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AECOM Imagine it. Delivered.

EMS Summit 2018

Maintenance 4.0

The Future of Maintenance

27 November 2018

Berlin

Lars Skogmo
Dr. Frank Keul

Agenda

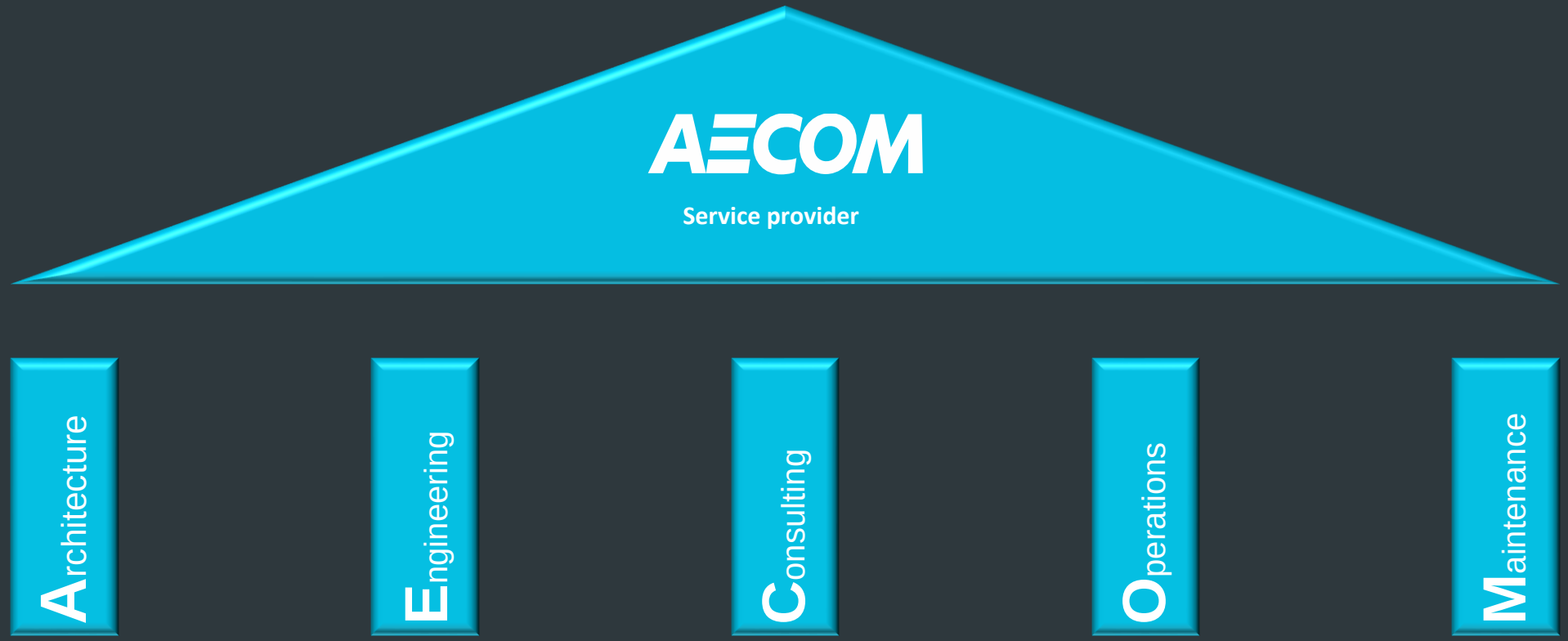
About AECOM

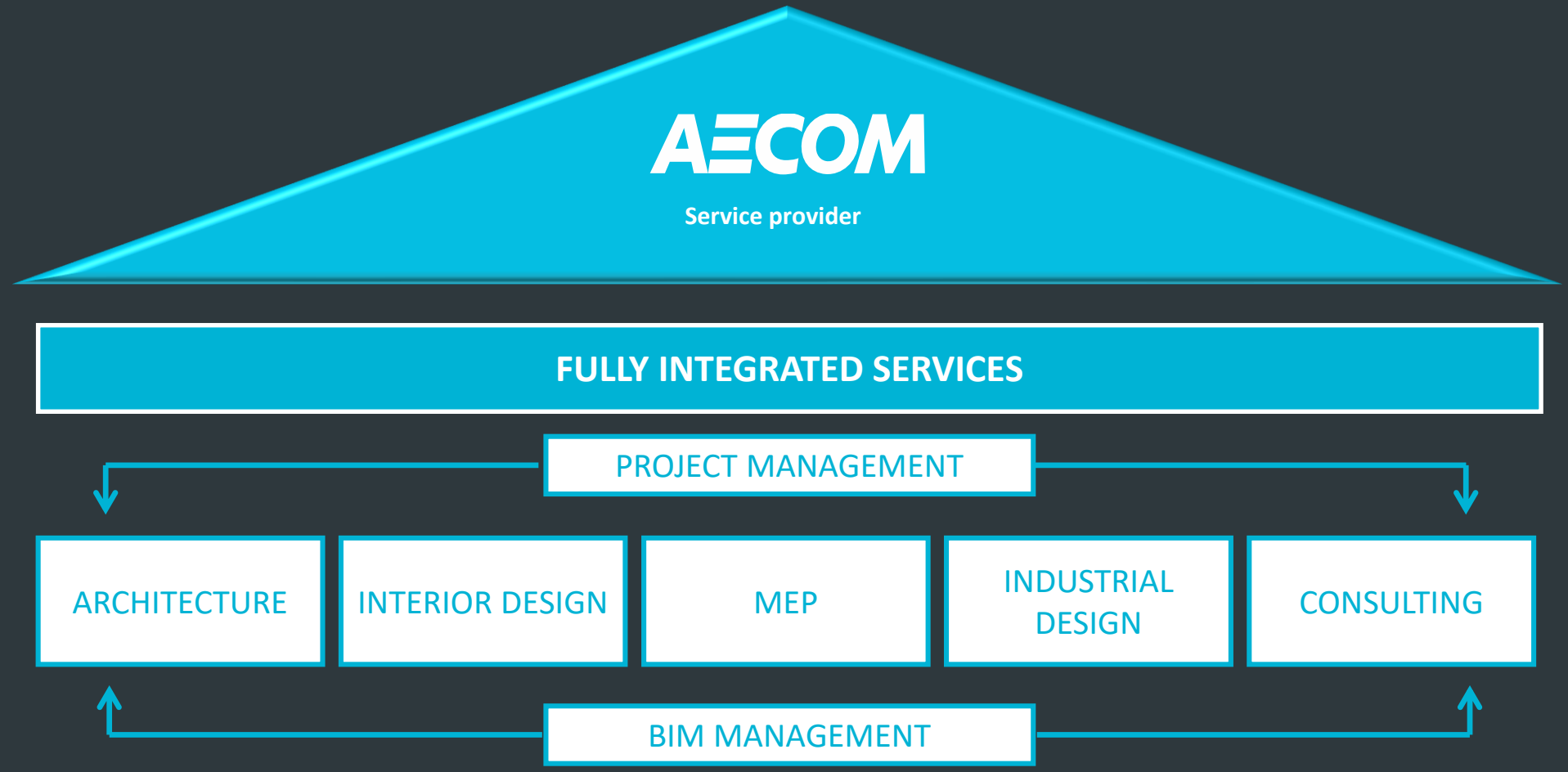
From Buildings to Production
Lars Skogmo

