Taking bold steps for lasting transformation

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INTERNATIONAL CONFERENCE FOR SUSTAINABLE CONSTRUCTION MATERIALS

Building the Future - Construction Technology of Tomorrow

November 6 & 7, 2018, Conrad Hotel - Dubai
This presentation will examine where construction AI solutions are starting to emerge; explore a few specific use cases; and look to the horizon for a map of its future possibilities. Today’s construction leaders can no longer afford to ignore the potential implications of AI, and as with many digital leaps, early movers will reap the largest benefits.
Ghassan Ziadat

*Vice President – Capital Projects & Infrastructure Major Projects*

Leads McKinsey’s work on major projects in the Middle East, bringing more than 30 years of experience in delivering major infrastructure projects—including airports, railways, roads, bridges, and general urban regeneration. Has deep expertise in project design, program management, value engineering, and public-private partnerships.

Learning Objectives

1. Technology landscape for E&C sector
2. AI as a different way to approach projects
3. Digital transformation

The purpose of this presentation is to convey technical knowledge to the conference participants.

The presentation also contains slides with text that summarises the content of the presentation and the main learning objectives.
Contents

The productivity challenge: A call for technology disruption

The digital landscape

Steps for lasting transformation
Construction constitutes 13% of Global GDP but productivity growth remains dramatically low.

**Global GDP**

USD, trillions

- 74$ Trillion
- 64.5 (87%)
- 9.5 (13%)

**Global productivity growth trends**

Real gross value added per hour worked by persons engaged, indexed 1995 = 100

1 Real (2005 USD) gross value added per hour worked by persons engaged, indexed 1995 = 100, 20-year CAGR

Lagging construction productivity costs the global economy $1.6 trillion a year.

Total productivity differential, 2015
Real gross value added per hour, 2005 $

~1/3 of lost value globally in the construction sector comes from North America (primarily the United States).

1 Assumes construction sector output remains constant and current workers are re-employed in other sectors at the total economy productivity rate.

Source: OECD; WIOD; GGCD-10; World Bank; BEA; BLS; Turkish National Statistics Bureau; Singapore National Statistics Agency; Malaysian Statistics Agency; Rosstat; IHS; ITF; GWI; McKinsey Global Institute analysis.
7 key levers were identified that could improve productivity by 50-60%.

Potential global productivity improvement¹ from implementation of best practice

% impact on productivity

1 The impact numbers have been scaled down from a best case project number to reflect current levels of adoption and applicability across projects, based on respondents to the McKinsey & Co Global Construction Industry Productivity survey who responded agree or strongly agree to the questions around implementation of the solutions.

SOURCE: McKinsey Global Institute analysis

 Cumulative impact

Gap to Total Economy Productivity

Enabler

8 - 9%

8 - 10%

7 - 8%

6 – 10%

14 – 15%

5 - 7%

48 - 60%

50%

Regulation 2 Collaboration & Contracting 3 Design & Engineering 4 Supply Chain Management 5 Onsite execution 6 Technology 7 Capability building

External forces

Industry dynamics

Firm-level operational factors

SOURCE: McKinsey Global Institute analysis
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Steps for lasting transformation
We mapped the construction technology investment landscape over the last 10 years…

All project lifecycle phases ~ 2400 firms

2018

Firms
2400

Clusters
Constellations
$18B

Investment
Geo center of gravity
North America
85%
Constellations of new solutions and use cases are emerging around proven technologies – will accelerate impact
Construction remains the most active phase: AI and VR/AR are starting to gain momentum

<table>
<thead>
<tr>
<th>Use Case Category</th>
<th># Companies with Transactions</th>
<th>Number of Transactions</th>
<th>Total Transaction Value ($M)</th>
<th>Average Transaction Value ($M)</th>
<th>% Founded in Past 5 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept &amp; Feasibility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Small all around</td>
</tr>
<tr>
<td>Design &amp; Engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Niche market – established, small, and expensive</td>
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<tr>
<td>Pre-construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Large but well established</td>
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<tr>
<td>Construction &amp; Commissioning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Very large market growing quickly</td>
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<tr>
<td>Operation &amp; Maintenance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Medium-to-large market growing quickly</td>
</tr>
<tr>
<td>Overarching</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Very young category</td>
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<tr>
<td>Back Office</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Very established, niche market</td>
</tr>
</tbody>
</table>

Note: Early Stage VC, Late Stage VC, M&A and PE transactions included in analysis
Transactions driven by established use-cases (e.g. document management) and talent acquisition (e.g. Machine Learning)

1 Total number of transactions in past 5 years, includes PE/VC, M&A and private placements. Does not include debt financing
2 Number of companies with transactions in the past 5 years, companies with multiple use cases are counted towards each use case (total is not MECE)

SOURCE : McKinsey Startup and Investment Landscape Analytics

McKinsey & Company
Some technologies we are excited about

- Artificial intelligence
- Twin models
- Robotics & 3D printing
Artificial intelligence can revolutionize the way we approach projects

**Refining quality control and claims management.**
Neural networks can help owners and firms alike understand the likelihood that a contractor or subcontractor will file a claim, enabling owners and firms to proactively allocate contingencies and deploy targeted mitigation plans.

