

A photograph of three people in a server room. A man in a plaid shirt and glasses is pointing at a computer monitor. A man in a light blue shirt and glasses is looking at the monitor. A woman in a brown jacket is looking at the man in the plaid shirt. The background shows server racks and equipment.

How can technology improve challenges faced within the E&C industry?

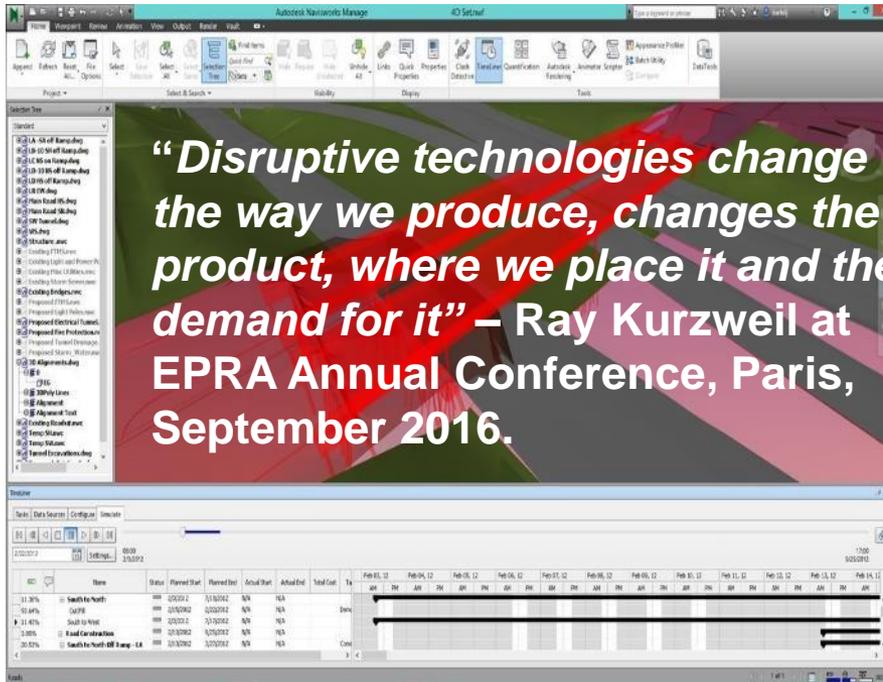
April 2018

The EY logo, consisting of the letters 'EY' in a bold, white, sans-serif font, with a yellow diagonal line above the 'Y'.

EY

Building a better
working world

The Speed of Change



“Disruptive technologies change the way we produce, changes the product, where we place it and the demand for it” – Ray Kurzweil at EPRA Annual Conference, Paris, September 2016.

ID	Name	Status	Planned Start	Planned End	Actual Start	Actual End	Total Cost	...
11.3%	South to North	...	01/01/12	01/01/12	NA	NA	...	...
11.4%	SWP	...	01/01/12	01/01/12	NA	NA	...	...
11.4%	SWP to West	...	01/01/12	01/01/12	NA	NA	...	...
11.5%	East to West	...	01/01/12	01/01/12	NA	NA	...	...
30.0%	South to North Off Ramp EA	...	01/01/12	01/01/12	NA	NA	...	...



Agenda

01

What are some of the critical challenges you face?

02

How can technology solve these problems?

03

What methods are E&C companies using today to realize efficiencies in operations by lean construction ?

04

How do we change and how do we embed this in a digital strategy?

05

Wrap up and Questions and answers



01

Critical Challenges Facing the Industry



EY's latest construction studies reveal that the industry remains conservative and reactive

Scope of the study

- ▶ Value chain research in North-America (52% of companies) , Europe (41%) of companies) and Asia (7%)
- ▶ Scope: general contractor, specialist contractor, EPC/EPCI, Infrastructure developer, Designer (architect/engineer/consulting)
- ▶ Combined turnover of participants, thus far, in excess of: US\$ 3000B

68%



of study participants agree that digital innovation will have a transformative/ game changing character. They assume, the competition is already investing in digital innovation and see it as a threat

BUT the industry remains conservative:

of companies prefer to wait and then to react; believe that early adopters (second fastest category of individuals who adopt innovation) will win in the market (neither innovators nor late majority)

59%



Increasing customer needs and expectations



Cost Pressure

Digitization will be driven mostly by:

Biggest advantages of digital technologies seen within:



73%

Smart customer interactions (platforms)



