McKinsey
& Company

Embedding Digital Technologies to Build Infrastructure

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Vice President & Junior Partner
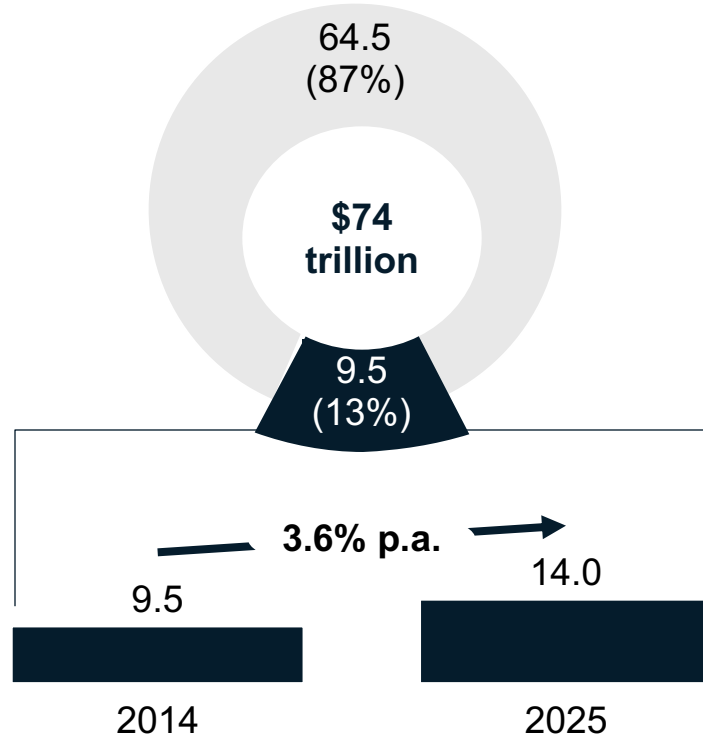
ASEAN Smart City Summit | October 2020

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The productivity challenge: A call for digital disruption

The digital landscape

Steps for lasting transformation

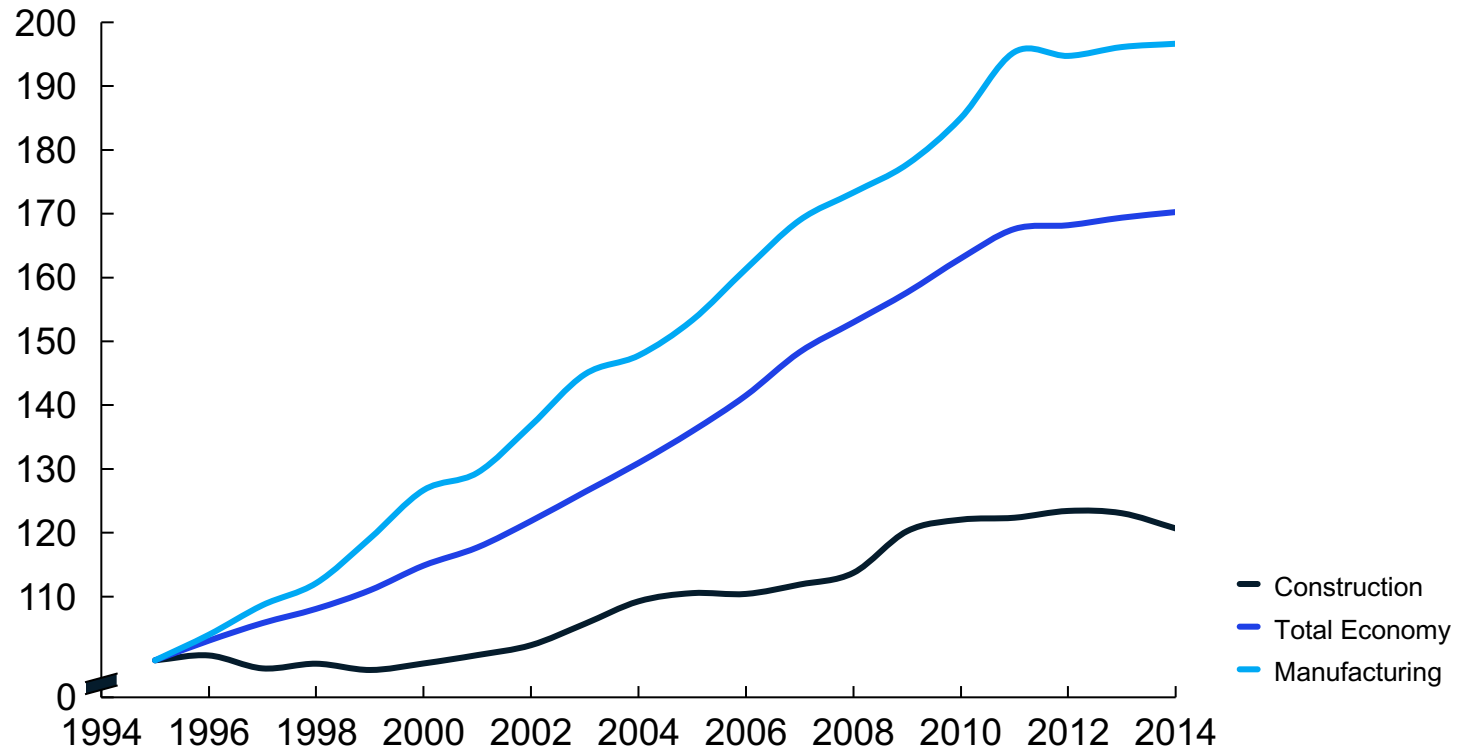# Construction constitutes 13% of global GDP…
…but productivity growth remains dramatically low