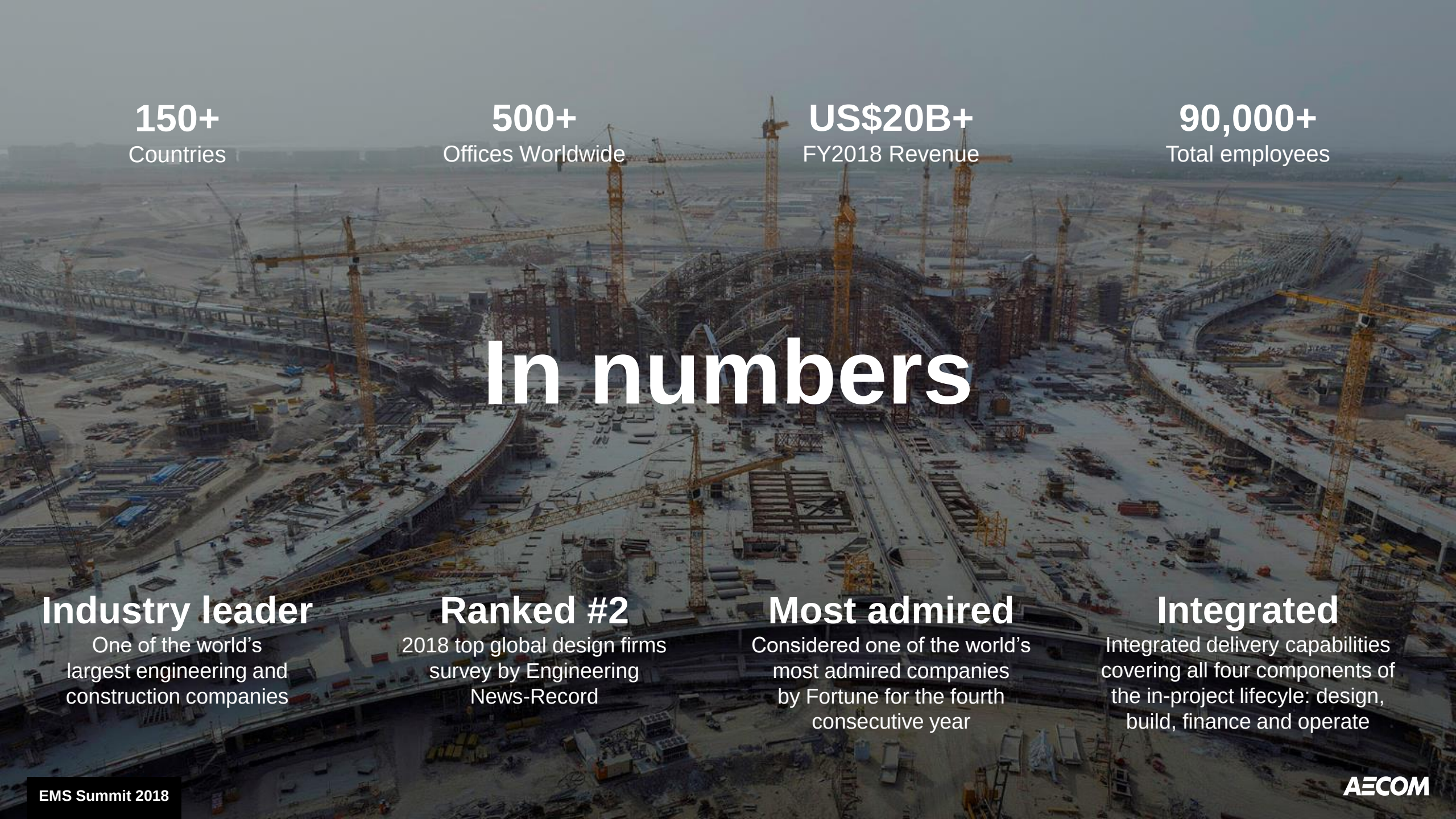
The Future of Maintenance
Dr. Frank Keul

Q&A session

About AECOM


AECOM
Service provider
Architecture
Engineering
Consulting
Operations
Maintenance


AECOM
Service provider
FULLY INTEGRATED SERVICES
PROJECT MANAGEMENT
ARCHITECTURE
INTERIOR DESIGN
MEP
INDUSTRIAL DESIGN
CONSULTING
BIM MANAGEMENT



150+
Countries

500+
Offices Worldwide

US$20B+
FY2018 Revenue

90,000+
Total employees

In numbers

Industry leader
One of the world's largest engineering and construction companies

Ranked #2
2018 top global design firms survey by Engineering News-Record

Most admired
Considered one of the world's most admired companies by Fortune for the fourth consecutive year

Integrated
Integrated delivery capabilities covering all four components of the in-project lifecyle: design, build, finance and operate

AECOM

Best in class technical teams provide **market leading services worldwide**

Industrial Centres of Excellence

Key projects
Automotive and Industrial

Heavy equipment manufacturing

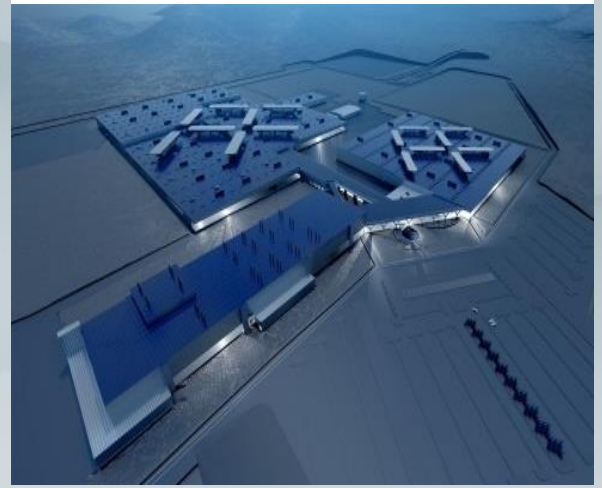
Caterpillar
Facility and production maintenance contract spanning 35 locations on a global platform. AECOM has approximately 1200 employees providing maintenance services.