86%

Improved: cost/schedule/management

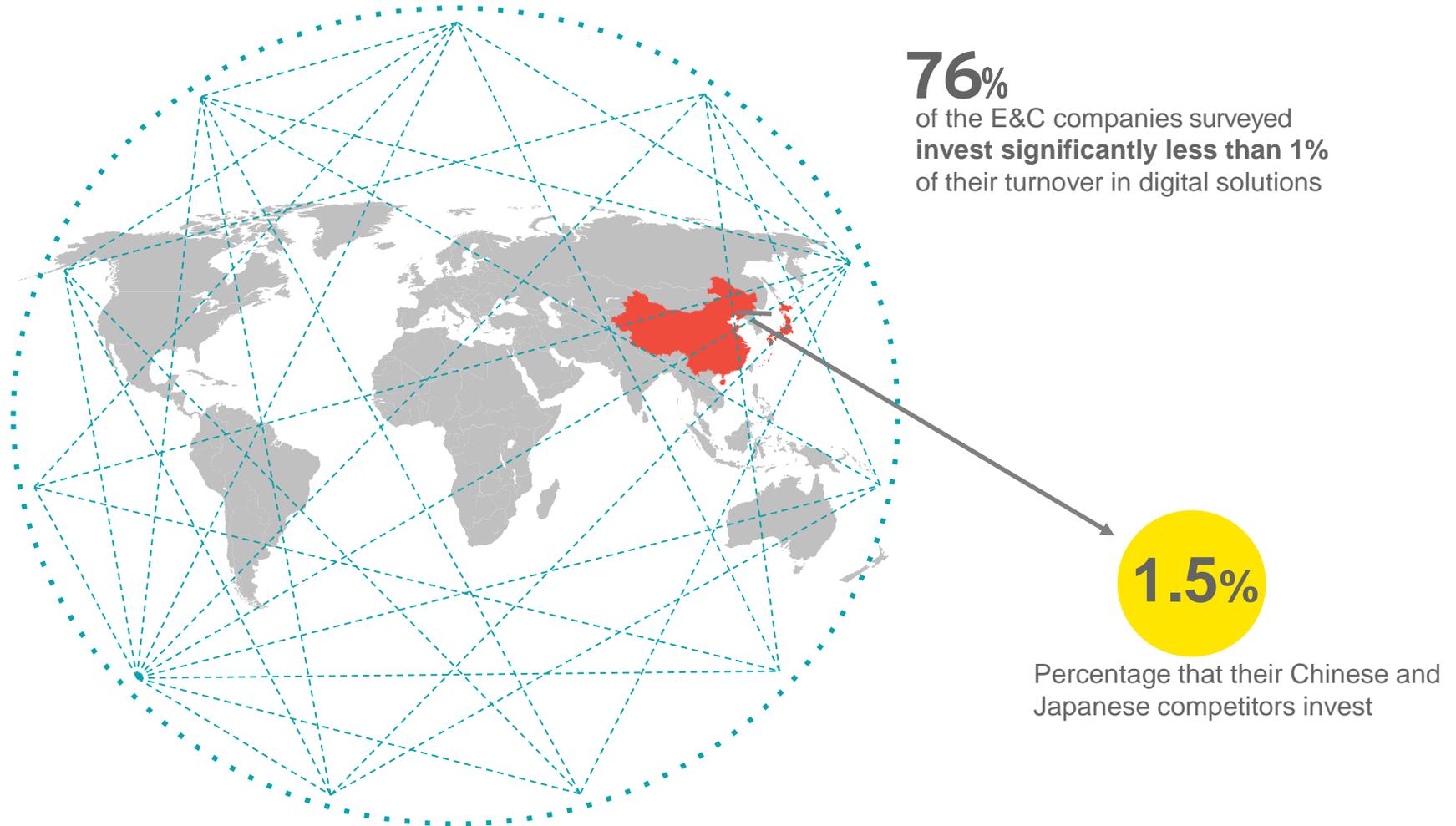
Big Bets

Top 5 Digital enhanced Technologies and products that will add most value to growth:

- ▶ BIM (2D + 3D)
- ▶ ERP
- ▶ Cloud solutions
- ▶ Analytics
- ▶ Drones and Hand-held tech



Globally there is a disconnect in investment in R&D



What are some of the critical challenges you face?



Declining workforce and skills shortage

The engineering and construction (E&C) industry is facing a challenge with an aging workforce, a skills shortage and a smaller talent pipeline than other industries



Reduced productivity

Less experienced workers and a lack of training have reduced the efficiency of many construction roles. Productivity is among the lowest of all sectors.



Low Margins

Profit margins are the lowest in any industry, with the exception of retail



Project Failures

Labour, Scope, Planning, Financing, Delays, Underestimation of whole project. The vast majority of projects is not completed on budget or in time.



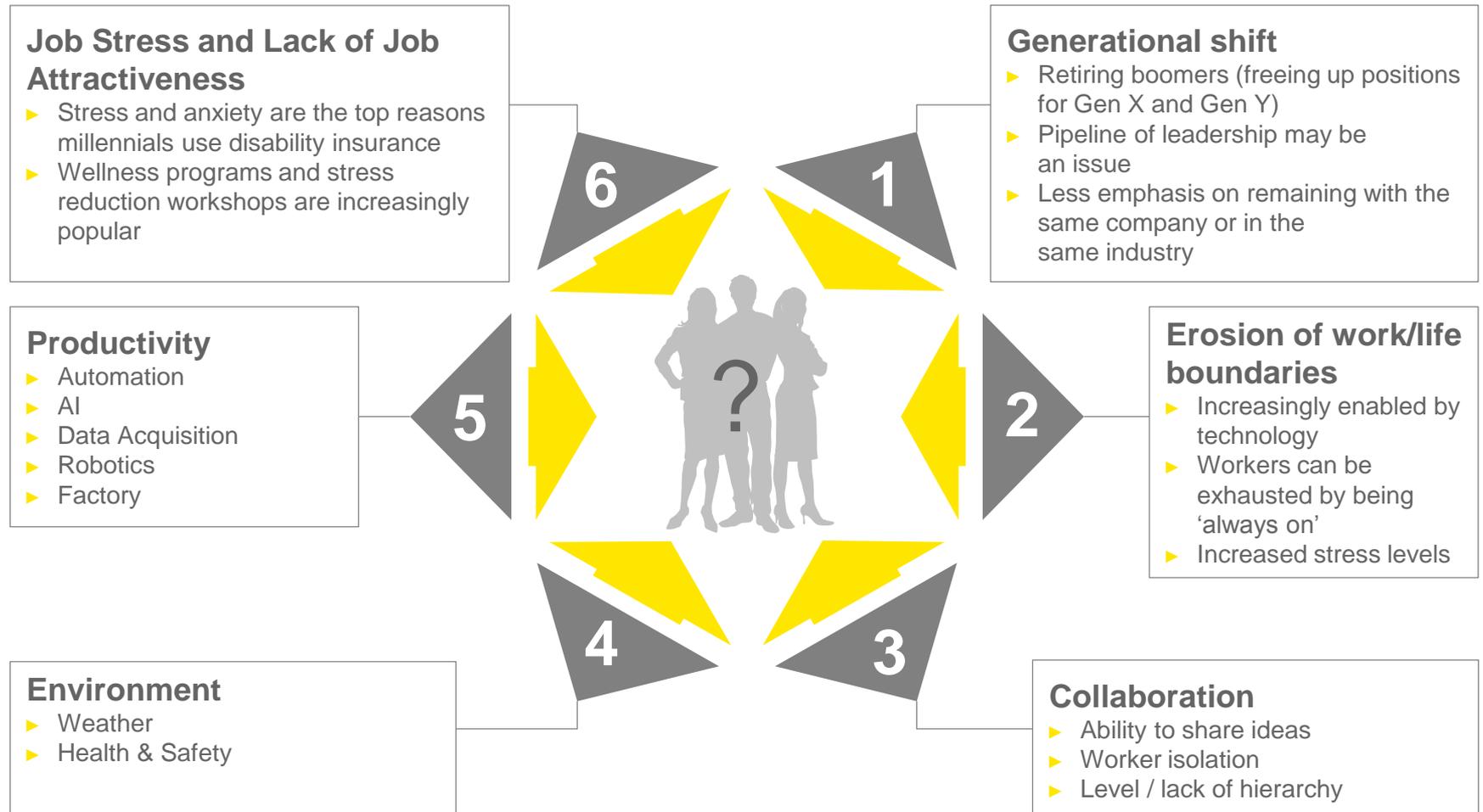
Data Transparency

Lack of timely and accurate data, yet the Industry's spending on R&D is again the lowest among all sectors.

Key figures for the industry are not that great

Top 30; Key figures	FY16	FY15	FY14
Revenue (US\$ millions)	775,301	752,533	725,914
International revenue as a percentage of total revenue - unweighted average	46%	46%	46%
Percentage revenue growth - weighted average	3.0%	3.7%	-0.2%
Net profit (US\$ millions)	20,420	20,111	18,808
Net profit as a percentage of sales - weighted average	2.6%	2.7%	2.6%
Net profit as a percentage of sales - unweighted average	2.2%	2.6%	2.4%
Percentage Net profit growth - unweighted average	1.5%	6.9%	15.8%
Order book (US\$ millions)	1,624,931	1,498,873	1,478,865
Percentage Order book change	8.4%	1.4%	8.2%
Order book as a percentage of annual sales for total Top 30	209.6%	199.2%	203.7%
Gearing ratio - unweighted average	0.32	0.48	0.54
Gearing ratio - weighted average	0.35	0.50	0.62
Net Debt to EBITDA - unweighted average	1.3	2.9	1.6
Net Debt to EBITDA - weighted average	1.6	2.3	2.6
Total Asset Turnover Ratio	0.8	0.8	0.8
Return on Total Assets (net income/ total assets)	2.0%	2.1%	2.1%
Return on Equity (net income/ equity)	10.6%	6.9%	8.6%
Return on Working Capital (operating income/ working capital) - unweighted average	46%	47%	72%
SG&A cost as a percentage of revenue - unweighted average	11.1%	9.8%	13.0%
Revenue per employee (millions of US\$) - weighted average	0.39	0.38	0.37

What's affecting the current workforce and causes the skills crunch?