Global GDP
USD, trillions

64.5
(87%)

$74 trillion

9.5
(13%)

3.6% p.a.

9.5

14.0

2014

2025

Global productivity growth trends
Real gross **value added per hour worked** by persons engaged
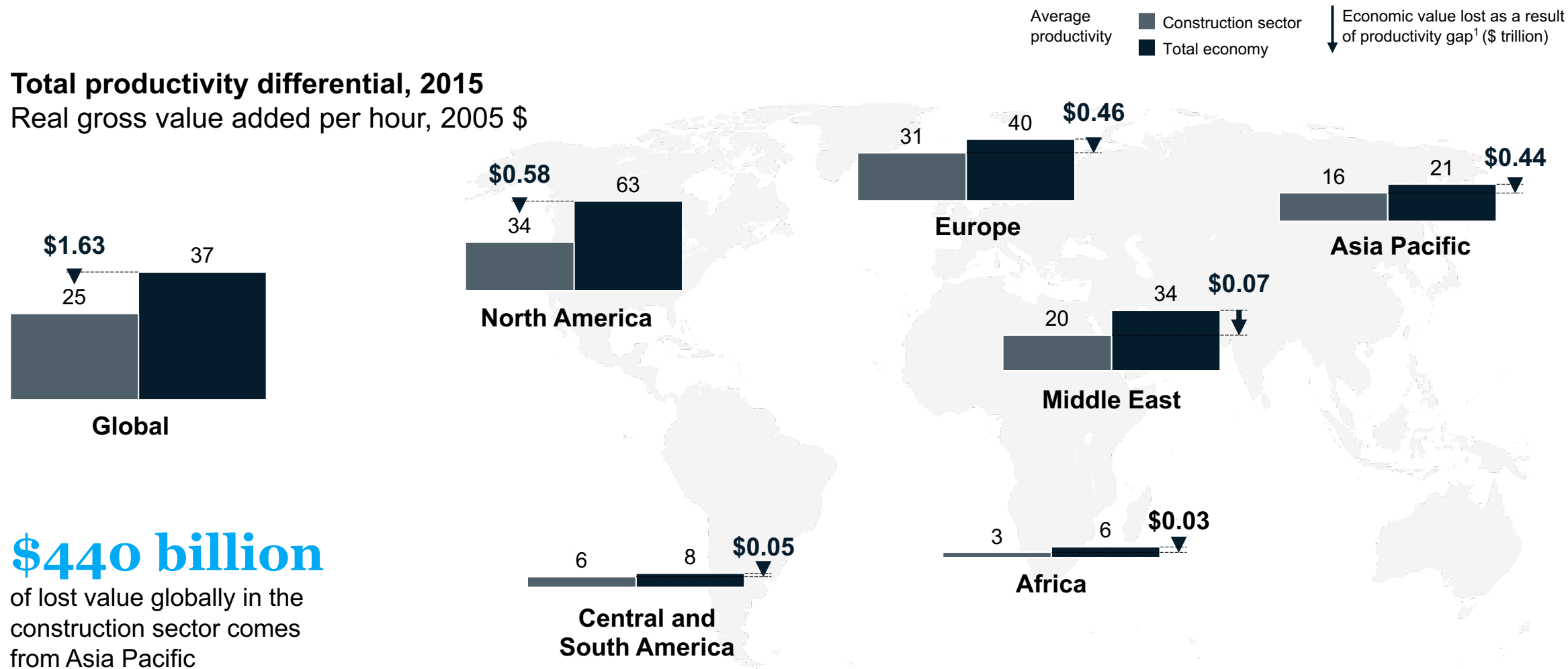