Automotive assembly plant

BMW Mexico
Greenfield assembly plant. Services include master planning, project management of design, construction management, and start-up services.

New electric vehicle

Faraday Future in Nevada
Design/build 3 million square foot greenfield electric car plant. Services include master planning, design packages, engineering, procurement, and construction.



Engine manufacturing

Pratt & Whitney
Facility Management and waste water treatment services supporting complex jet engine manufacturing processes. This contract services multi locations.

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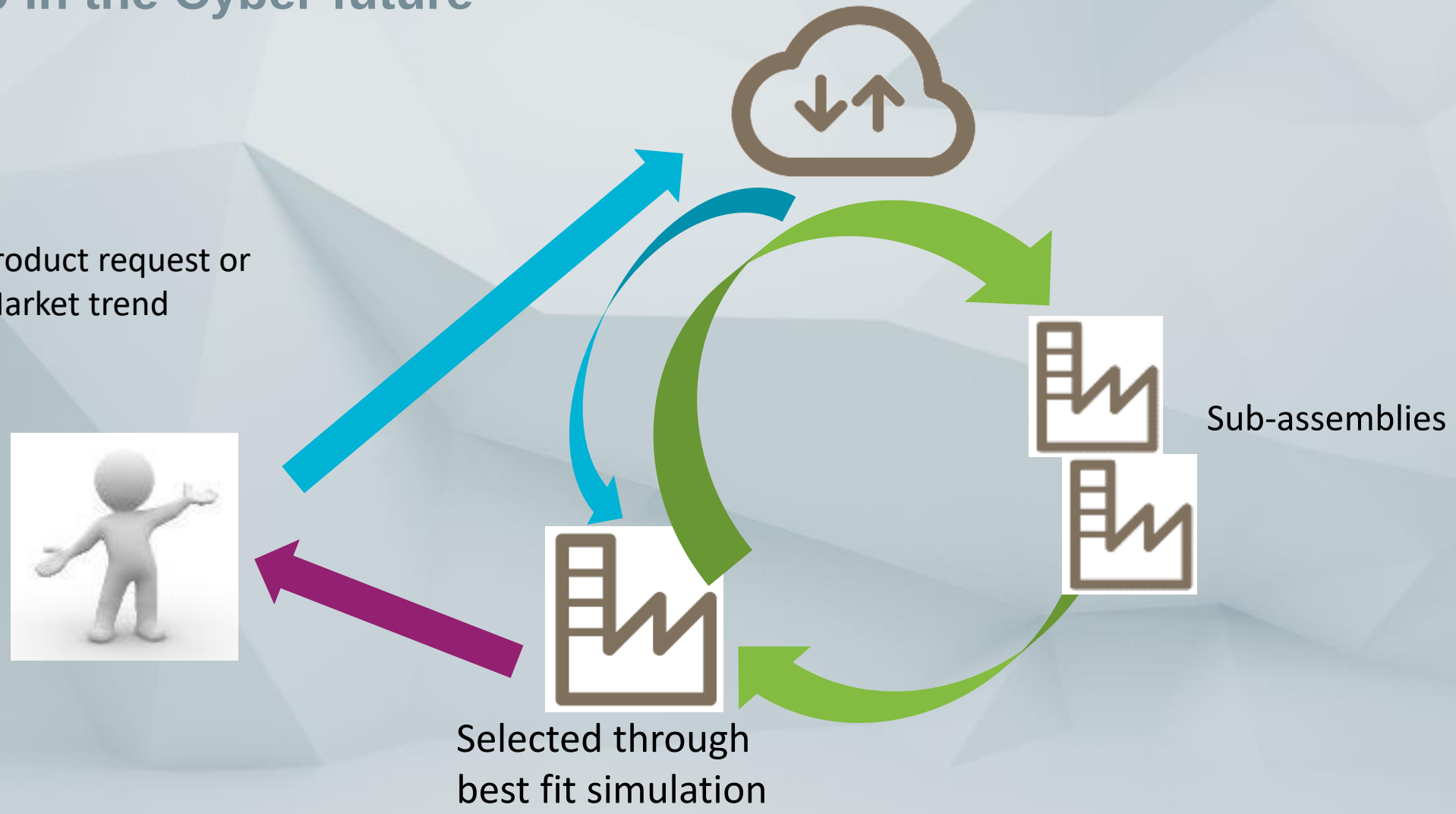
From Buildings to Production