What are the critical challenges you face?

Skilled labor shortage

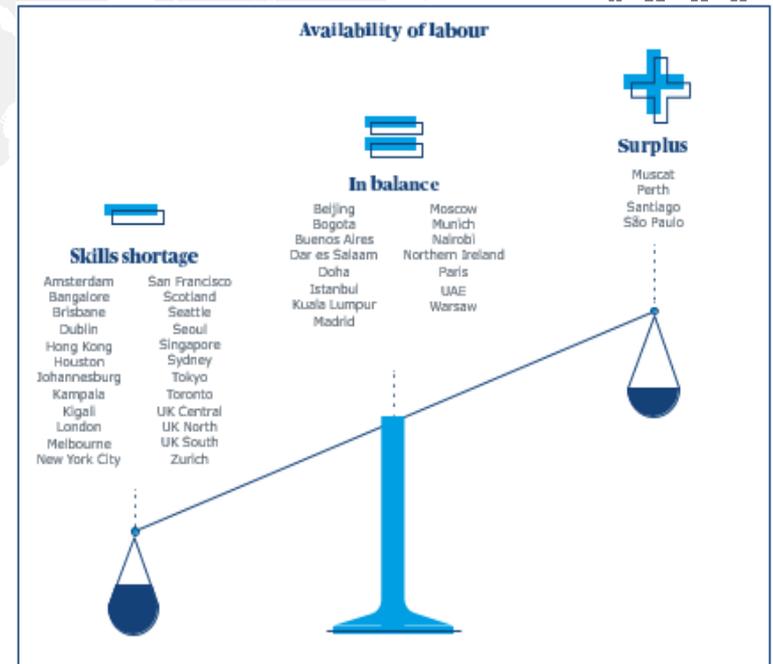
- ▶ The European countries face the challenge of skill shortages, which is a subsequent result of skill mismatch
 - ▶ 31% of labourers are overqualified for the jobs they do
- ▶ Another challenge faced by some EU countries is an increase in employment vacancy rates*, another factor contributing to labour supply and demand mismatch
 - ▶ Vacancy rates in Germany and Belgium grew by 3.3% during 2009 – 2015
 - ▶ Slovenia, Croatia and the United Kingdom, followed the above with a 1% increase
 - ▶ The UK, could also lose about 8% of their construction workforce (more than 175,000 EU workers), post Brexit



Evolution of vacancy rates in the EU construction sector



The increasing vacancy rates indicate that the mismatch between supply and demand is increasing in the construction sector



Skills shortage are a common theme in this edition of our survey with 24 of the 43 markets analysed suffering from a skills shortage. Source: IHS, 2017.

*Vacancy rates in the construction sector define the extent to which demand for labour is unmet

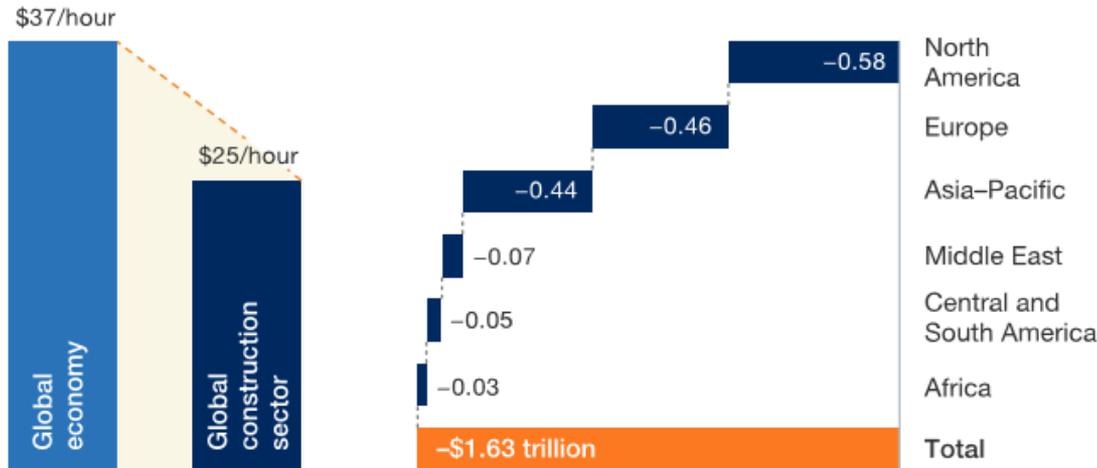
Source: European Construction Sector Observatory, European Commission, Improving the human capital basis, April 2017

Yet productivity is decreasing

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

Productivity gap =
\$1.63 trillion

Economic value lost as a result of the gap,²
by region, \$ trillion



Average value added by
employees per hour worked¹

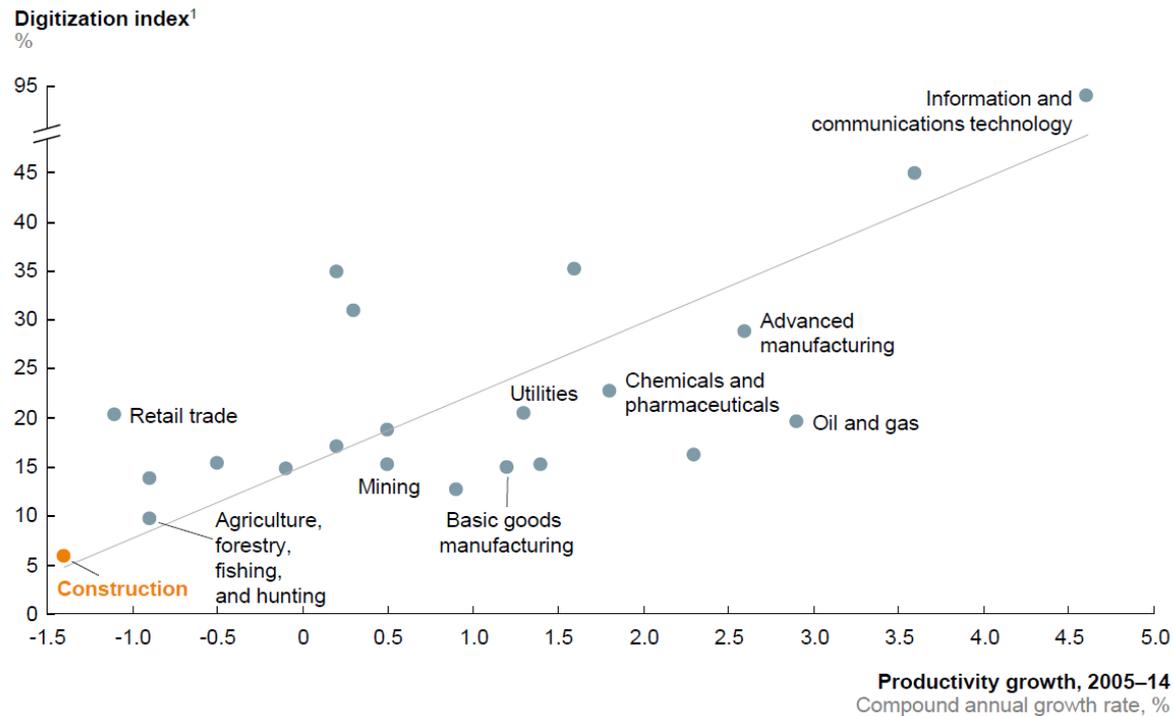
¹2015 data in real 2005 dollars.

