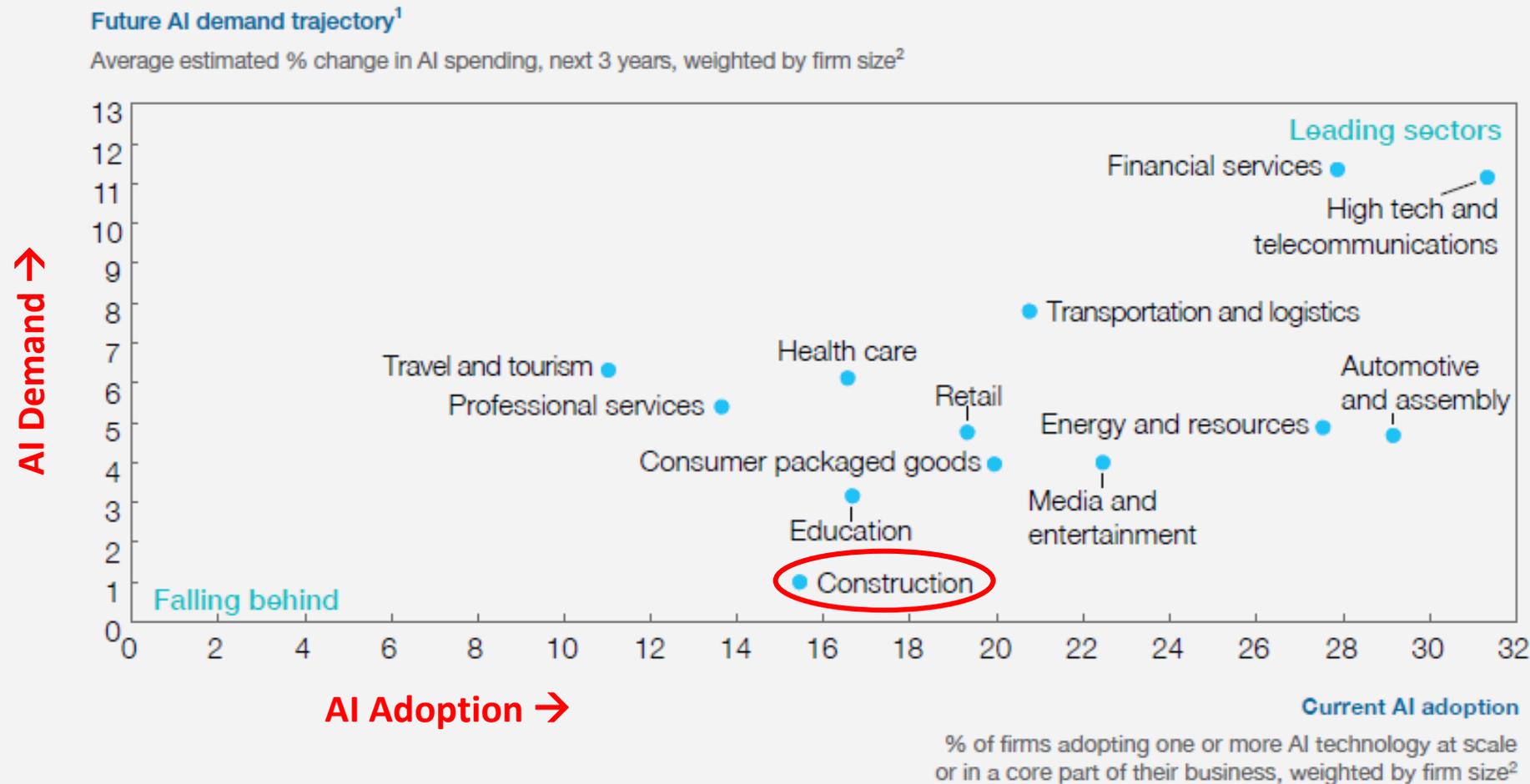


- At the same time, engineering is one of the hardest sectors to automate while some construction activities are most susceptible to automation (Kaplan, *'Artificial Intelligence'* Oxford University Press, 2016).
- According to McKinsey & Company, both **engineering and construction are behind the curve** in implementing artificial intelligence solutions (Jose Luis Blanco et al, *'AI: Construction technology's next frontier'*, April 2018).



# AI Adoption: E & C compared to other sectors

Exhibit 1 Sectors leading in AI adoption today also intend to grow their investment the most



<sup>1</sup> Based on the midpoint of the range selected by the survey respondent.

<sup>2</sup> Results are weighted by firm size. See Appendix for an explanation of the weighting methodology.

Source: Michael Chui, James Manyika, and Mehdi Miremadi, "What AI can and can't do (yet) for your business," *McKinsey Quarterly*, January 2018, McKinsey.com

# What is AI?

- Today we use the term loosely
- Do we apply the Turing Test? - developed by Alan Turing in 1950, is a test of a machine's ability to exhibit intelligent behaviour equivalent to, or indistinguishable from, that of a human.
- Do we assume that AI systems will typically demonstrate at least some of the following behaviors associated with human intelligence: planning, learning, reasoning, problem solving, knowledge representation, perception, motion, and manipulation and, to a lesser extent, social intelligence and creativity.
- For this Forum let's assume we each use a definition that is close to some of the concepts shown above.