- Construction
- Total Economy
- Manufacturing

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

Average productivity

- Construction sector
- Total economy

Economic value lost as a result of productivity gap[1] ($ trillion)

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

Global
$1.63
25 / 37

North America
$0.58
34 / 63

Europe
$0.46
31 / 40

Asia Pacific
$0.44
16 / 21

Middle East
$0.07
20 / 34

Central and South America
$0.05
6 / 8

Africa
$0.03
3 / 6

$440 billion
of lost value globally in the construction sector comes from Asia Pacific

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

Technology is the most promising lever for productivity improvement …

Productivity challenges can be solved by addressing multiple levers[1]

Impact on productivity (%)[2]

Regulation

Enabler

Collaboration & contracting

8-9%

Design and engineering

8-10%

Procurement and supply-chain management

7-8%

On-site execution

6-10%

Capability building

5-7%

Digital Technology

14-15%

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 MGI Construction Productivity Survey who responded "agree" or "strongly agree" to the questions around implementation of the solutions.; 2. Range reflects expected difference in impact between emerging and developed markets.

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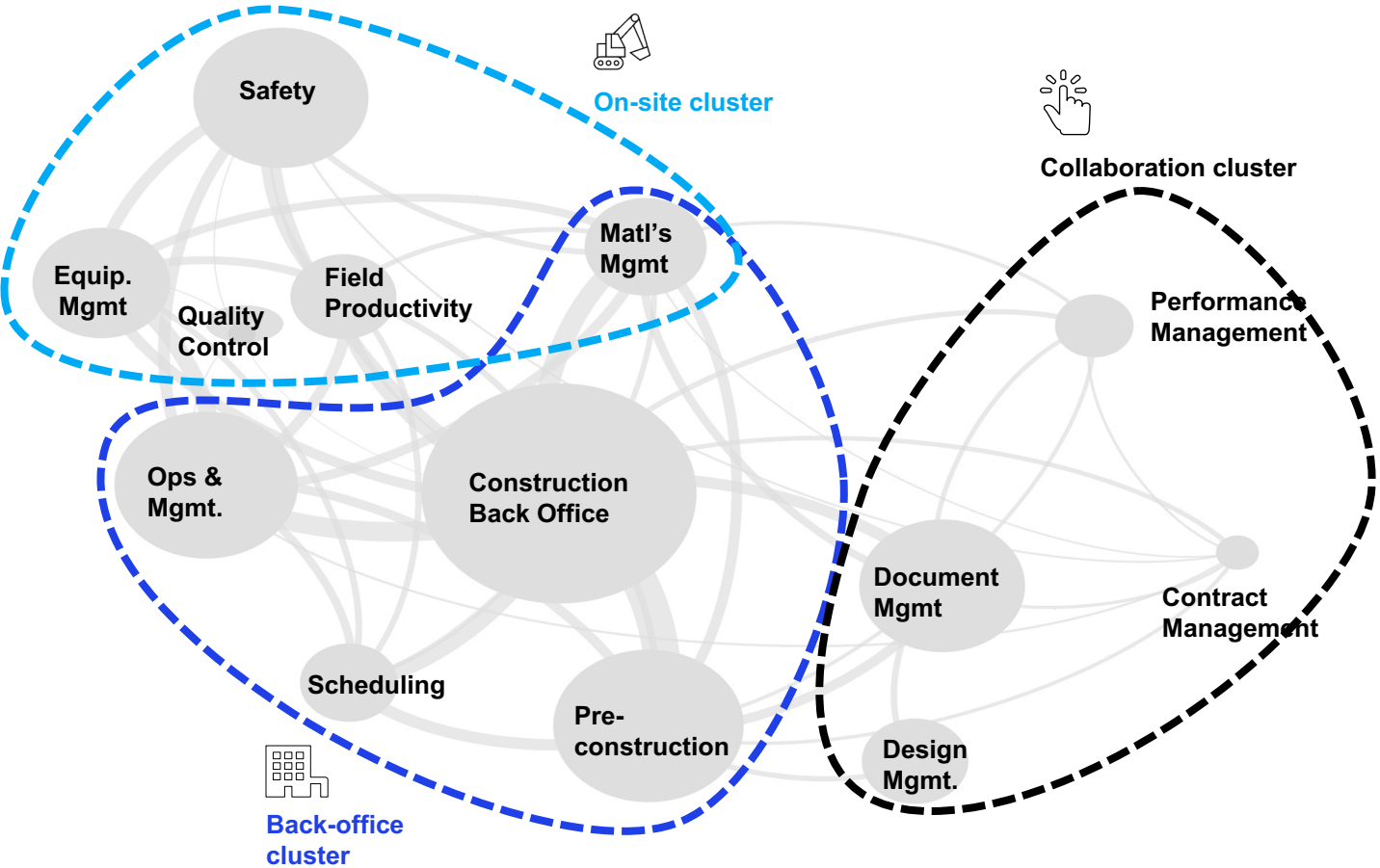# In 2017, we mapped the digital landscape for construction uncovering 3 clusters of innovation ...
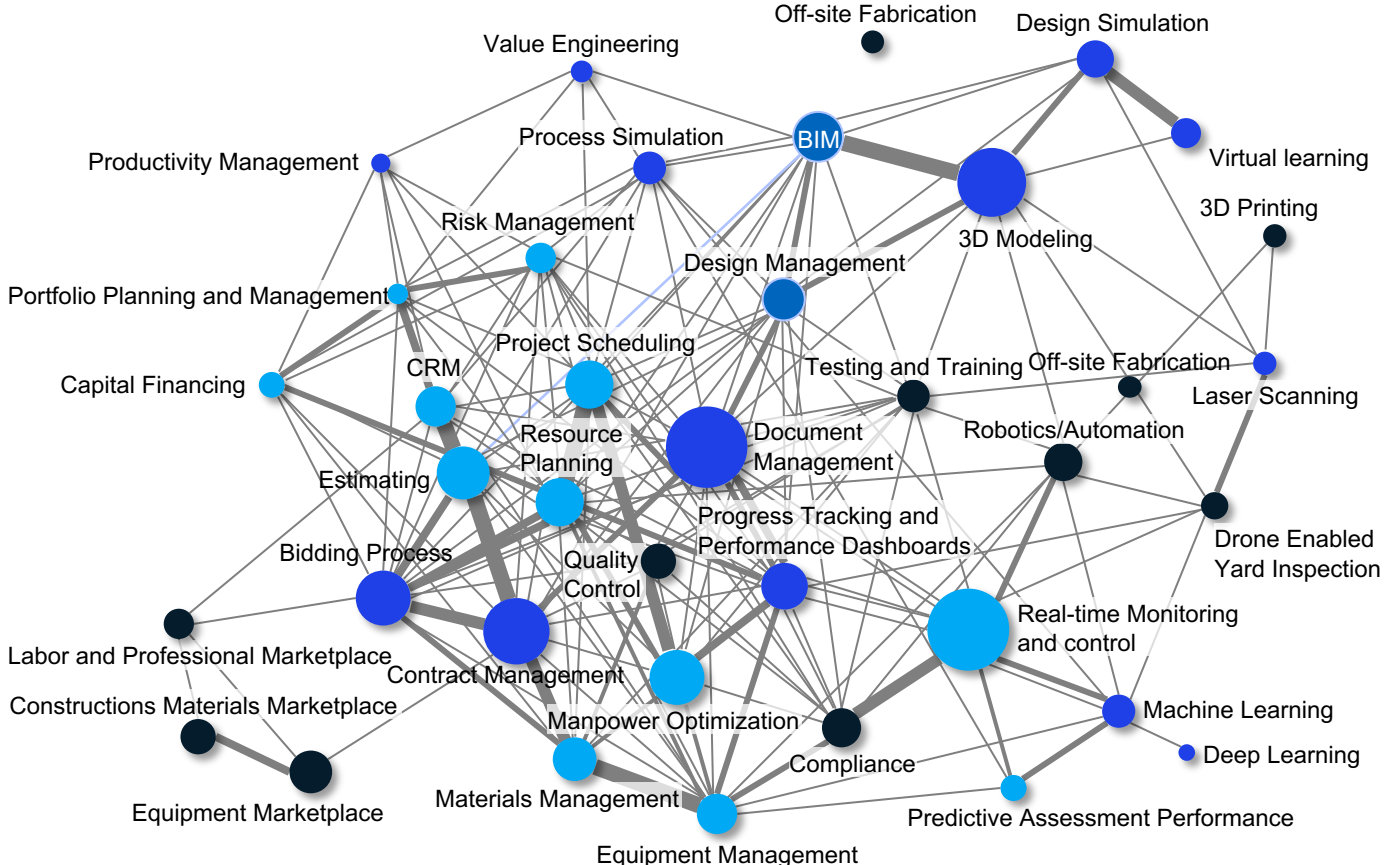
~1,000 firms in the construction phase

On-site cluster

Collaboration cluster

Safety

Matl's Mgmt

Performance Management

Equip. Mgmt

Field Productivity

Quality Control

Ops & Mgmt.