²Assumes construction productivity catches up with total economy productivity and current workers are reemployed at the total economy productivity rate.

McKinsey&Company

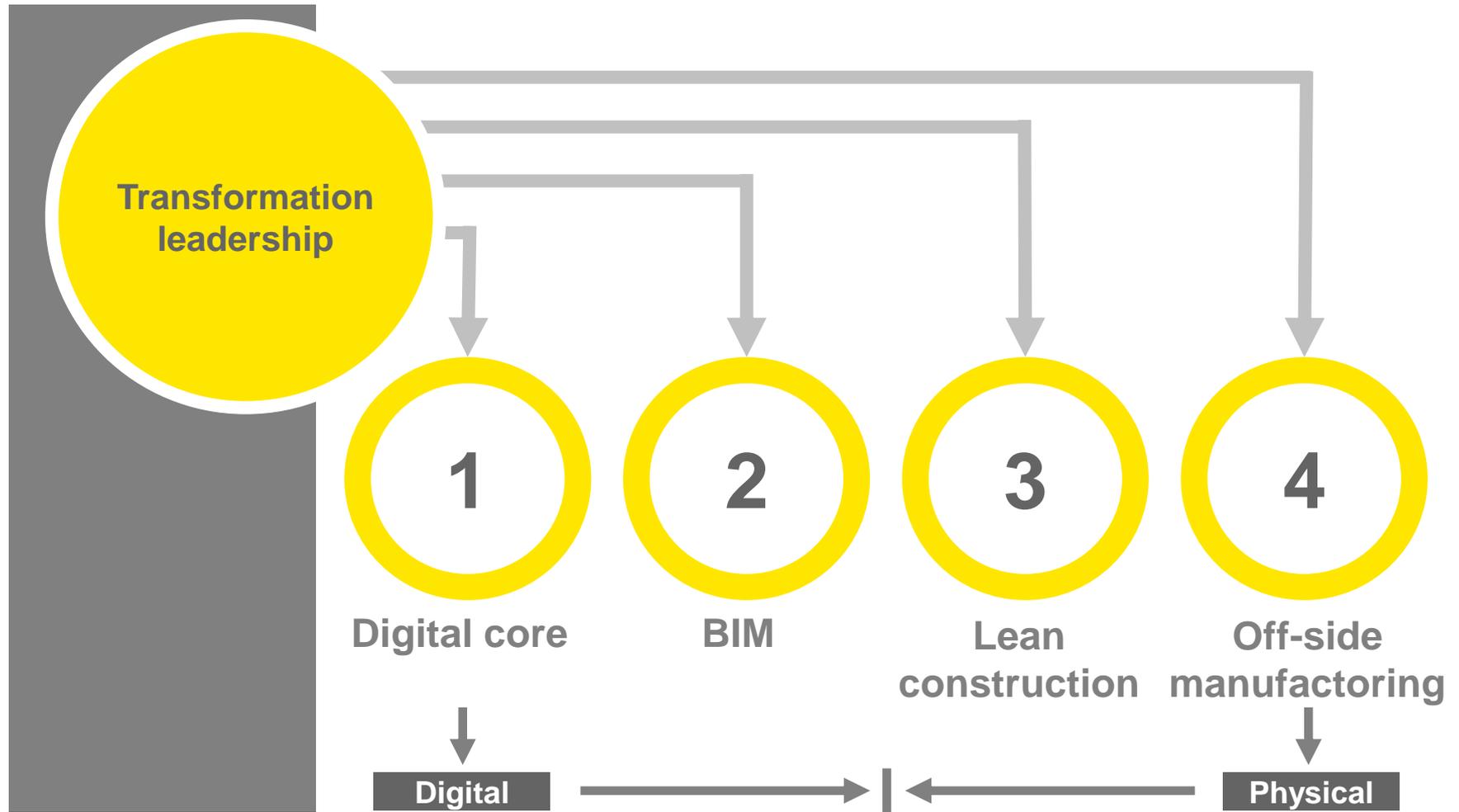
Lower digitalization leads to Lower productivity

Lower digitization in construction relative to other industries has contributed to the productivity decline



Source McKinsey Global Institute – Reinventing Construction (feb 2017)