# What is AI?

- Big Data
- Machine Learning,
- Robotics,
- Deep Learning,
- Optical Recognition,
- IoT
- and many more...



## What is **NOT** AI?

- 3D and 4D Design
- Smart P&IDs
- Manufacturing process robots
- Basic Building Information Modelling (“BIM”)
- Material Management Systems
- Risk management systems
- Etc.

# Impediments to AI Development in E&C

- Extremely competitive market place
- Lower margins
- Cost to research and implement AI is considerable
- AI is a long term investment and is likely only capable by larger firms
- Where does one start to make an impact and improve productivity, execution efficiencies, etc.?
- Microsoft, Apple, Amazon, Google are big investors in AI – \$\$\$\$\$\$\$\$ billions are being spent
- Should E&C wait and use platforms developed by others?



# A personal view...

- I have 45 years of engineering/project/construction experience
- My database is significant...but is it?
- I have had direct experience on maybe 5-10 major/mega projects
- I have knowledge of dozens of minor projects and reports
- What if my 'database' of experience could have accessed a 100 project experiences or even a 1,000 or 10,000...
  - Would my decisions have been better?
  - Would project safety be better?
  - Would project execution improve?
  - Would the company have been more successful at securing more work and have been more profitable?
  - Would I have received a bigger bonus?

# What are the E&C AI Opportunities that are possible...

- Machine Learning – construction projects amass significant data during the life of a project – can this information be mined to improve the project outcomes?
- ‘Alexa’ for Construction – potential for numerous applications in administration – project updates, safety statistics, productivity, status of procured items, material management, status of changes and schedules etc.
- Robotics – difficult to apply as the construction site is ever changing but advantages are working through poor weather conditions, working longer hours, possibly higher productivity...

**Source:** Much of the following (Slides 11-16) is from: Graeme Green, *Reva Report – Demystifying AI in Construction*, March 2019

# What are the E&C AI Opportunities that are possible...

- Optical recognition – facial recognition related to safety training or access to restricted areas for workers, potential recognition of unsafe areas, measure progress of work vs. the digital model, pinpoint construction errors or design flaws
- AI in design
  - mining data from all projects rather than the limited 5-10 projects that designers may have.
  - By learning from previous mistakes – potentially lead to more cost predictability on projects, improved constructability
  - Could provide computer generated design solutions
  - Results could be improved by sharing data collectively – engineers, architects, construction firms, owners, software companies

# What are the E&C AI Opportunities that are possible...

- AI in Project Services
  - Estimating for unique projects requires a significant cognitive ability – some activities would be difficult to apply AI
  - Scheduling – existing programs are robust but mining data from a greater database than 5-10 people would improve schedules and hence improve execution and potentially reduce project costs. Accessing data from a large database as well as human input can only improve the scheduling efforts on projects.
  - Project Monitoring – again accessing digital images from drones or other devices (laser imaging) and comparing data with previous output can improve reporting and progress measurement on the project. Potentially providing better completion forecasts.

# What are the E&C AI Opportunities that are possible...

- AI and Safety – AI can be used to monitor compliance of workers to PPE requirements, training, hazardous conditions or identifying personal health distress. AI can identify unsafe work conditions and issue alarms or prevent a machine being started until the conditions are corrected.
- AI Administrative Applications - Materials Management including ordering of material, sending out invoices and payments. Monthly reporting and calculating earned value can be made more efficient with AI.

# What are the E&C AI Opportunities that are possible...

- AI and Physical Construction activities – self driving mining trucks are here can they also be used for civil highway projects, what other activities can be automated – not an easy task as conditions are ever changing and not like a fixed assembly line
- AI and Post Construction – Turnover, commissioning and operations are huge task on major projects and the data generated is enormous. As-built information leads to a ‘digital twin’ that could be used to harvest operating data and predict maintenance requirements and eventual replacement timeframes hence reduce operating costs and risks for the owner

# What are the E&C AI Opportunities that are possible...

- AI for Claims and Disputes and ‘Lawyers’ – successful claims require analysis of cause and effect – this requires analysis of a massive amount of data – if data is collected appropriately from the beginning then the analysis is that much easier using AI. The legal profession is already addressing AI mostly related to contract analysis, case prediction, document analysis.

# What are the E&C AI LIMITATIONS

- \$\$\$\$\$
- Data collection
- Sharing of data – intellectual property
- Privacy concerns of individuals
- Security of data
- Societal acceptance
- Emotional intelligence and making value judgements

# So how fast are things moving?

- In my life... a party line → private rotary phone → smart phone
- Fax first used commercially in late **1970's** (invented in 1843!)
- In **1983**, the DynaTAC 8000x was the first commercially available handheld mobile phone.
- Microsoft release Internet Mail in **1996** – first version of Outlook
- First iPhone in **2007** (IBM had first Smartphone in 1994)



*Maybe the skies the limit*

# So now what.....

- AI is here
- It can be applied to all industries/sectors in some manner
- If you are not examining AI you'll be left behind
- Are there downsides to AI?
- What career advice would you give your children or grandchildren?
- Adapt baby adapt.....



# AGENDA

1. Opening Remarks
2. Engineering and Construction Perspectives in AI
3. University of Calgary R&D in AI
4. Round Table Discussions
5. Summary Remarks
6. Lunch and Networking