Construction Back Office

Document Mgmt

Contract Management

Scheduling

Pre-construction

Design Mgmt.

Back-office cluster

	2017
Firms	1000
Clusters	3
Investment	$9B

A year later, the digital ecosystem looks very different with exciting movement

~2,400 firms across the full project lifecycle

Legend: Back-office · On-site Execution · Digital Collaboration

Nodes: Off-site Fabrication, Value Engineering, Design Simulation, Process Simulation, BIM, Virtual learning, Productivity Management, Risk Management, 3D Printing, Design Management, 3D Modeling, Portfolio Planning and Management, Project Scheduling, Testing and Training, Off-site Fabrication, CRM, Laser Scanning, Capital Financing, Resource Planning, Document Management, Robotics/Automation, Estimating, Progress Tracking and Performance Dashboards, Drone Enabled Yard Inspection, Bidding Process, Quality Control, Real-time Monitoring and control, Labor and Professional Marketplace, Contract Management, Constructions Materials Marketplace, Manpower Optimization, Machine Learning, Equipment Marketplace, Materials Management, Compliance, Deep Learning, Equipment Management, Predictive Assessment Performance

	2018
Firms	**2400**
Clusters	**Constellations**
Investment	**$18B**

Note 1: Mapping during 2018 was focused on the full project lifecycle vs. construction phase in 2017
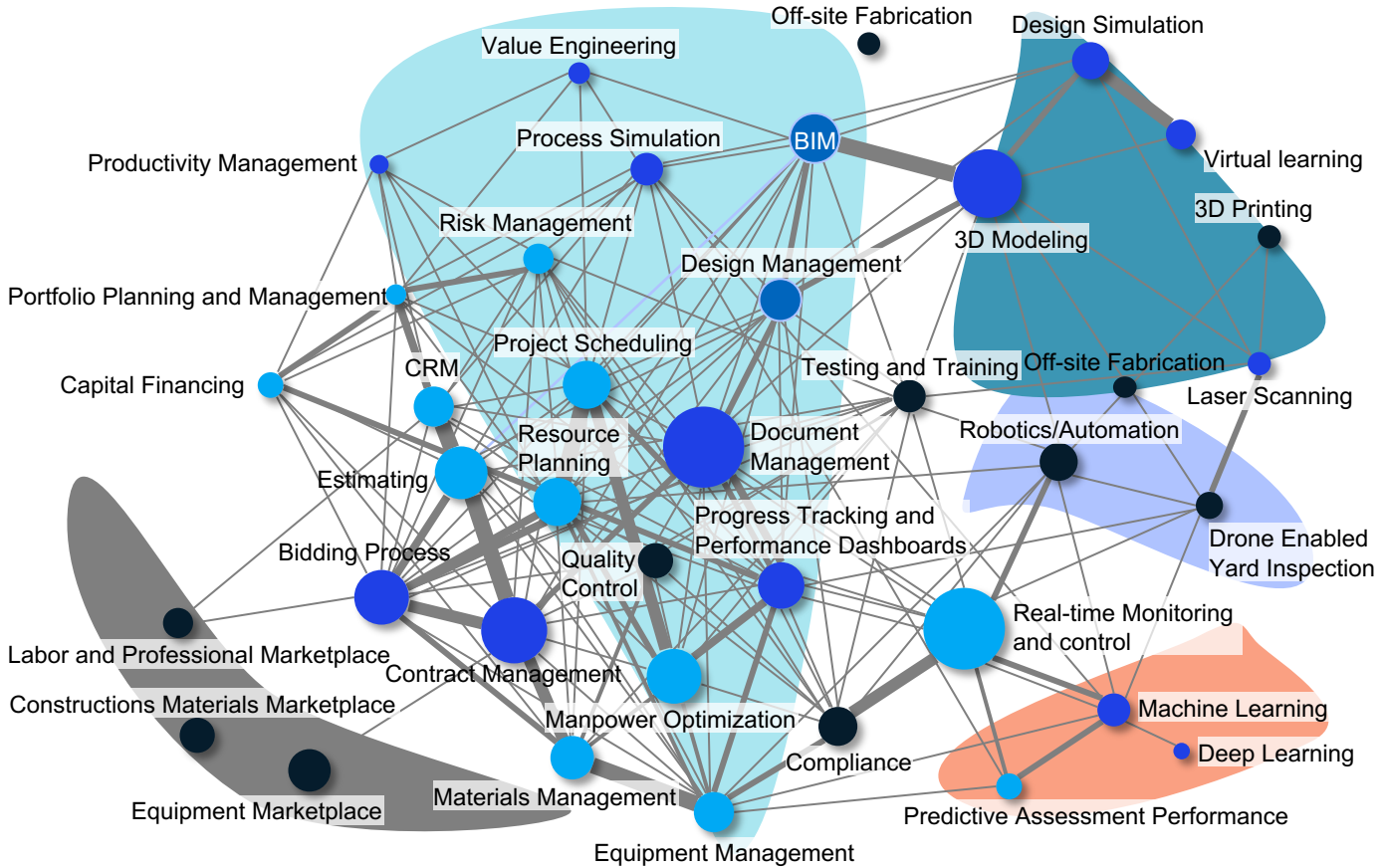
Note 2: Thickness of the lines corresponds to solutions that address more than one use case