Addressing critical challenges four ways

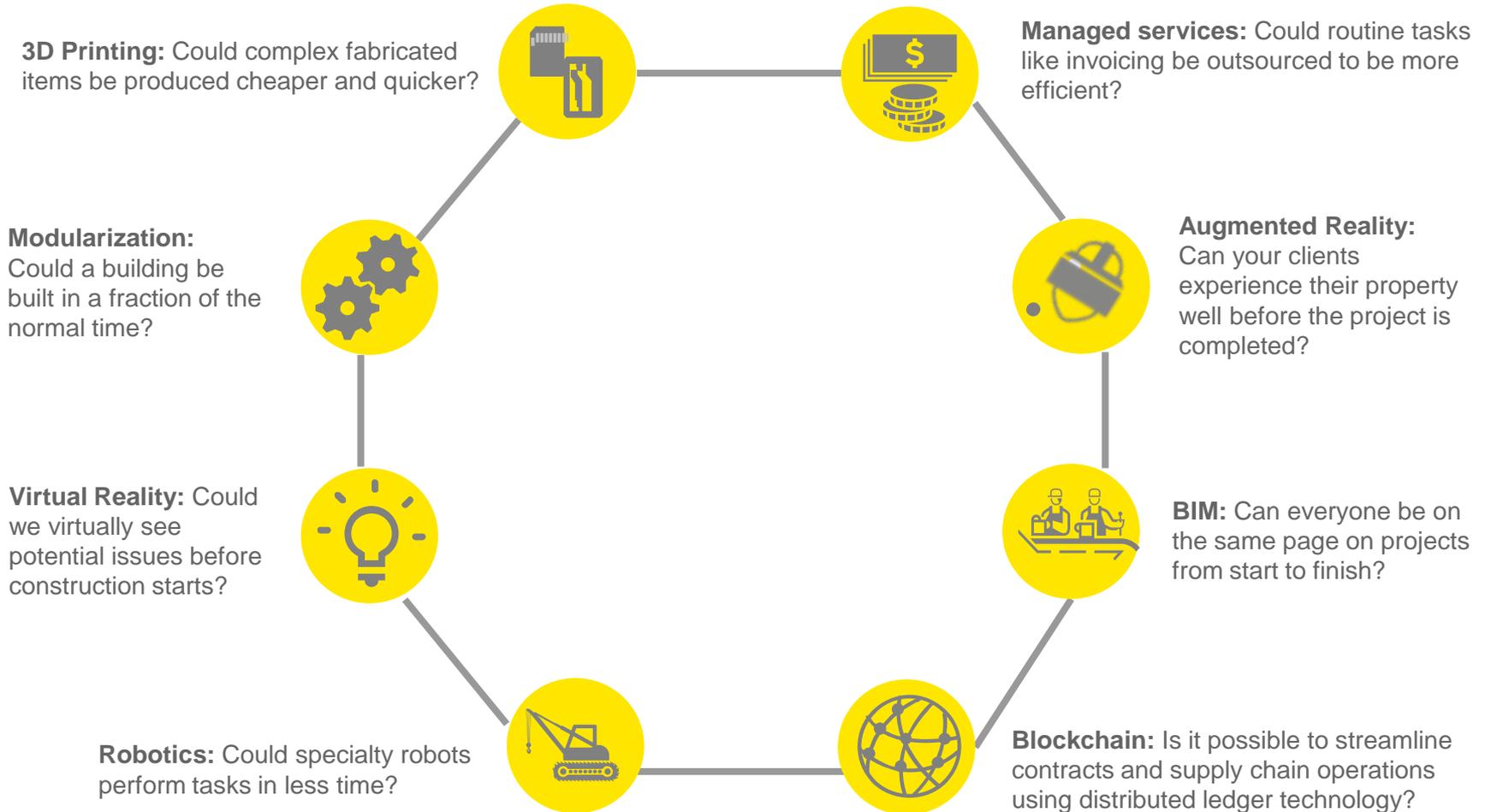


02

**How can
technology solve
these problems?**



How can technology solve these problems?



How can technology solve these problems?

Modularization



Challenges to modularizing the construction industry

- ▶ Changing the mindset on quality and monetary value (financing and resale) of modularization
- ▶ Depreciation/taxes of modular buildings treated differently from traditional construction

- ▶ Additional collaboration between stakeholders: owner, design, contractor and vendors

- ▶ Flexibility in design and material selection to match traditional construction options

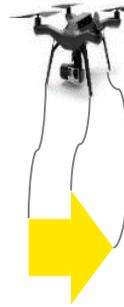
How can technology solve these problems?

Robotics

Integration of robots into construction industry is already underway.

Current application of robotics:

- ▶ Drones are being commonly used for site inspection and monitoring.
- ▶ Komatsu has developed unmanned haul trucks and driverless dozers with use of drones
- ▶ Q-Bot applies floor insulation beneath floorboards to reduce heat loss
- ▶ Construction Robotics has developed a Semi-Automated Mason, SAM100, a brick laying robot



Increasing the innovation of robots and integrating collaboration with humans will reduce cost and save time on construction projects.

Areas of focus for robotics innovation:

- ▶ Develop robots to perform high volume, difficult and repetitive tasks
- ▶ Develop robots perform dangerous tasks the enhance safety
- ▶ Develop robots for lifting and placing heavy objects (i.e. steel and rebar) to reduce the need for additional workers
- ▶ Develop robots to perform tasks associated with precise surveying, measurements and layouts



How can technology solve these problems?

Virtual, augmented and mixed reality



Augmented reality (AR)

- ▶ Augment holograms in real world
- ▶ View live virtual overlays of buildings or systems
- ▶ Can view static virtual objects from any angle simply by walking around them and pointing your device
- ▶ Will become more prevalent with the adoption of Apple's ARKit

Virtual reality (VR)

- ▶ Fully immersive BIM model
- ▶ Project teams can review the space and context better than just looking at drawings
- ▶ Usability and clashes can be improved earlier than the traditional process
- ▶ Stakeholders and end users can get a better understanding of what is to be built



How can technology solve these problems?

Building Information Modeling (BIM)

Definition

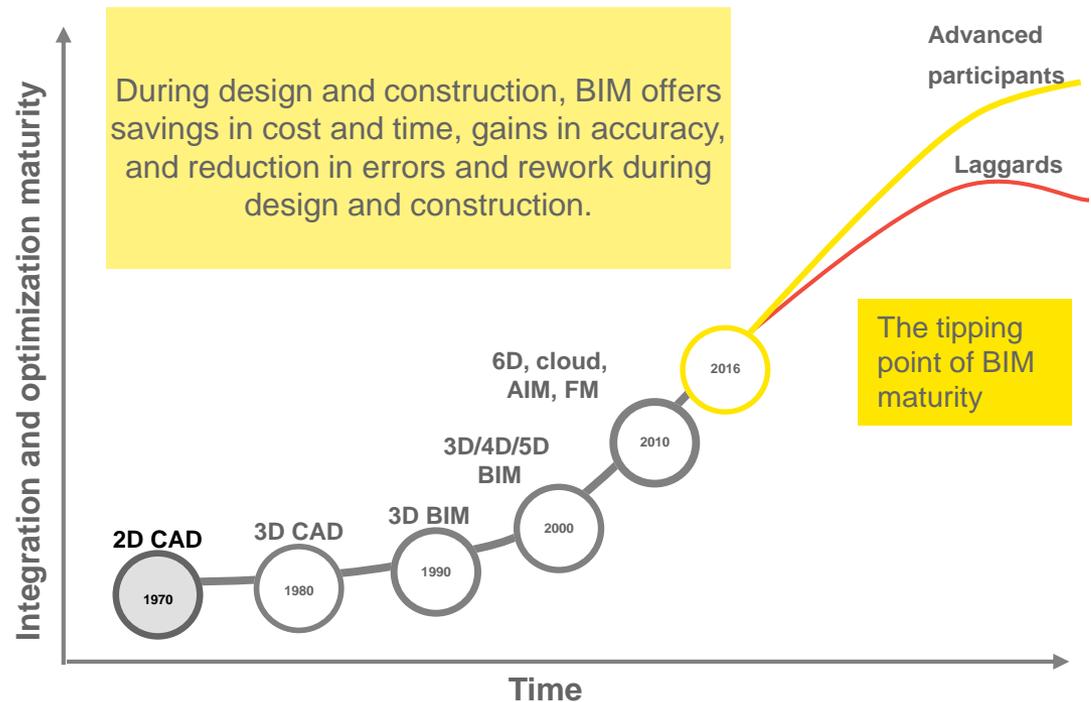
BIM is an acronym for Building Information Modeling or Model. At the highest level, “BIM is a digital representation of the building process to facilitate exchange and interoperability of information in digital format.” – Charles Eastman, 1999

Emerging opportunities include:

- ▶ Integrated Project Delivery (IPD)
- ▶ Enabling of digital asset management
- ▶ Virtual collaboration of project stakeholders

Note:

- ▶ CAD: computer aided design
- ▶ BIM: building information modeling
- ▶ 2D: two dimensional building/infrastructure drawings
- ▶ 3D: three dimensional building models
- ▶ 4D: 3D models interconnected with schedule data
- ▶ 5D: 3D models with material quantity and unit cost data
- ▶ 6D: 3D models with operations and maintenance property data



How can technology solve these problems?

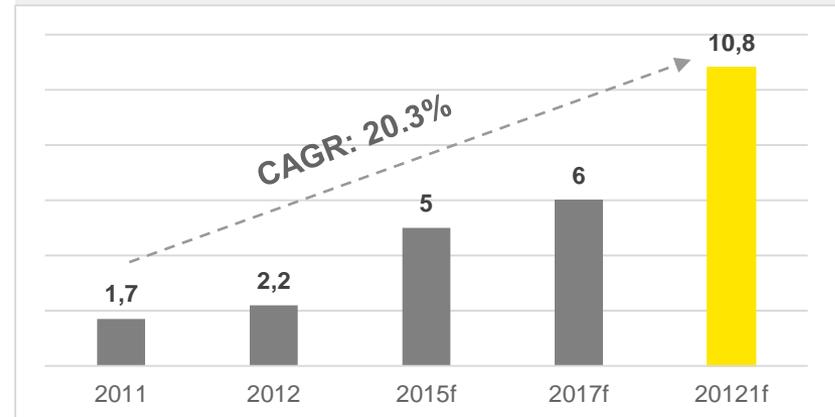
Overview of 3D printing

3D printing is the process of **creating a three dimensional object** from a digital model.