**Boosting project monitoring and risk management.**
These applications would dramatically reduce decision-making cycles in a construction project from a monthly basis to a daily basis—through full automation of the project scheduling and budgeting update on the combination of BIM, AI, drone, and laser capabilities.

**Constant design optimization.**
These applications can recommend to engineers and architects the use of a specific design, such as a structural solution based on various criteria including total cost of ownership, execution timeline, and likelihood of construction mistakes during execution.

**Building commercial excellence and a competitive edge.**
Supervised and unsupervised learning algorithms can boost an E&C firm’s project win rate, enhance margins, and ensure project value.
AI adopters with a proactive strategy have significantly higher profit margins

Self-reported current profit margin

Difference from industry average (unweighted) (percentage points)

-10  -5  0  5  10  15  20

1 Firms that are big data and cloud services users and report their strategic posture toward AI to be: “Disrupting our industry using AI technology is at the core of our strategy,” “We have changed our longer-term corporate strategy to address the AI threat or opportunity disruption,” or “We have developed a coordinated plan to respond to the AI threat or opportunity but have not changed our longer-term corporate strategy.”

2 Operating profit margin for selected sectors as a share of turnover, for continuing operations and before exceptional items.

SOURCE: McKinsey Global Institute AI adoption and use survey; McKinsey Global Institute analysis
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We are seeing change …. but there’s still so much untapped potential!

Level of digitization
MGI industry digitization index, 2015 or latest available data

R&D investment
% of revenue spent on R&D

IT spending
% of revenue spent on IT

1 Based on data of top 20 E&C companies by market value Globally
2 Top 20 companies by market value

SOURCE: Capital IQ, Gartner IT key metrics data 2012

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There are a few enablers that will make digital successful in construction delivery

<table>
<thead>
<tr>
<th>Strong data foundation</th>
<th>Building core capabilities</th>
<th>Supportive contract strategies</th>
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<tbody>
<tr>
<td>▪ All project participants need to work with one shared data backbone in one system</td>
<td>▪ Invest in training of staff as the traditional project management roles will shift to digital</td>
<td>▪ Digital participation needs to be part of the bidding contracts for all project participants</td>
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<tr>
<td>▪ Even the early conceptual design needs to be done in at least 3D BIM, otherwise the amount of later rework will be prohibitive</td>
<td>▪ Hire new talent and integrate with the core team to develop a digital unit</td>
<td>▪ Digital project emulates an IPD (Integrated Project Delivery) setup, this needs to be leveraged in the contracts to prevent emergence of claim culture</td>
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<tr>
<td>▪ Data will need to be made available to all project participants, with up from agreement from all</td>
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Building capabilities is the biggest challenge for digital transformations.

77% of executives we interviewed mentioned skill gaps as a hindrance to driving digital transformation.

"The skills needed go beyond pure IT to include specific technologies, such as social media or mobile, as well as the analytic skills to drive value from [big] data."

McKinsey Global Survey 2014: The Digital Tipping Point; survey among 850 C-level executives

Out of 12 possible challenges to meeting priorities for digital programs, leaders selected difficulty finding talent as the #1 challenge.

Organizations that invest in developing leaders through the transformation are 2.5 times more likely to succeed compared to those that did not.

Transformations where the company invested a great deal in developing leaders through the transformation are 63% more likely to succeed.

Transformations where the company did not invest in developing leaders are 26% of transformations that were very or extremely successful.

SOURCE: McKinsey Transformational Change Survey, Digital Academy
Questions to address along the digital transformation journey

**Digital strategy**
What is the value at stake?

**Digital ecosystem**
What digital solutions are going to enable us to capture the value?

**Advanced analytics**
What types of decisions do we want to make with the support of analytics?

**Data collection**
How do we generate insights from data?

**IT infrastructure and org**
Is our IT infrastructure and organization set up appropriately?
McKinsey has extensive experience in digital and in capital productivity

**Unparalleled digital and capital productivity practices …**

- **6,480**
  - digital engagements in the last three years

- **40%**
  - of our digital work is in technology transformations

- **1,880+**
  - capital productivity and infrastructure engagements in the last eight years

- **700+**
  - digital designers and developers with McKinsey Digital Labs

**… and we invest in research that’s on the cutting edge of many sectors, including construction**

- **28 years**
  - in business economic research, McKinsey Global Institute (MGI) was created in 1990

- **6**
  - Groundbreaking areas of research, including productivity, competitiveness, and growth

- **#1**
  - ranked private sector think tank by University of Pennsylvania think tank guide

- **10**
  - regional roundtables as part of McKinsey’s Global Infrastructure Initiative, with dozens of senior leaders from engineering and construction joining the discussion

- **50-60%**
  - Boost in construction sector productivity possible through seven levers, as identified in MGI’s 2017 report *Reinventing Construction: A Route to Higher Productivity*
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