Constellations of new digital solutions and use cases are emerging around proven technologies, which will accelerate impact

All project lifecycle phases

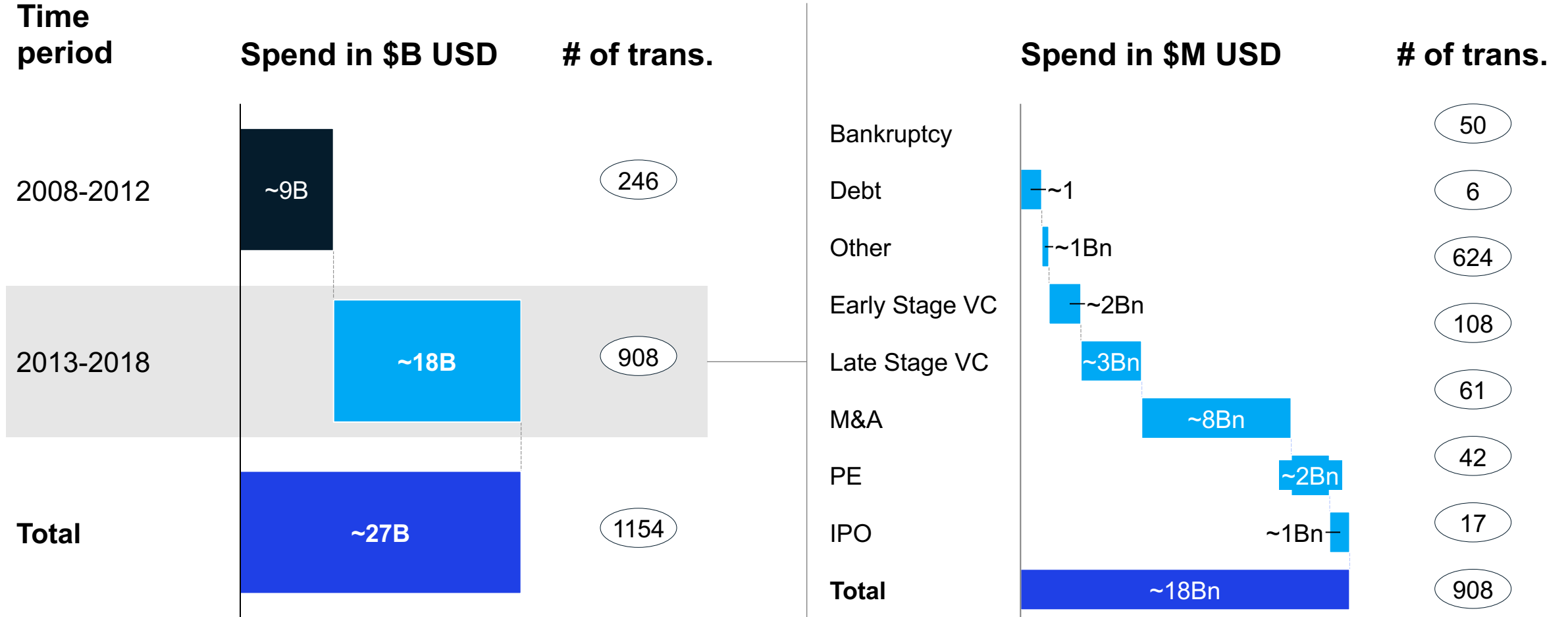■ Back-office ■ On-site Execution ■ Digital Collaboration