Current usage – 36% of companies are already applying or intend to apply 3D printing, according to a recent EY global survey of 900 companies, with Aerospace, Defense and Automotive being the most mature industries in applying 3D printing.

Worldwide 3D-printing products and services (\$B)



Source: Wohlers Associates

Emerging opportunities include:

- ▶ Simple house builds
- ▶ Embed MEP systems within printed walls
- ▶ Extrude quick-setting concrete into sections that would normally require complicated formwork
- ▶ Piping and plastic fittings

How can technology solve these problems?

Managed services

E&C firms will be looking for different ways to **optimize standard project processes** by outsourcing.

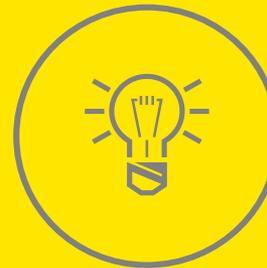
Managed services are the combination of outsourced expertise and a software technology to provide E&C companies with an efficient data-centric process, saving time and resources.

Managed Services



Sample services

- ▶ Invoice / payment application compilation and processing
- ▶ Data analytics and trend analysis
- ▶ Claims analysis



Benefits

- ▶ Reduced overhead
- ▶ Enhance communication and transparency between all stakeholders
- ▶ Identification and reduction of risk
- ▶ Predictive views of your business

Robotics

RPA is the application of a cost-effective software that mimics human action and connects multiple fragmented systems together through automation **without changing** the current enterprise IT landscape, allowing employees to focus on other critical tasks.

Process

Automation



People management

- ▶ Timesheet administration
- ▶ Job role change
- ▶ Amendment of address details
- ▶ On – and off-boarding procedures



IT

- ▶ Password resetting
- ▶ System maintenance
- ▶ Data cleansing
- ▶ Data analytics



Finance

- ▶ Account closure and opening
- ▶ Account audit requests
- ▶ Foreign exchange payments
- ▶ Claims processing

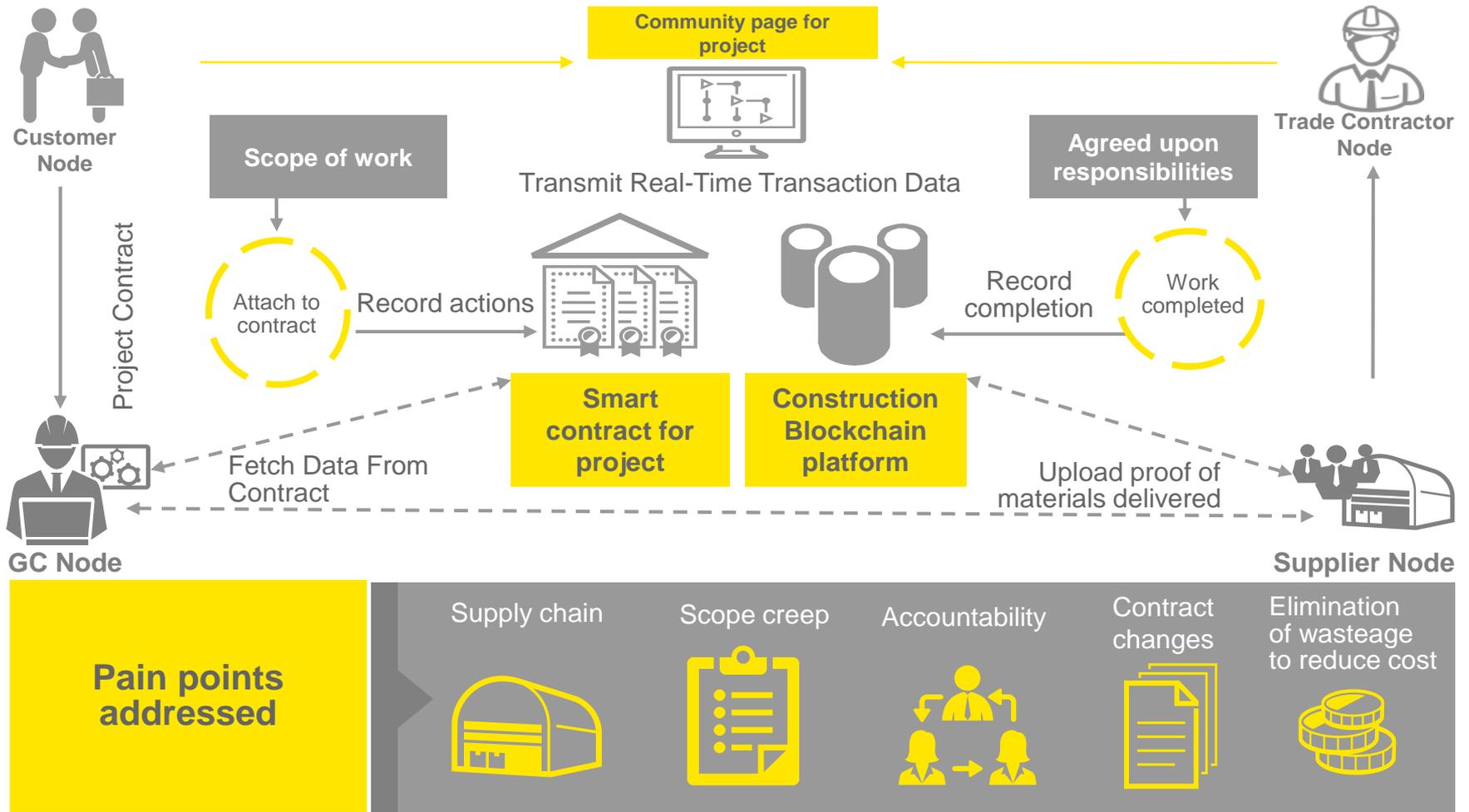


Supply chain

- ▶ Order management
- ▶ Material requirements planning system
- ▶ Energy consumption and procurement
- ▶ Payment protection measures

How can technology solve these problems?

Blockchain



03

Towards lean Construction



Lean construction

Construction is a fragmented process with the general contractor, individual trades and multiple suppliers each operating as separate functions on a project, which regularly affects time, quality and cost.

“Digital in construction is about automating, connecting, integrating. Lean ensures the underlying operations which you are automating are optimised to begin with, leading to exponential benefits from digital and BIM.”

In summary, lean is about synchronising the value-adding steps to create flow – and compressing as much value creation as possible into the shortest possible lead time.

Lean construction in 5 basic steps:

- ▶ Identify value from the customer standpoint and the associated steps you are currently taking to provide this value
- ▶ Seek to eliminate all unnecessary, non-value creating steps
- ▶ Reduce any wasted time between steps to create a nearly continuous process (flow)
- ▶ This allows for the customer to pull value from the next level of value creating activities
- ▶ Repeat the process to achieve maximum value for the customer

Note: While it may seem repetitive, with each iteration through the individual processes efficiencies are gained and steps can potentially be eliminated, therefore creating maximum efficiency throughout the project lifespan.