Lars Skogmo

The Future of the Customer
Industry 4.0 in the Cyber future



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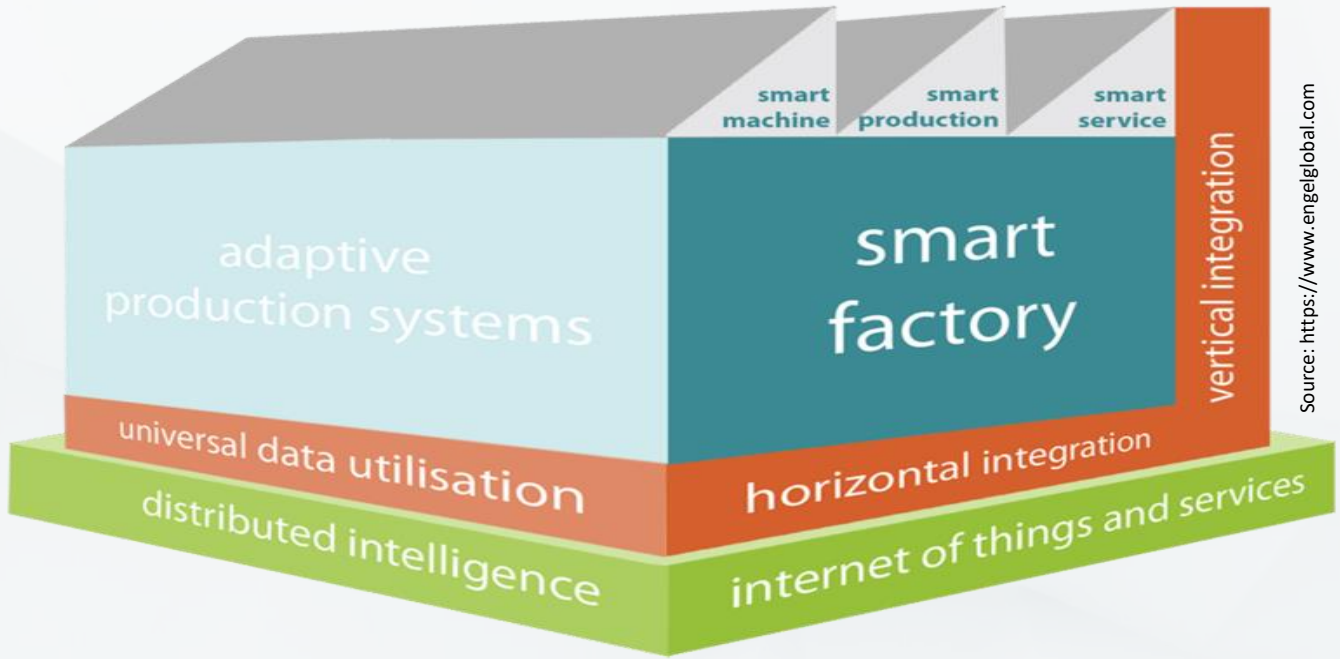
The Future of Factories
Smart Factories

- Modular and adaptive designs for rapid expansion or reconfiguration of both product and location
- Designs that encourage greater openness, integration and collaboration
- Optimised relationship between building, machinery and production processes
- Circular economy strategies including whole life-cycle approaches - feasibility, design, maintenance and decommissioning
- Sustainable practices to reduce environmental impact



Source: https://www.engelglobal.com

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The Future of Production

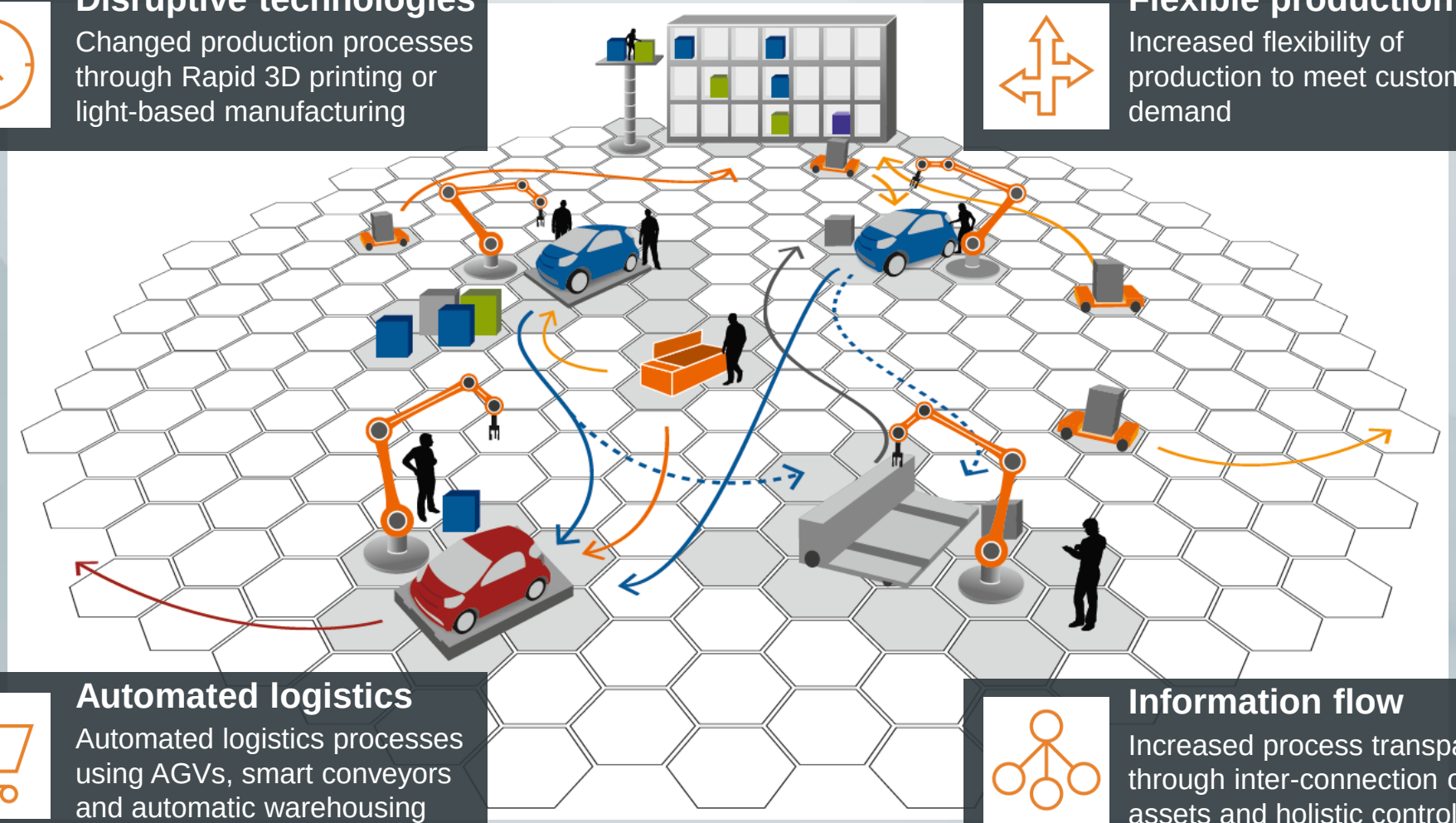
Builds upon Mature Production Methods and Optimizes Asset use

Disruptive technologies

Changed production processes through Rapid 3D printing or light-based manufacturing

Flexible production

Increased flexibility of production to meet customer demand



Automated logistics

Automated logistics processes using AGVs, smart conveyors and automatic warehousing

Information flow

Increased process transparency through inter-connection of assets and holistic controls

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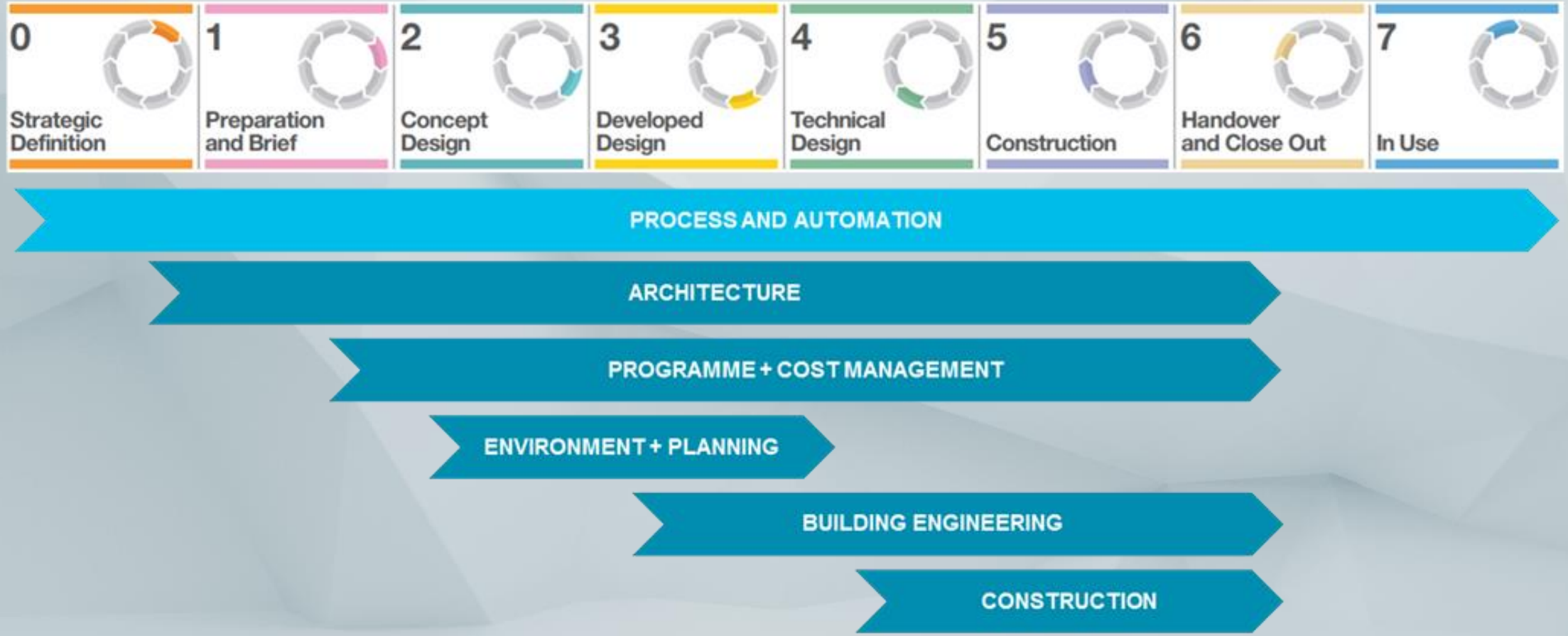
The Future of Process led Design
Integrated Engineering Services



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The Future of Maintenance

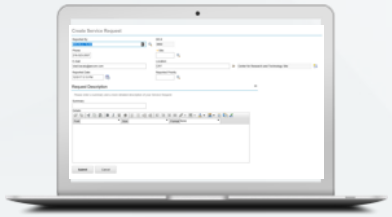
Dr. Frank Keul

EMS Summit 2018

Is AECOM doing Maintenance 4.0 for our Clients?

AECOM's blueprint approach

Mobile service requests



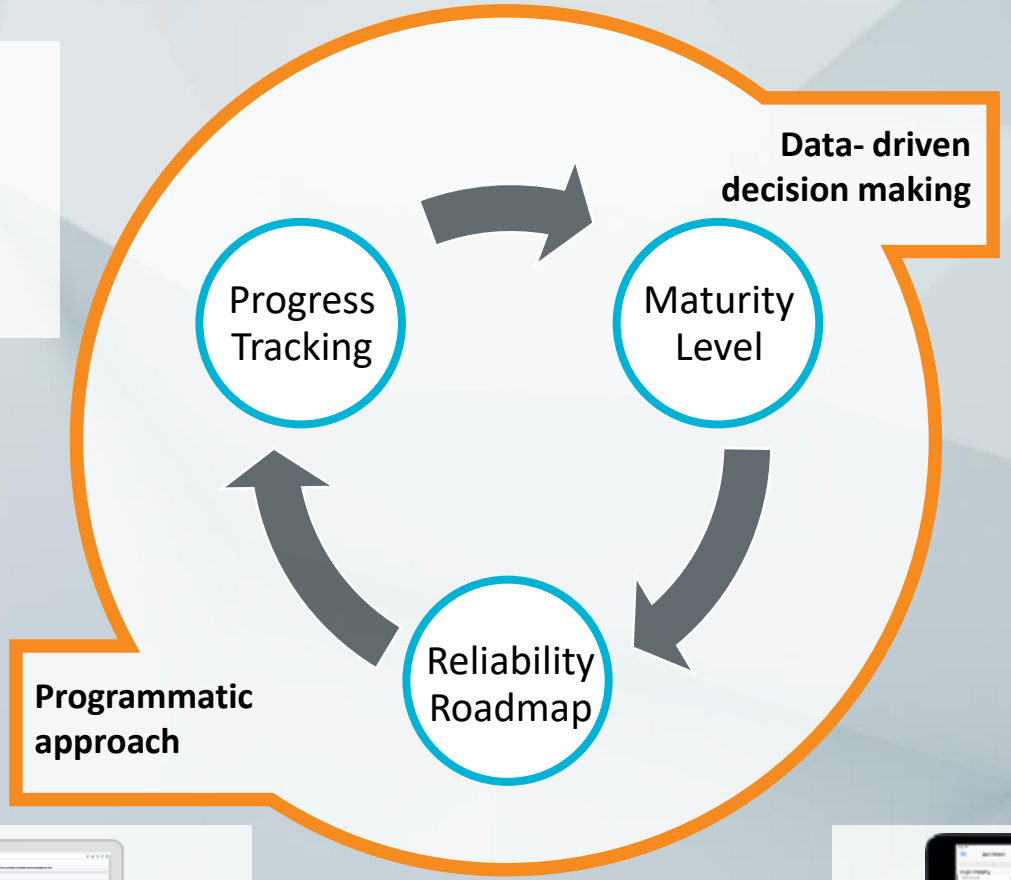
Online service requests

Live data collection

Digital job plan

In-depth analysis & condition based assesment

24/7 live support



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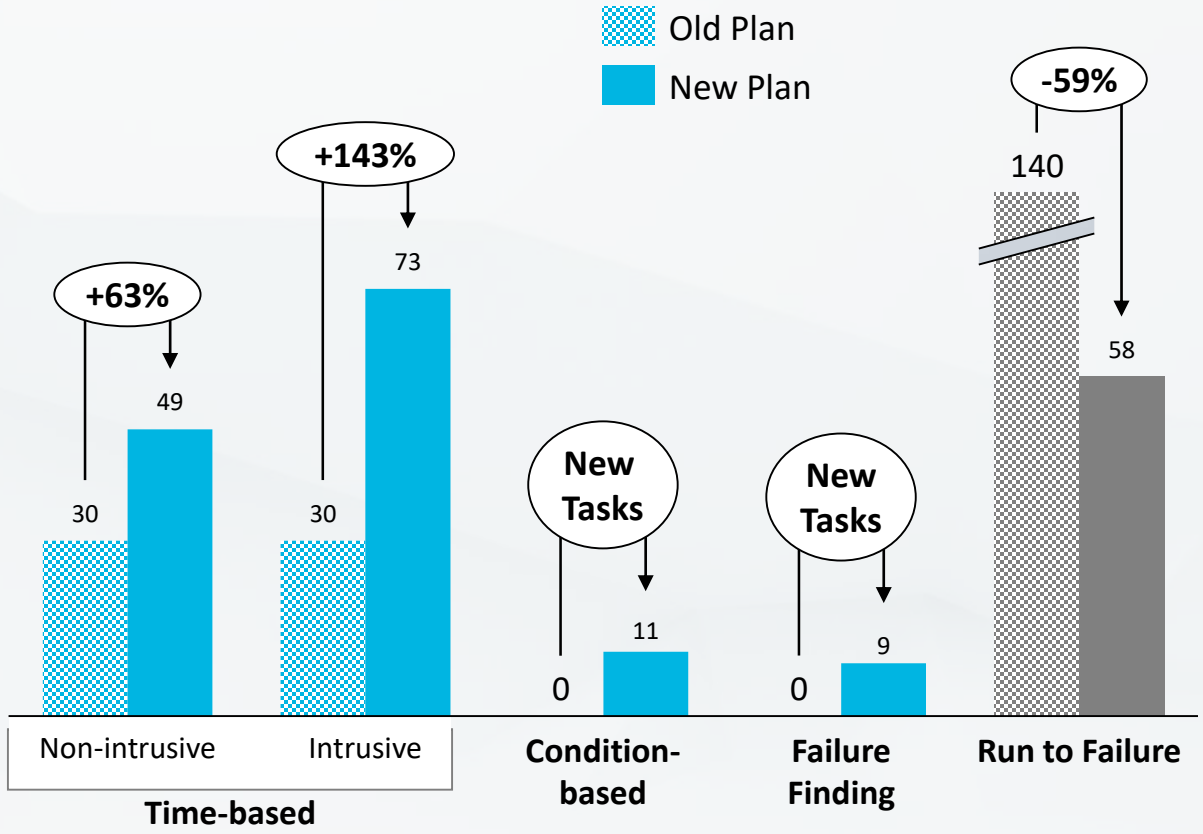
The AECOM Maintenance approach
Reliability Centered Maintenance (RCM)

RCM Implementation Process

1. System Selection and Information Collection
2. System Boundary Definition
3. System Description and Functional Block Diagram
4. System Functions and Functional Failures
5. Failure Mode and Effects Analysis (FMEA)
6. Logic (Decision) Tree Analysis
7. Task Selection
8. Task Packaging
9. Measurement and Update (“Living Program”)

Change in Maintenance strategy per task type



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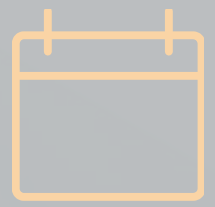
Defining Maintenance 4.0

The future of maintenance uses key aspects of Industry 4.0

Maintenance

1.0

Reactive Mode
Run to Failure then Repair



Maintenance

2.0

Preventive Maintenance Activities on Calendar Basis

Maintenance

3.0

Condition Based Activities Based of Predictive Maintenance

Maintenance

4.0

Interconnected Assets Analysed as a Whole System

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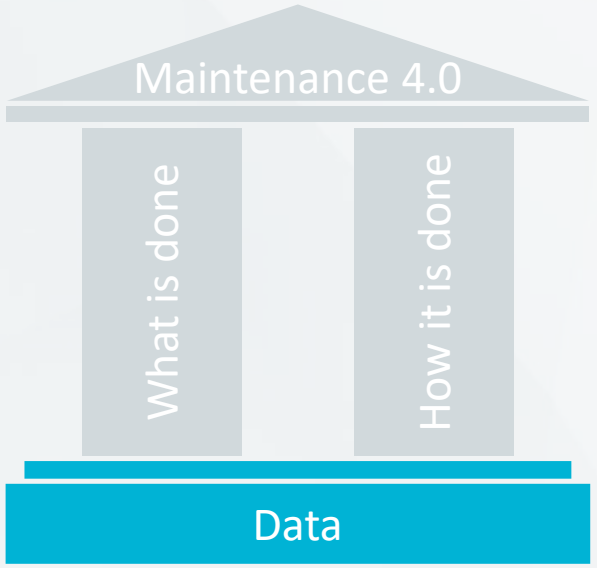
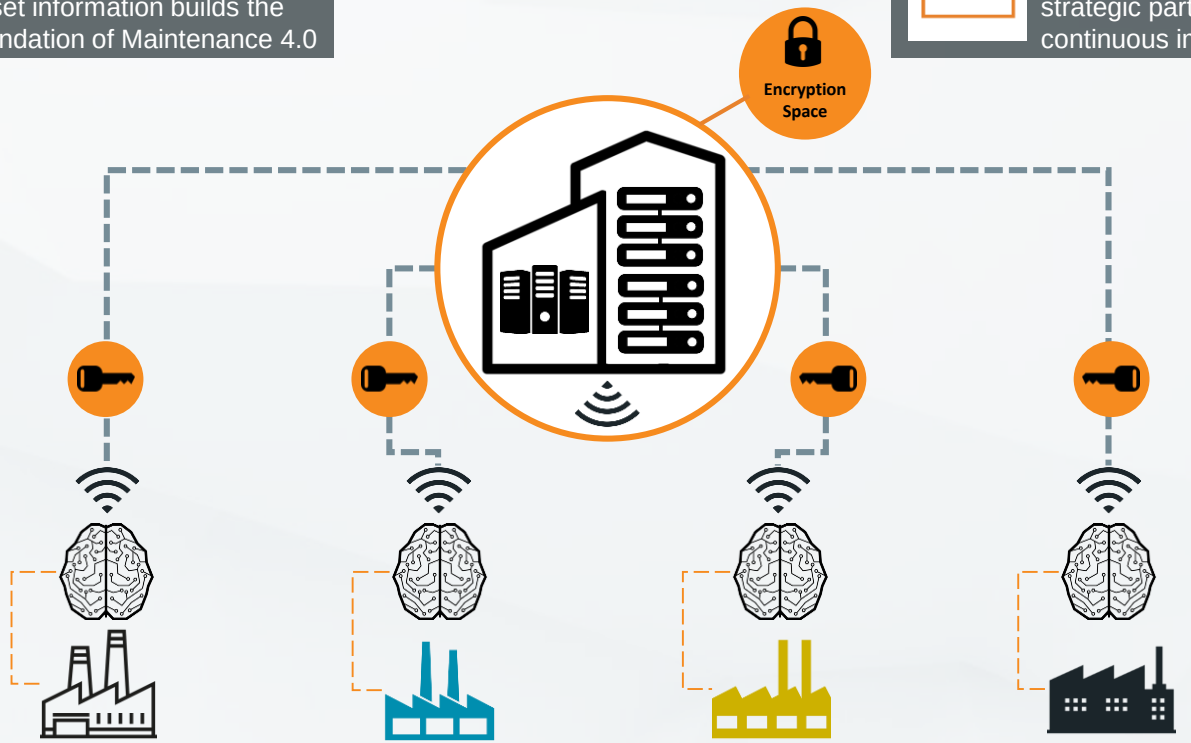
The foundation of Maintenance 4.0

Capturing complete data allows optimization on multiple levels



Captured
Collection and access to asset information builds the foundation of Maintenance 4.0

Controlled
Data access availability to strategic partner allowing continuous improvement



Transparent
Cost, stock, activities and productivity is recorded for human and machine assets

Complete
Data capture for all assets at all sites gives the complete picture of activities

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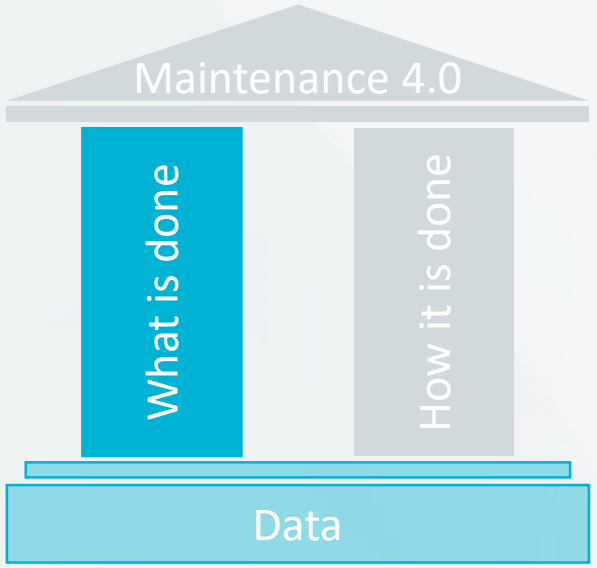
Revising activities in Maintenance 4.0

Using the data foundation holistic maintenance can be redisigned



Defined

Data analytics allows identification of failure modes and definition of actions

Holistic

Data capture for all assets at all sites to enable organizational learning

Modified

Modification of corrective actions and existing maintenance schedules

Predictive

Building on past experience new activities are derived to prevent occurrence

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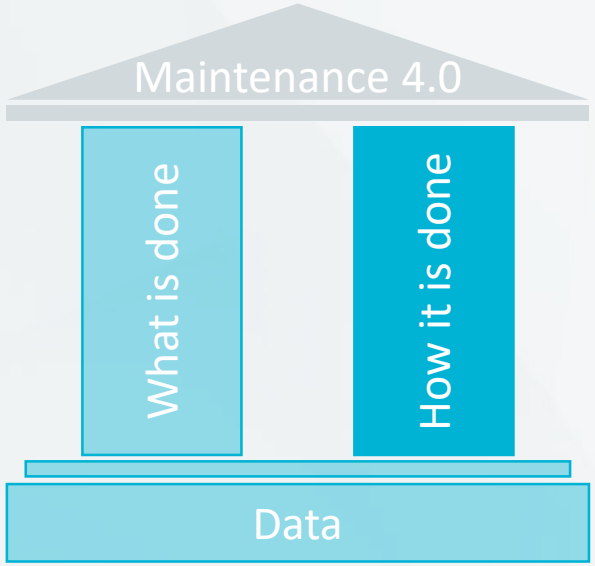
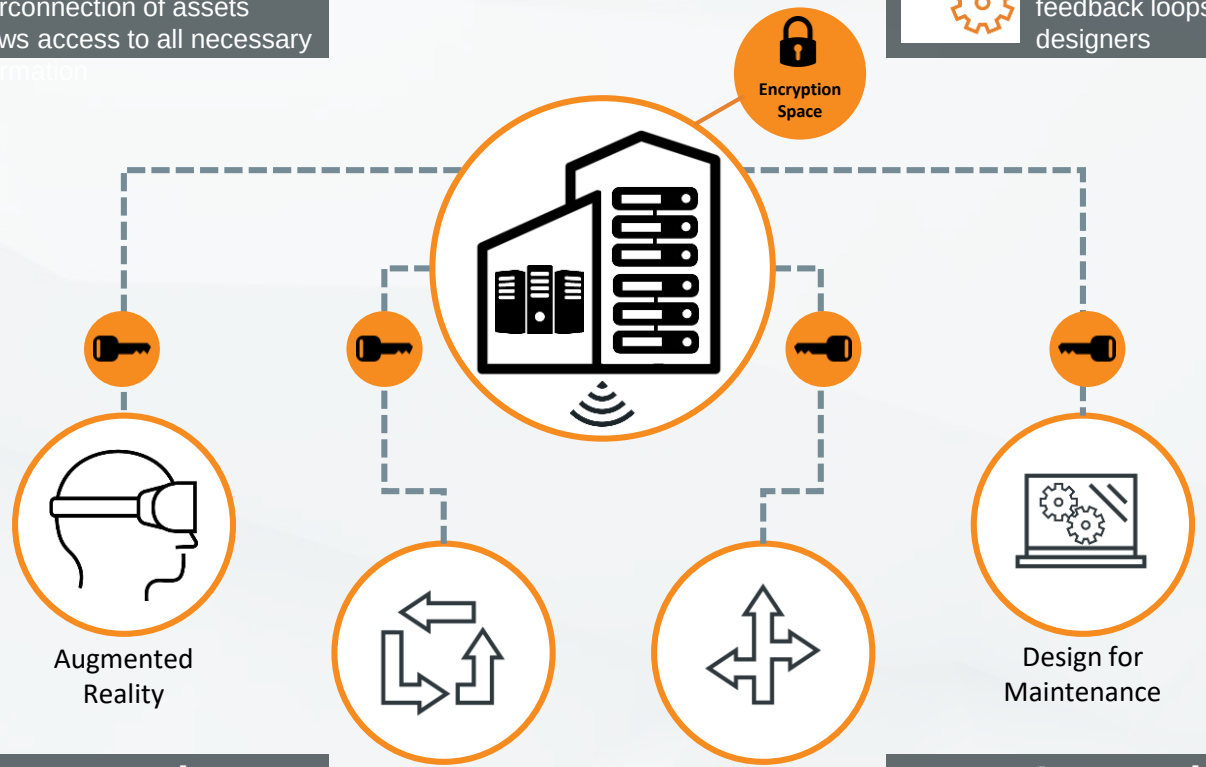
Refining activities in Maintenance 4.0

Through disruptive technologies activities are optimized



Connected
Vendor agnostic interconnection of assets allows access to all necessary information

Efficient
Increased efficiency through feedback loops to equipment designers



Augmented
Using augmented reality tools for virtual upskilling of personnel and CIP

Learned
Instantaneous adaptation of activities by communication between assets

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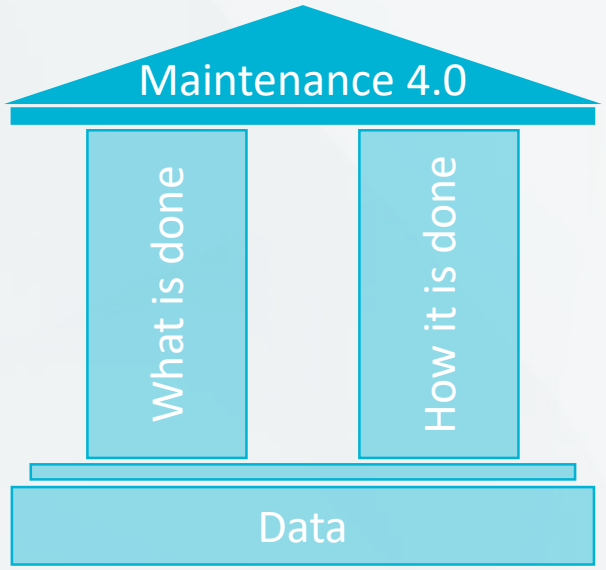
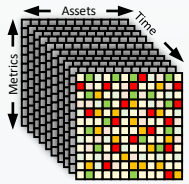
Maintenance 4.0 in a nut shell

Building on well established continuous improvement principles



Standardized

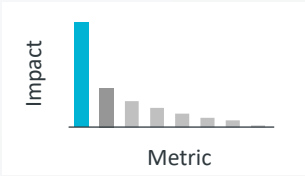
Unified methodologies to define maintenance activities dynamically on case-by-case basis

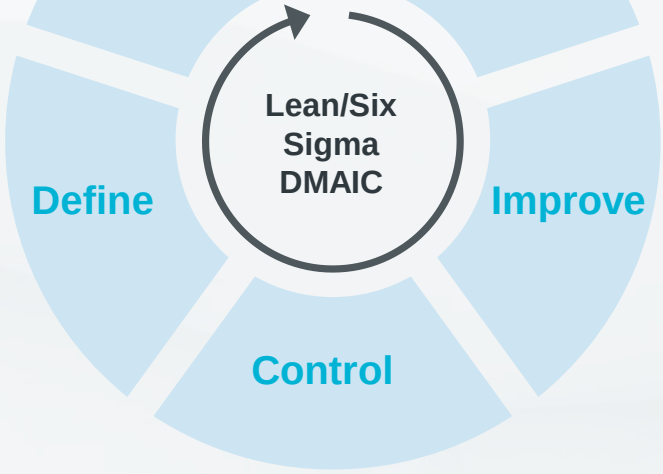


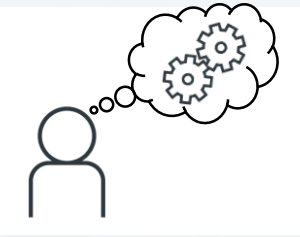
MTBF	MTBR	MDT	MTF	OEE	TEEP
VAR	MTC	CMC	CMH	CBMC	MSC
PVI	HpST	PM yield	PdM yield	PM compl.	PdM compl.
ProAW	SWO	WOA	WOCT	PIBL	CWSR
DIMR	ISR	ISV	MMC	OMH	WTP
...	...	...	...	...	...

Transparent

Cost, stock, activities and productivity is recorded for human and machine assets

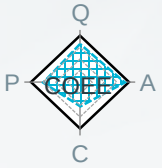






Comparable

By defining company-wide KPIs, comparability is achieved at all levels



Self-Improving

By using Artificial Intelligence system wide experiences are used to improve activities

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Closing Remarks

Dr. Frank Keul

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