Constellations:

■ Internet of things

■ Digital twins

■ 3-D Printing, & Robotics

■ AI & analytics

■ Supply chain optimization

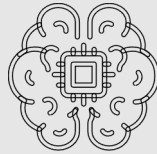# Investment has doubled over the last five years, compared to the previous five years
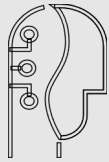
Over time and by type

Time period	Spend in $B USD	# of trans.
2008-2012	~9B	246
2013-2018	~18B	908
Total	~27B	1154

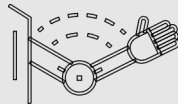|	Spend in $M USD	# of trans.
Bankruptcy		50
Debt	~~1	6
Other	~1Bn	624
Early Stage VC	~2Bn	108
Late Stage VC	~3Bn	61
M&A	~8Bn	42
PE	~2Bn	17
IPO	~1Bn	
Total	~18Bn	908

Some technologies we are excited about

1. Artificial Intelligence

2. IoT & Digital Twin

3. Robotics & 3D printing

1: Artificial intelligence can revolutionize the way we approach projects

Claims management

Design optimization

Project monitoring

Building commercial excellence and a competitive edge

2: IoT & Digital twin technologies present abundant opportunities to optimize project delivery

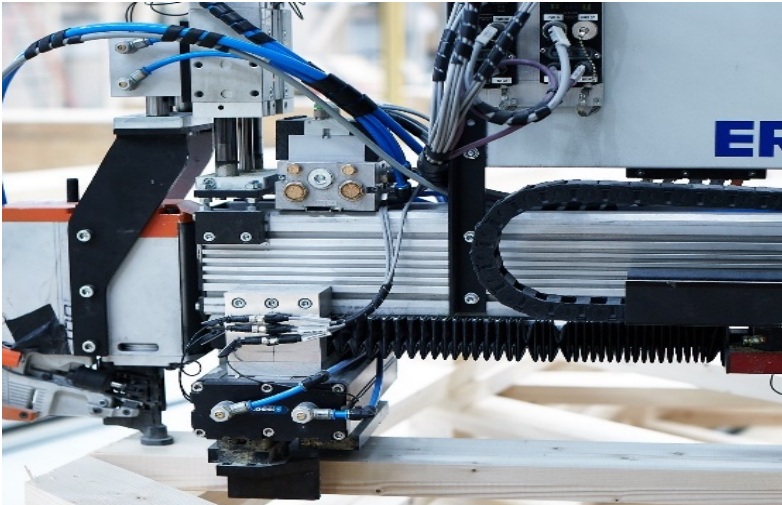## Integration of as-built data with 3D model

Data collection

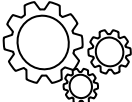| Digital twin	Progressing	Augmented reality	Model of truth	Surveying	Inspection

3: Robotics and 3D printing can push the industry towards a mass production system

Robotics

 Fully automated prefabrication process

Construction robotics

Self-driving machinery

Exoskeletons

3D printing

Metal 3D printing

Concrete 3D printing

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We are seeing change …. but there's still so much untapped potential!

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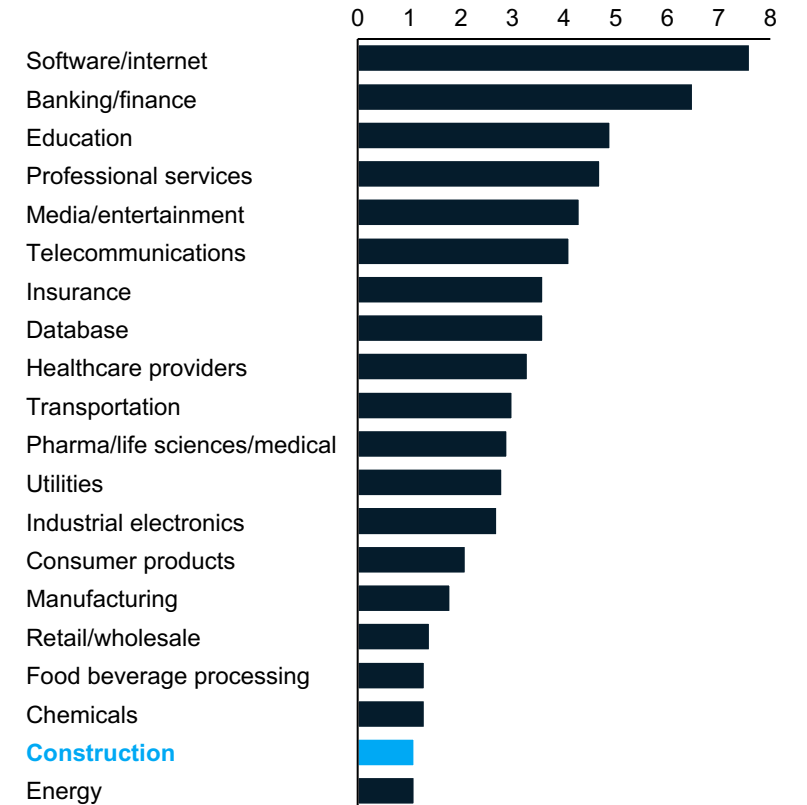MGI industry digitization index, 2015 or latest available data