Lean construction – benefits

- ▶ **Finance:** Better cash flow, lower inventories and working capital, ideally compressing lead times so payment for work completed is received prior to paying for materials
- ▶ **Time:** Synchronised processes improve flow between value-adding steps with waiting or queuing between steps eliminated
- ▶ **Quality:** Enhanced quality by eliminating wastage and blockages that restrict flow and consume capacity and resources
- ▶ **Productivity:** The product of efficient work routines, layouts, material flow, behaviours, quality and rework ratios
- ▶ **Satisfaction:** Both customer and staff satisfaction improves, further lowering costs

04

**How do we
change and how
do we embed this
in a strategy**

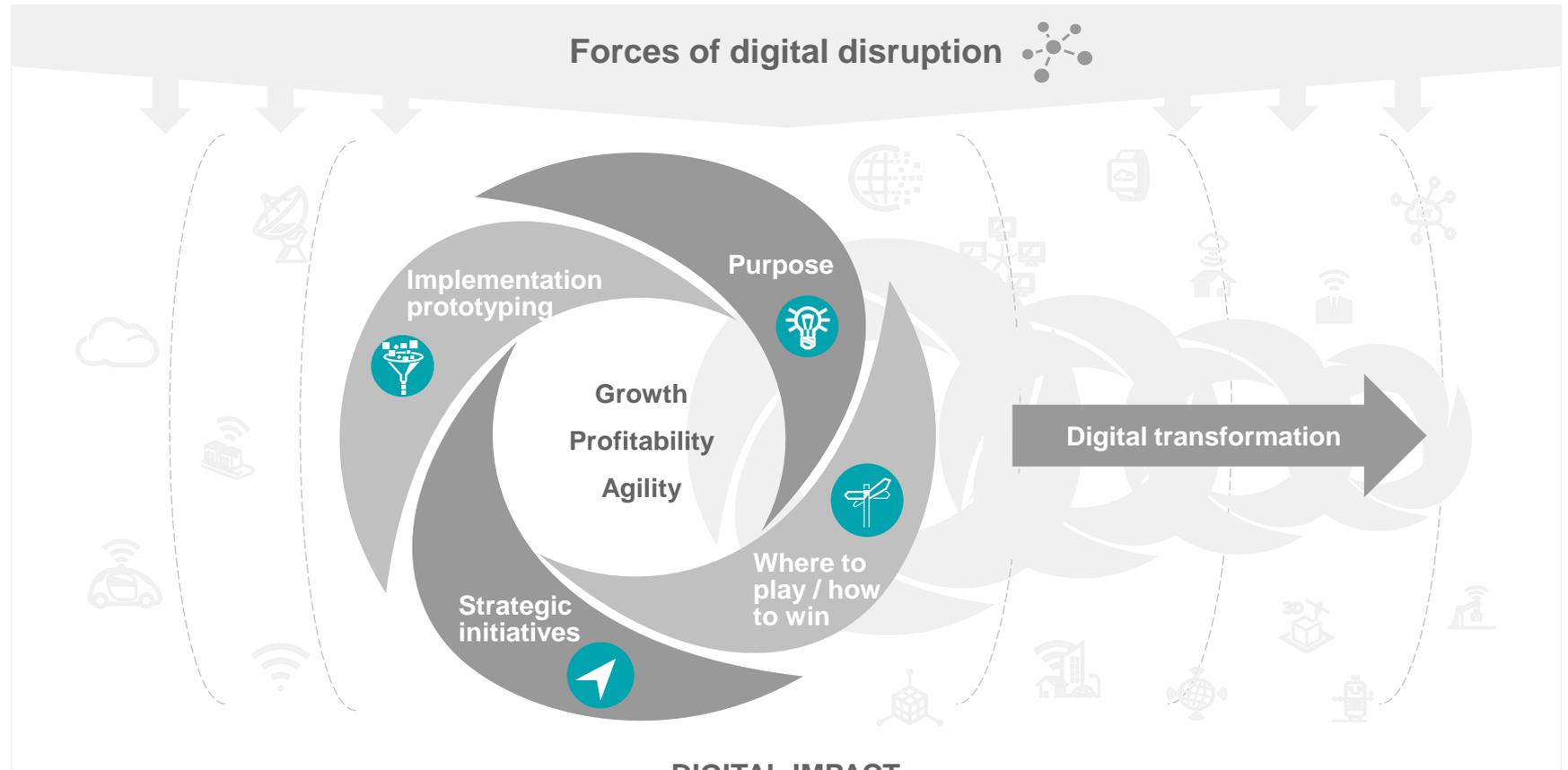


How do we change?



**“The ability to change and imagine must be among our core competencies”
– Jim Lawless**

Digital Strategy Design and Implementation is a dynamic and agile transformational process of the whole organization



DIGITAL IMPACT

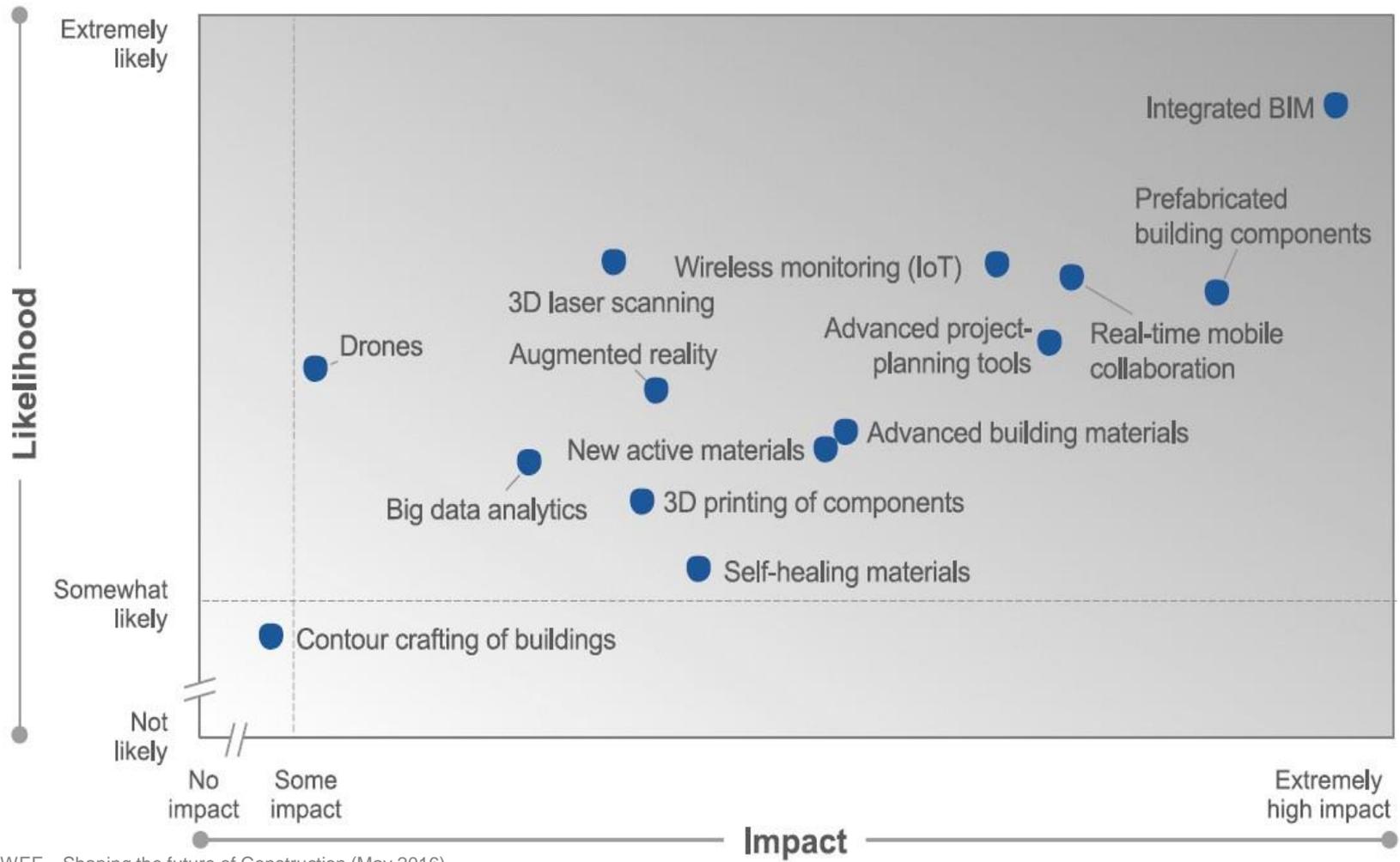
76% say the most important element for a successful digital strategy is **strategic vision mapped to digital needs***

* EY Study: Deal in a digital world, 2016



74% say **digital transformation** has a substantial or transformative impact on how they conduct business operations and processes*

Where to play/ How to Win



Source WEF – Shaping the future of Construction (May 2016)

Role of governments

- ▶ The construction industry is a vital part of a nation's economy contributing up to 10 percent of GDP. The industry is large and fragmented and often has not been a high priority for national governments
- ▶ By adopting a more innovative approach and improving links in the whole industry supply chain to undertake research and development, the construction industry would be better placed to innovate and as a consequence capitalize on the challenges and opportunities presented by the national and global market.
- ▶ The OECD in 2014 recommended that governments develop innovative digital strategies to contribute to national development and long term sustainable growth
- ▶ Governments should be providing leadership in driving a construction research and development agenda.
- ▶ Governments should recognize the importance of the Construction Industry and stimulate and support fostering change in the Industry.

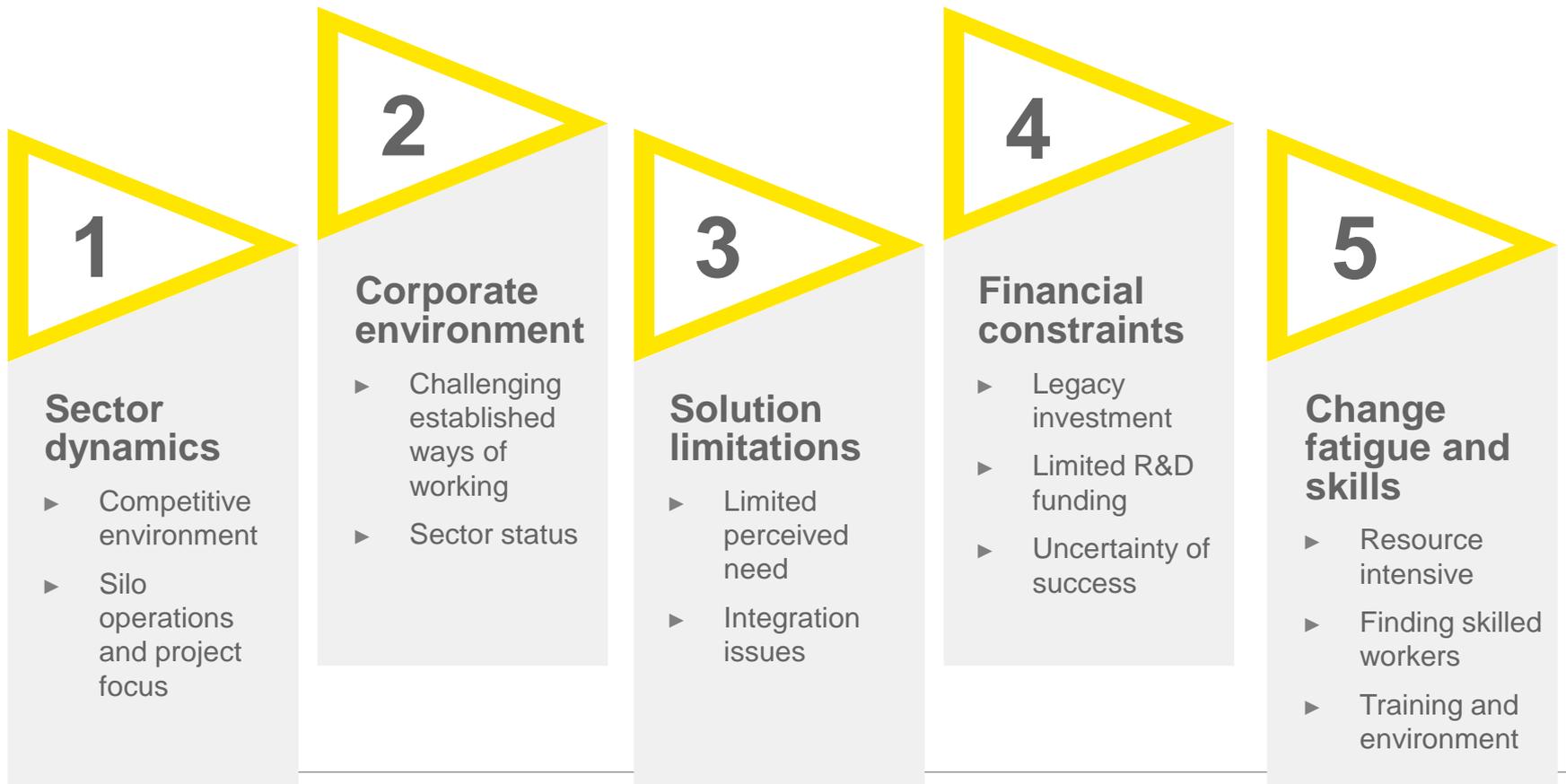
05

Wrap up and Questions & Answers



Risks and challenges

Despite the growing acceptance, the sector still faces some significant challenges in adopting new technology. These challenges can be seen across five broad pressure areas:



In summary...



The E&C industry is facing a challenge to meet current construction demands

There is an ever growing demand for housing, infrastructure, and energy projects, yet there are challenges with the current workforce that all companies must learn to adapt to



Advances in construction technology will change how projects are executed

Technological advances in construction will allow projects to be better designed, and constructed faster, leading to customer satisfaction and financial gains



Embarking on a digital journey requires nurturing from the top:

New technology is exciting and challenging; to navigate this medium, innovative and rapid ways to learn, assess, and develop new capabilities are required. Innovation requires governance and nurturing from the top

Questions and answers



Thank you!



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