- ICT
- Media
- Professional services
- Finance and insurance
- Wholesale trade
- Advanced manufacturing
- Oil and gas
- Utilities
- Chemicals and pharmaceuticals
- Basic goods manufacturing
- Mining
- Real estate
- Transportation and warehousing
- Education
- Retail trade
- Entertainment and recreation
- Personal and local services
- Government
- Healthcare
- Hospitality
- **Construction**
- Agriculture and Hunting

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

Legend:
- Automobile
- Industrials
- Chemicals & Energy
- **Construction**
- Consumer discretionary
- Aerospace
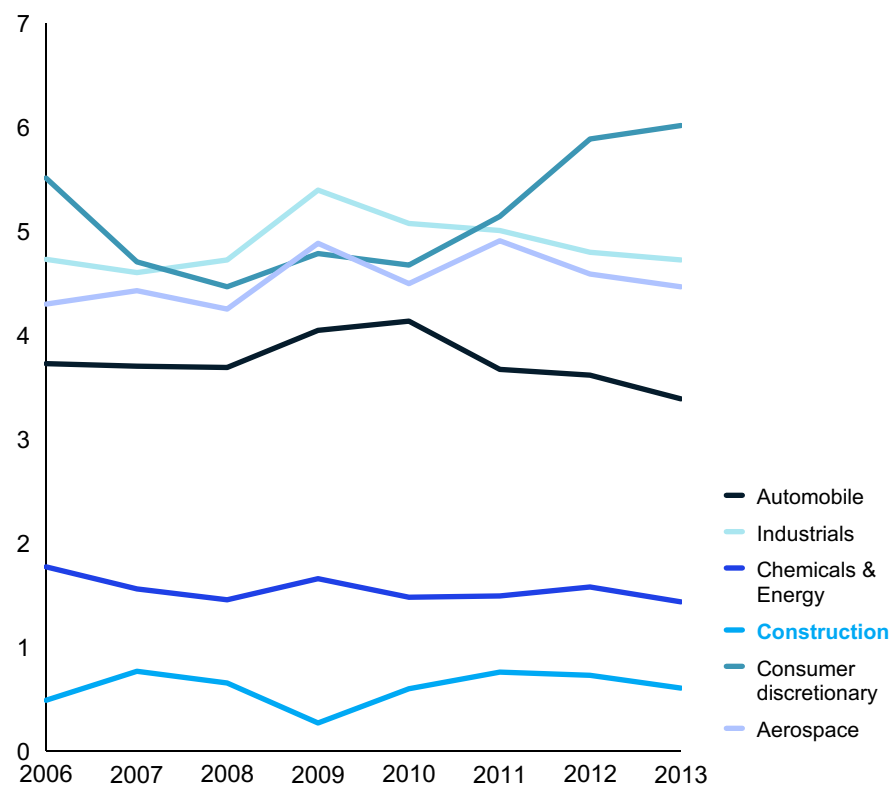
IT spending
% of revenue spent on IT

- Software/internet
- Banking/finance
- Education
- Professional services
- Media/entertainment
- Telecommunications
- Insurance
- Database
- Healthcare providers
- Transportation
- Pharma/life sciences/medical
- Utilities
- Industrial electronics
- Consumer products
- Manufacturing
- Retail/wholesale
- Food beverage processing
- Chemicals
- **Construction**
- Energy

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

Address that potential by answering these questions along your 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?

IoT

How do we generate data and create insights?

IT infrastructure and org

Is our IT infrastructure and organization set up appropriately?

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https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights