HEXAGON
empowering an autonomous future

Autonomy in industrial facilities & manufacturing

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Hexagon provides smart solutions **across the entire lifecycle** of manufacturing and process industries assets, from initial design to day-to-day operations.

Design

Intelligently design, engineer, and implement true workflow-managed integration across the project enterprise

- **Feed**
- **Detail Design**

Construct

Reduce project risk with a rules-based change management solution that communicates across procurement and construction processes

- **Projects**
- **Procurement & Materials**
- **Fabrication**
- **Construction**

Operate

Ensure safe, consistent operations with integrated data on physical assets, processes, and regulatory imperatives

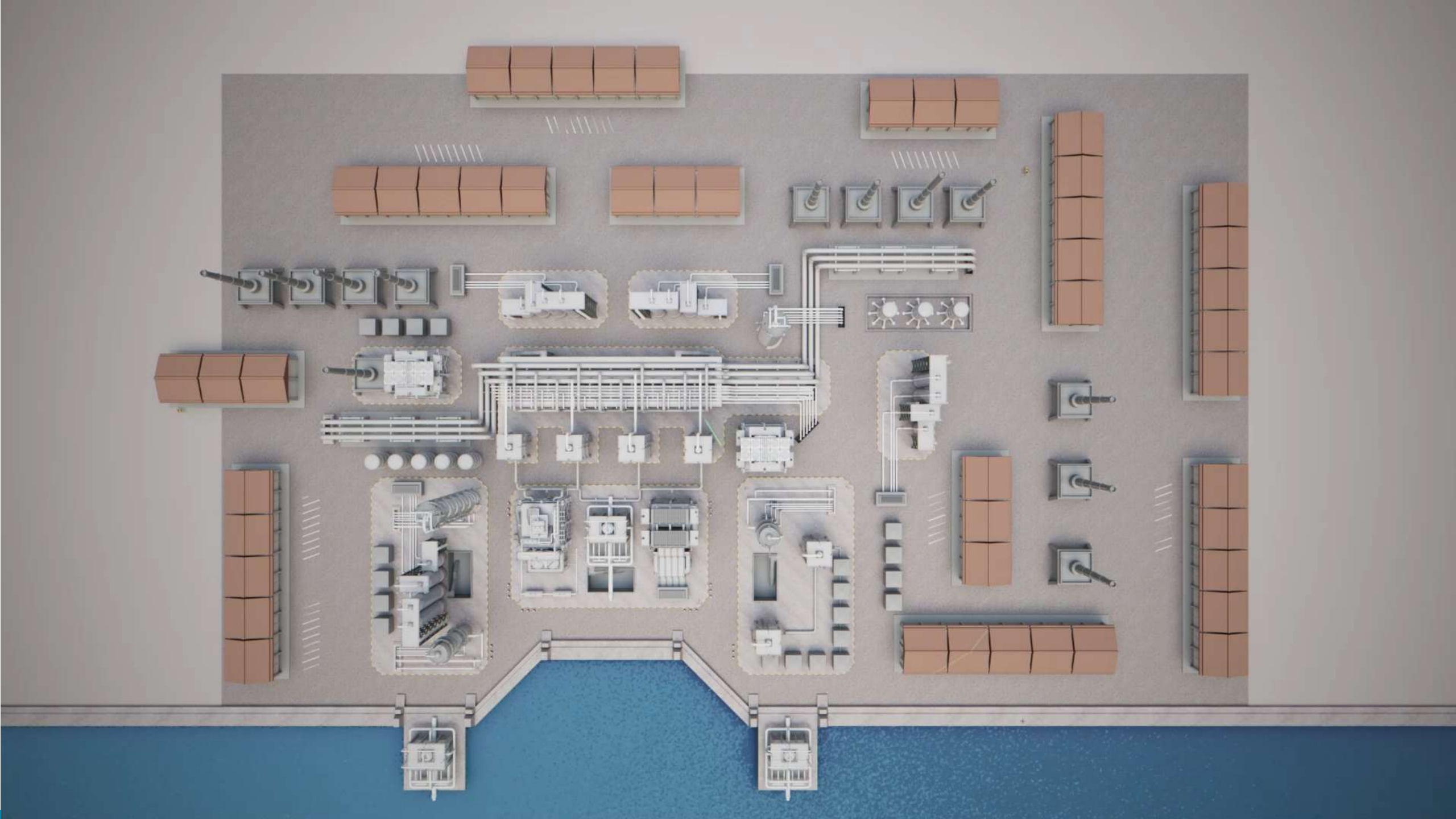
Embrace a "**single version of the truth**" for your projects, portfolios, and contracts

- **Asset Lifecycle Information Management**
- **Operations & Maintenance**

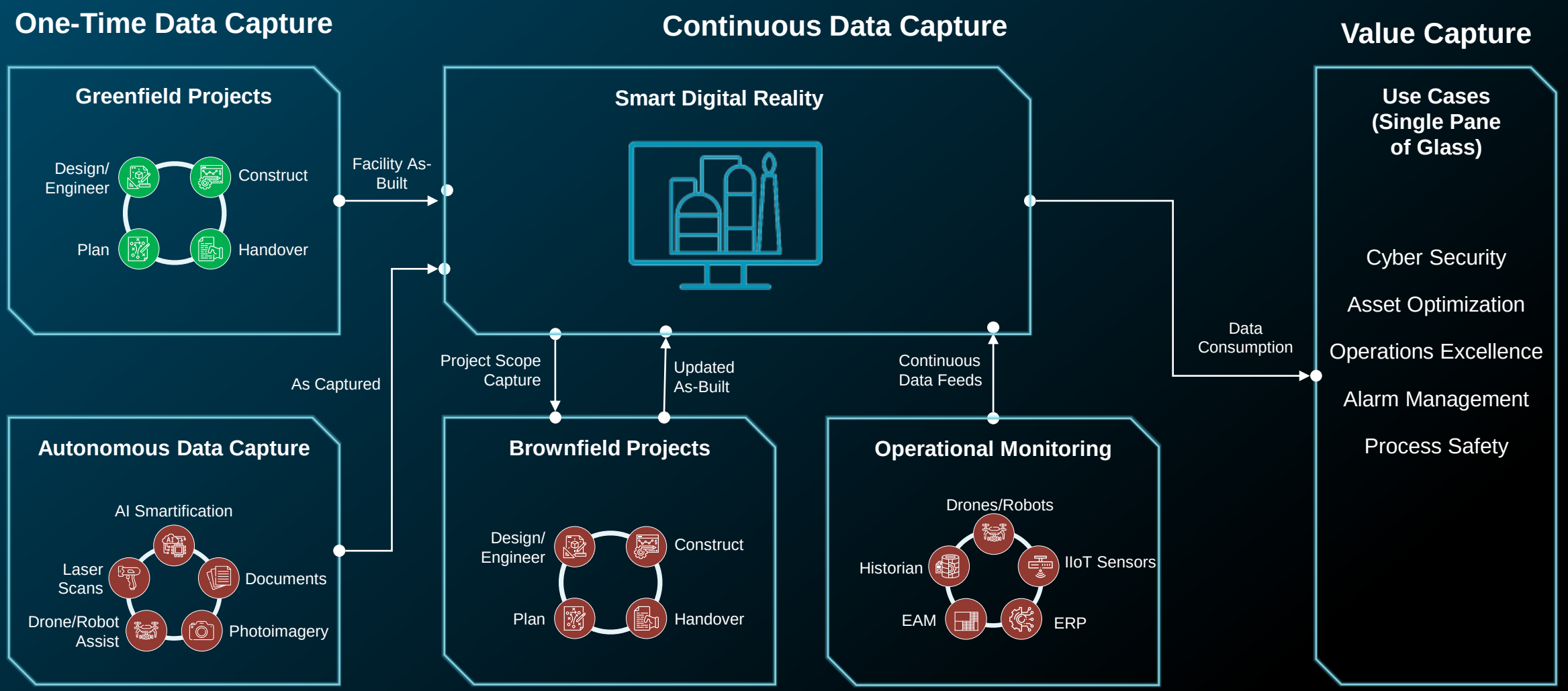
Secure

Secure operational technology (OT) systems for **critical infrastructure** by identifying and tracking a complete inventory of all OT and IT endpoints

- **Prevention**
- **Remediation**

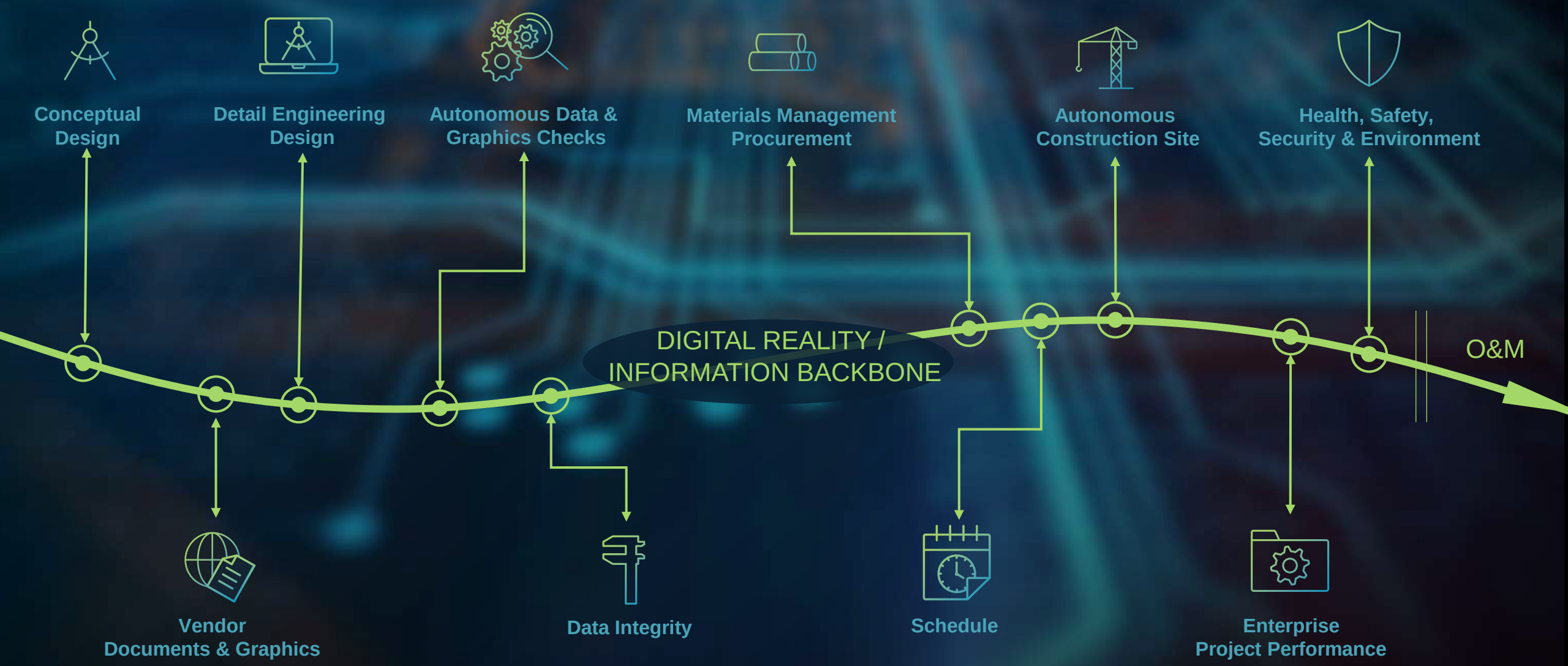


Smart digital reality for industrial facilities

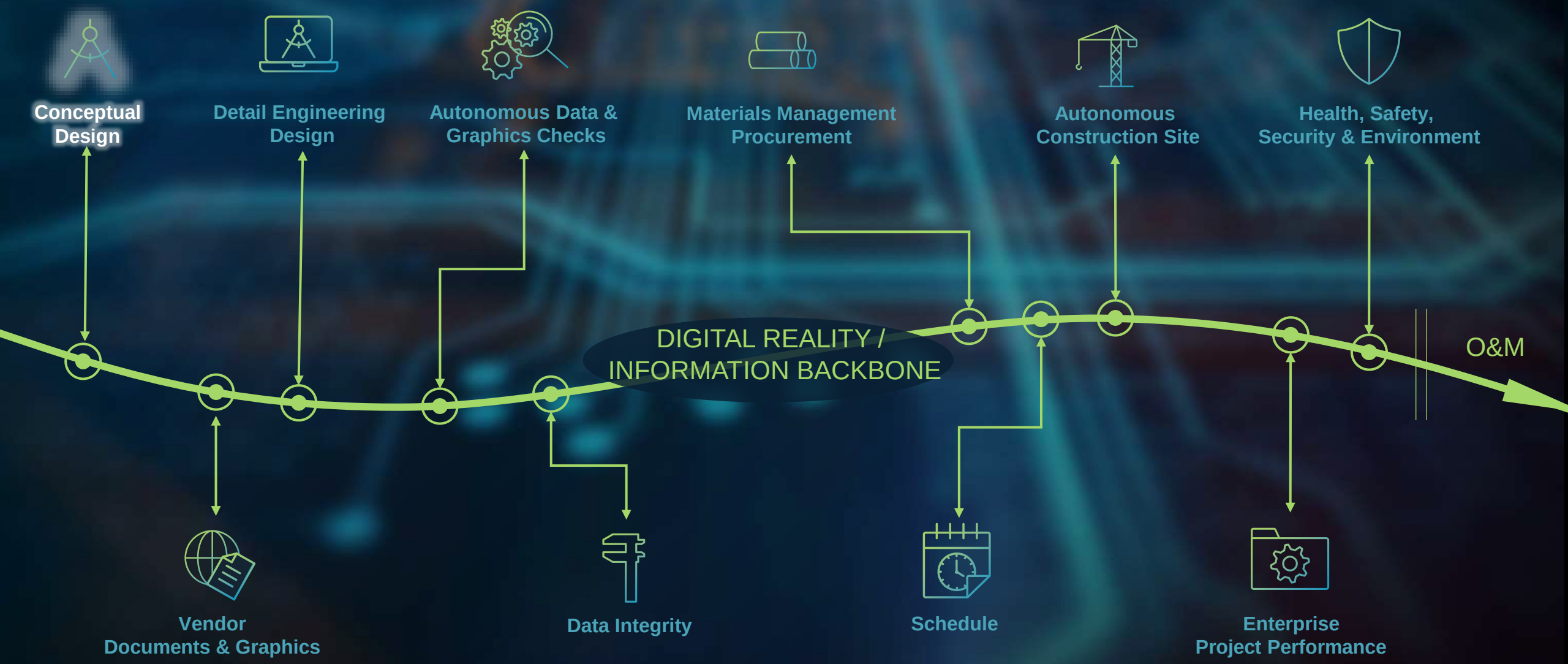


What is our approach?

Creating the digital twin – integrated project ecosystem



Creating the digital twin – integrated project ecosystem

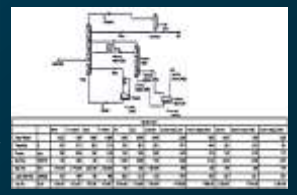


Conceptual Design | Basic Engineering | Detailed Design | Build

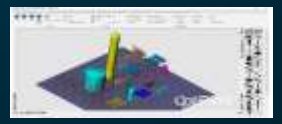
aspentech

Simulation & Concurrent Conceptual Engineering

- Equipment Design
- Safety Analysis
- Economics
- Energy Analysis
- Environmental



Basic Engineering



Conceptual Layout

Cost Estimation

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Integrated Detailed Engineering Design & Construction

- Data Centric engineering workflows
- Multi disciplinary collaboration
- Data reuse

- Digital Twin Handoff
- Efficient Project Execution and Controls

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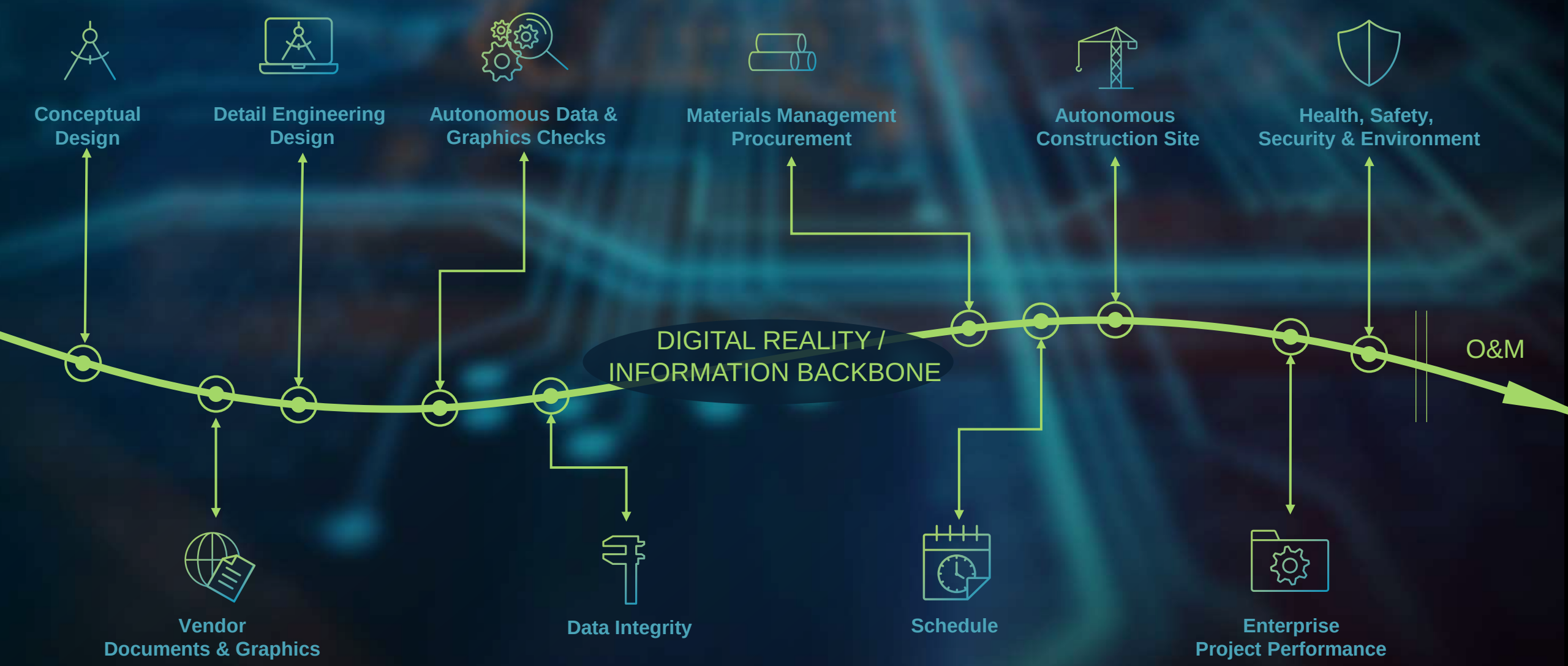
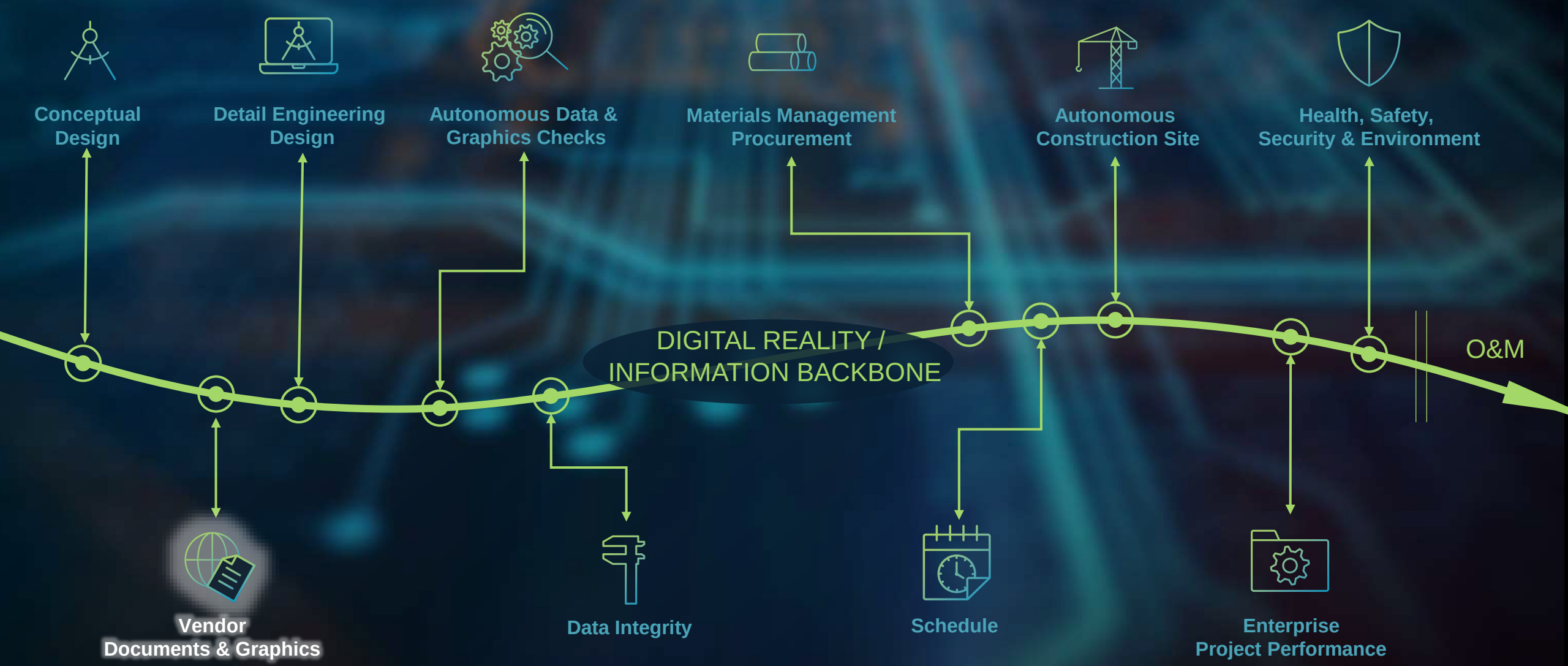
Creating the digital twin – integrated project ecosystem



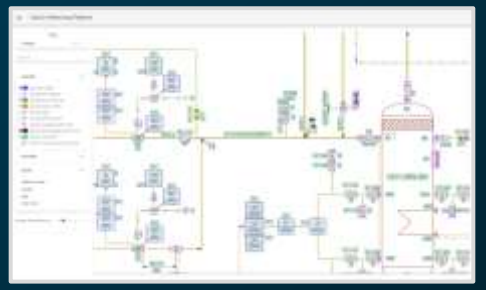
Creating the digital twin – integrated project ecosystem



Artificial intelligence for all foreign project data

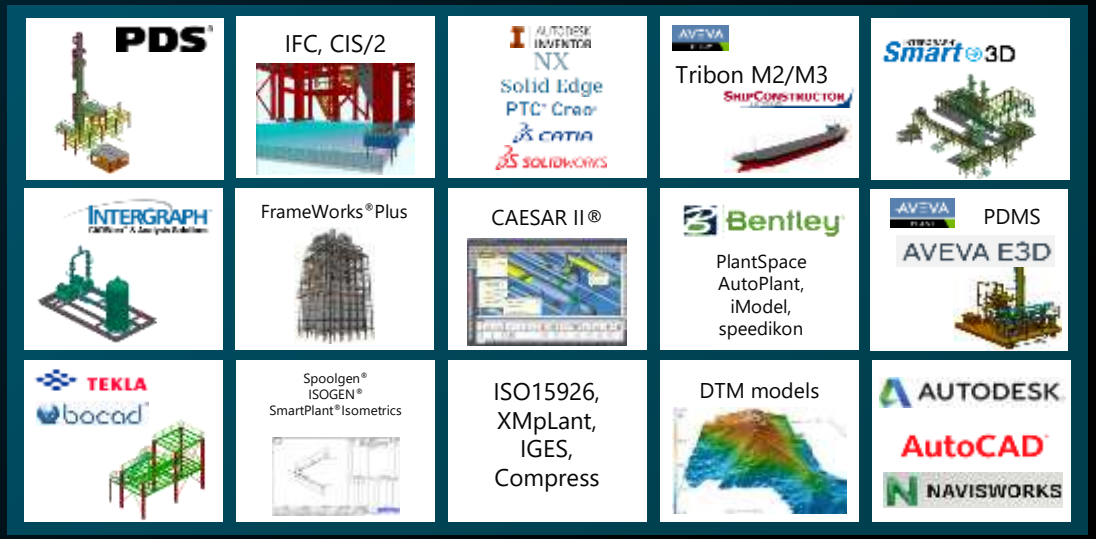
AUTOTAGGING

Vendor Drawing Smartification



Vendor Document Smartification

Skid Supplier Smartification
Pipe Fabrication Smartification
Steel Detailer Smartification



Programmatically Connecting Into Twin

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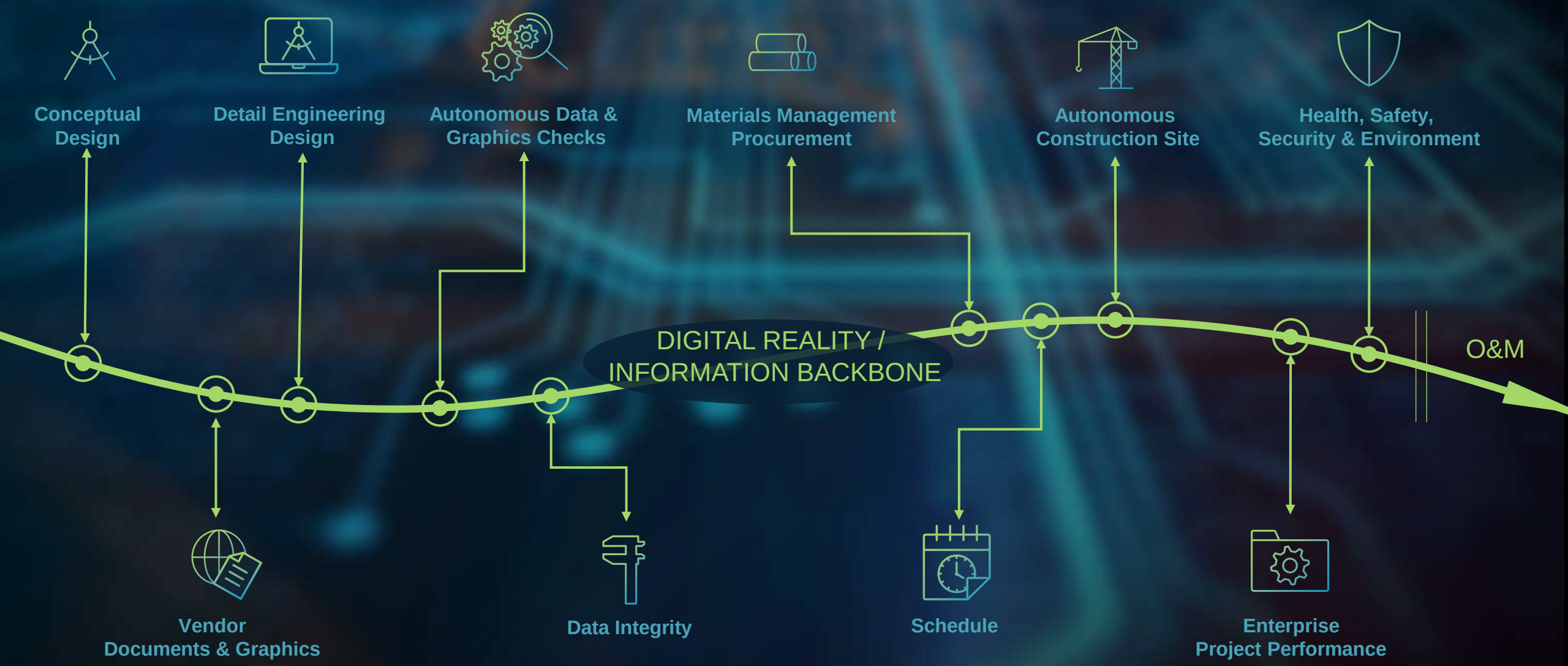
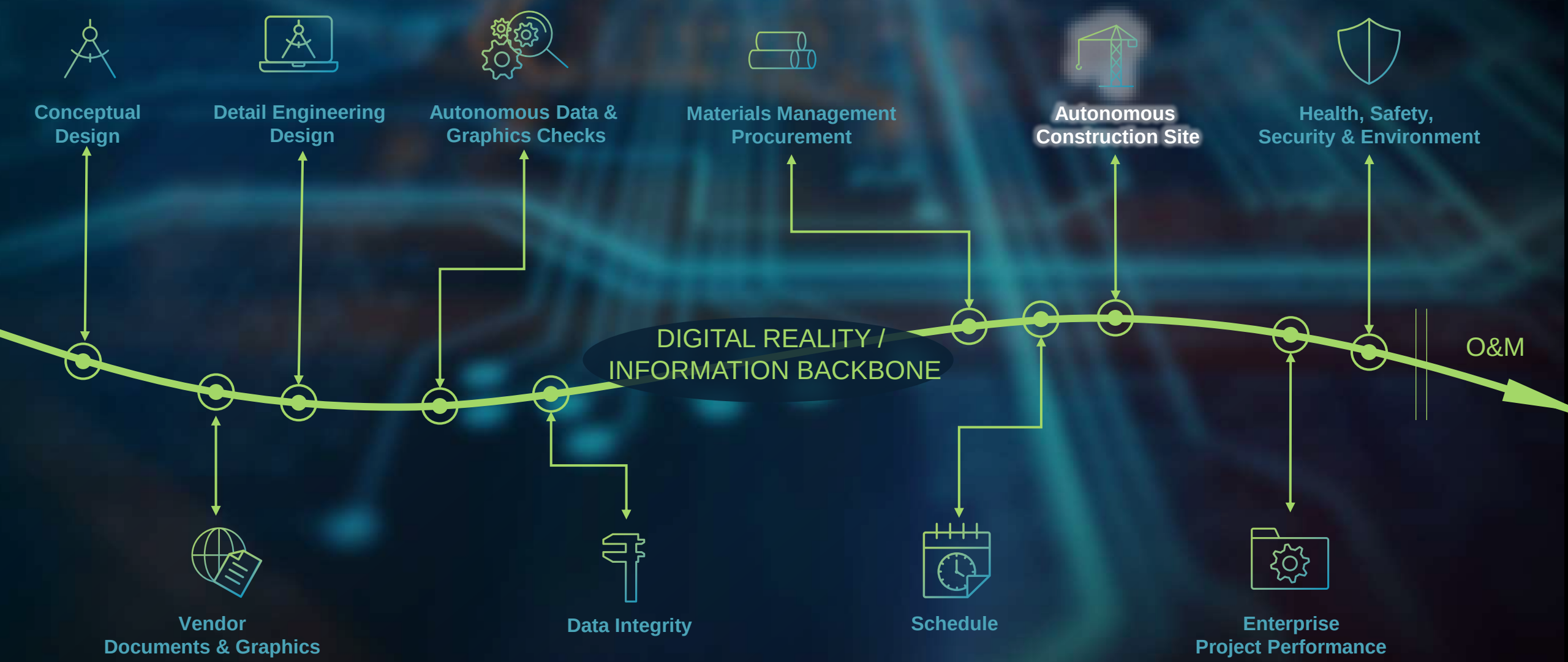
AUTOTAGGING PROCEDURE
IN PROGRESS
DZ - 040
194 63
NFG
CLAMP

Creating the digital twin – integrated project ecosystem



Creating the digital twin – integrated project ecosystem



Scanners

- Leica BLK2FLY Autonomous Scanner, Drone Mounted
- Leica BLK ARC Autonomous Scanner, “Spot” Mounted
- Complete Construction Site Coverage

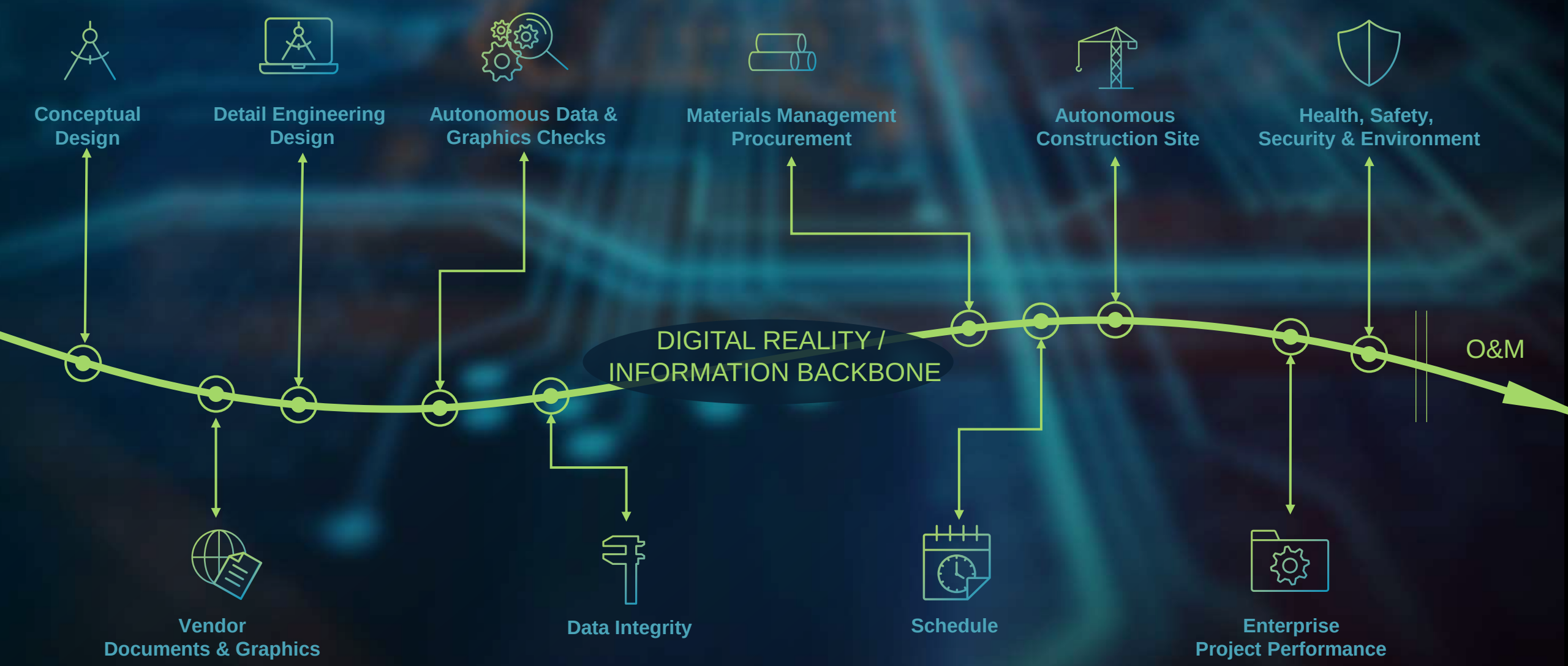
Reality Capture

- Nightly Autonomous Scans of Daily Work Areas
- Scans Automatically Processed by Artificial Intelligence Engine
- Progress and Deviations from Original Design Reported
- Analytics Engine Calculates Construction Team Velocities

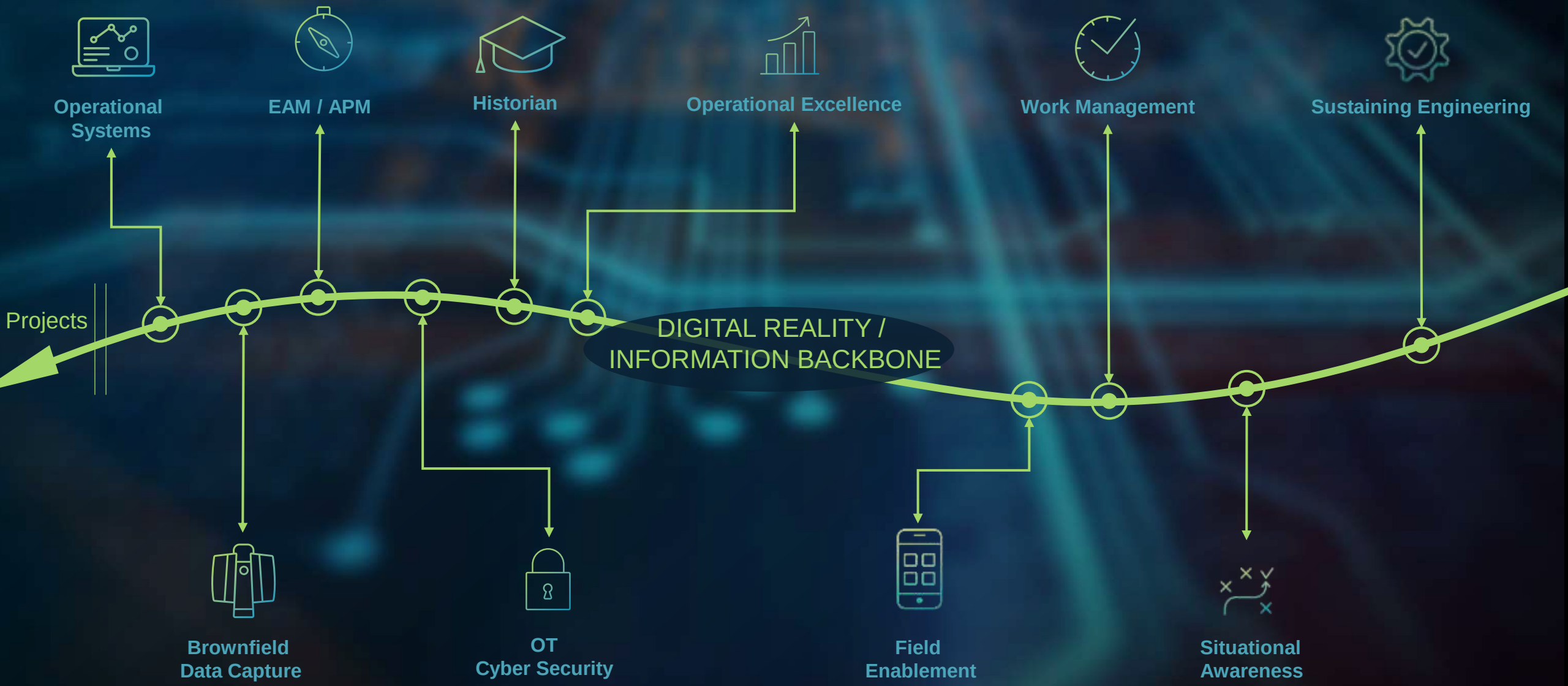
Construction Software/Project Performance

- Export a 3D model from Smart Build into Cyclone
- Import a Point Cloud of the building on Cyclone and align the scan with the model
- Publish the scan + model to Truview and view both together within Smart Build
- Enterprise Project Performance with Ecosys

Creating the digital twin – integrated project ecosystem



Leveraging the operational twin – operations & maintenance



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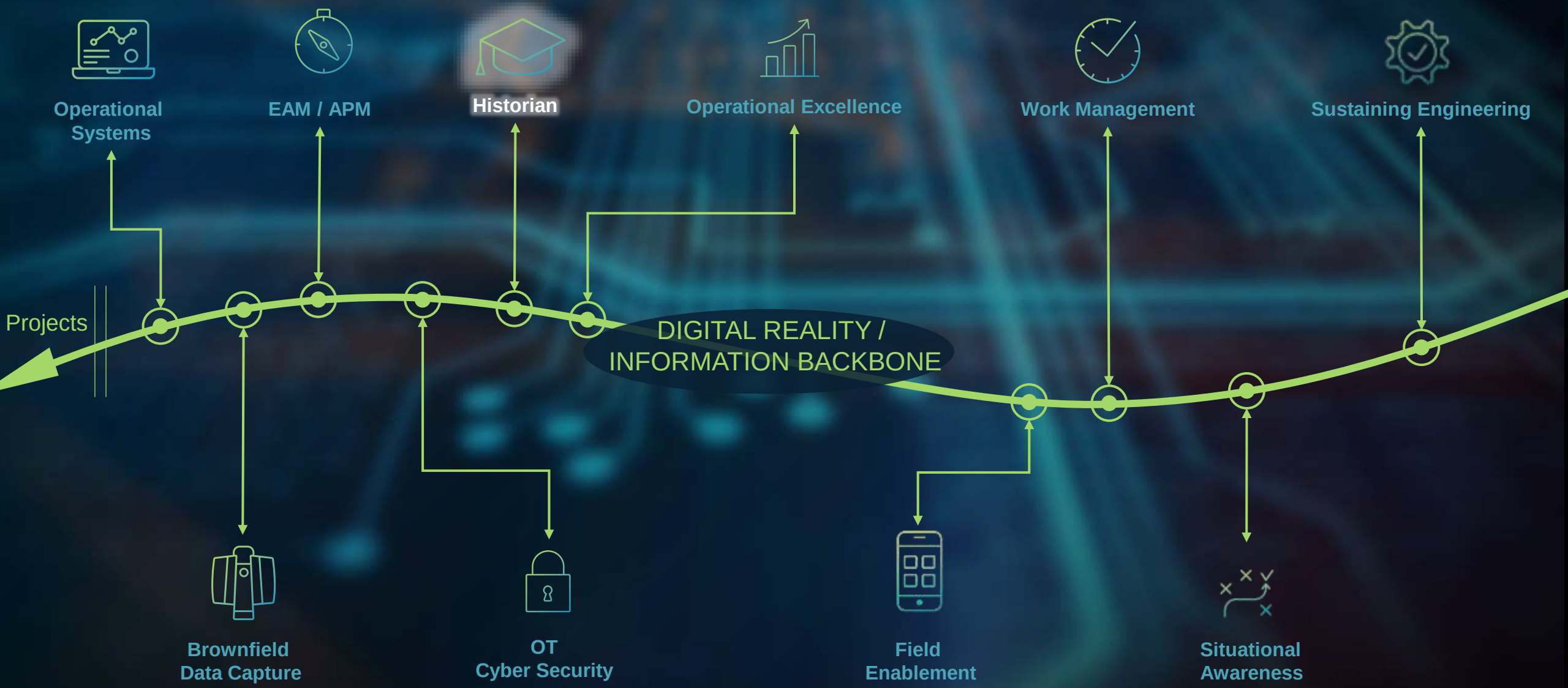
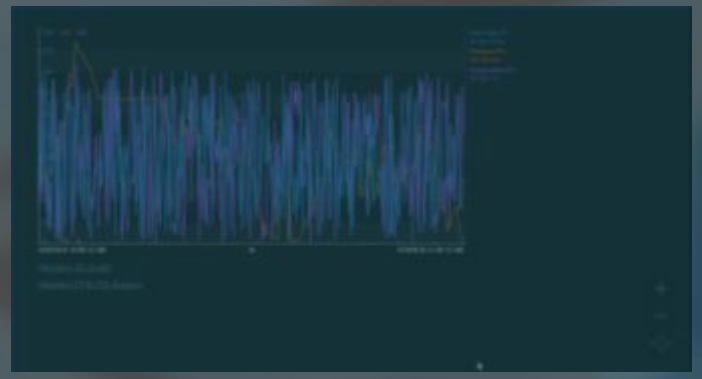


3RD PARTY
DATA SOURCES

OSIsoft.



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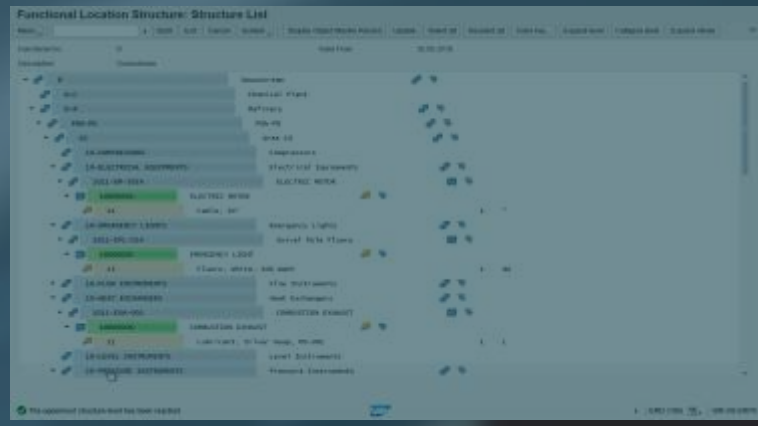
SAP



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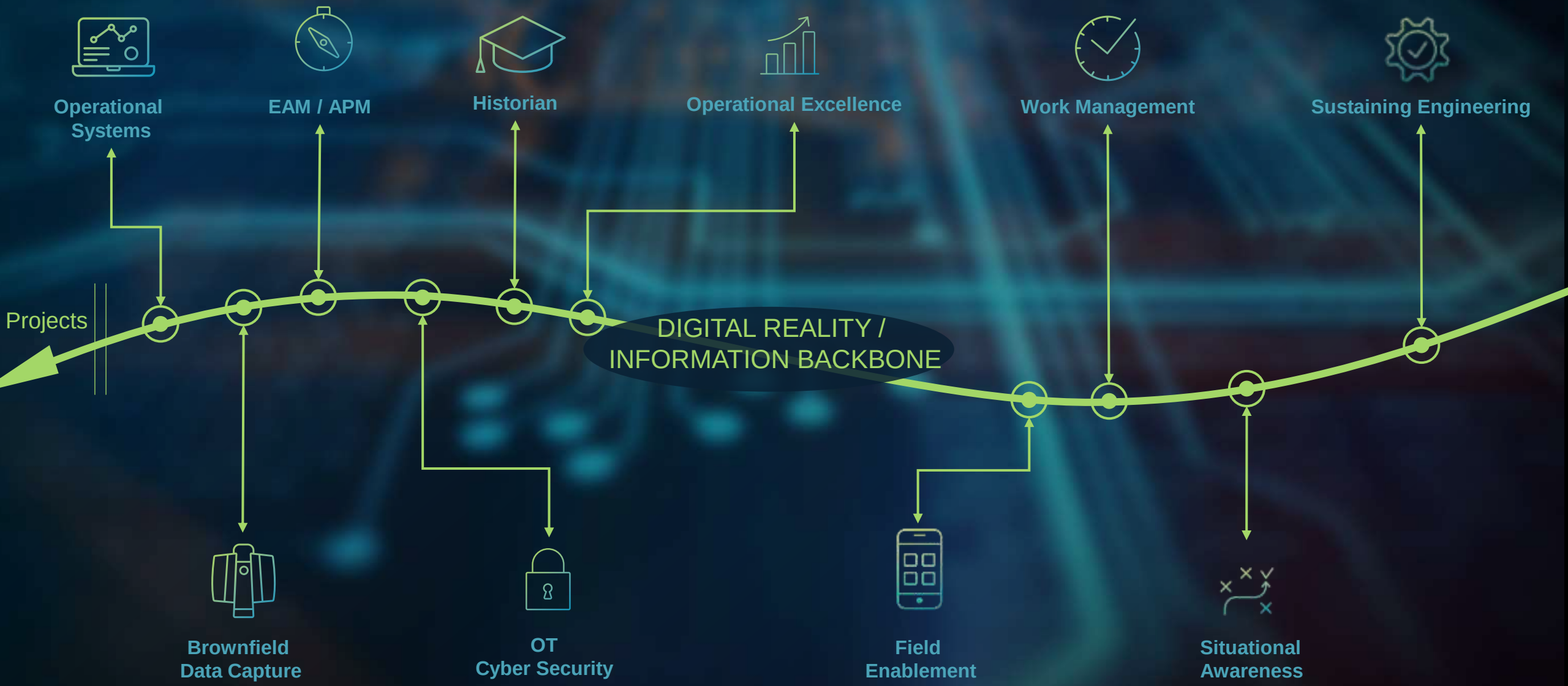

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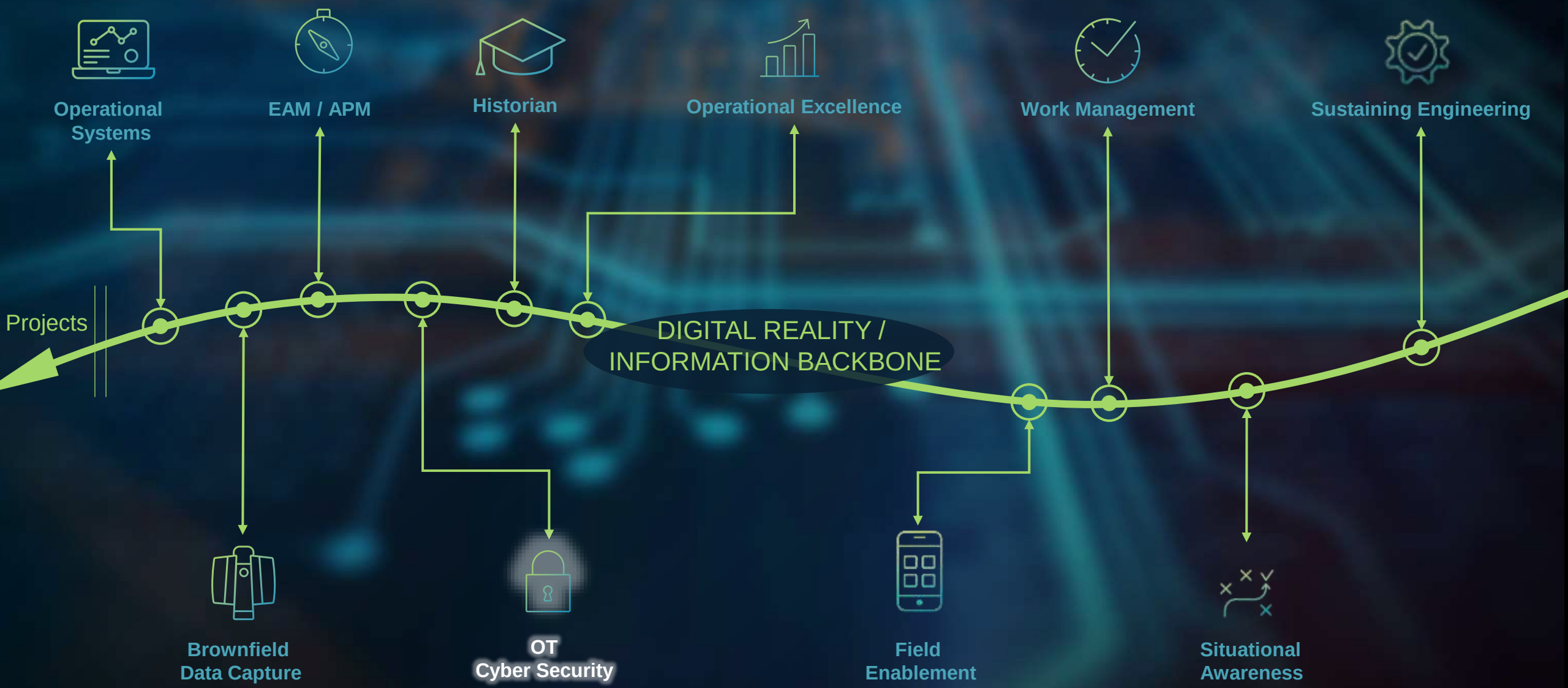

Hexagon’s OT cyber security offering

Inventory Management

Maintain and manage a complete inventory of OT and IT configuration data.

Vulnerability Management

Obtain immediate, comprehensive visibility into ICS vulnerability risk.

Configuration Management

Monitor, detect, and remediate unauthorized configuration changes.

Risk Analytics

Continuously identify and visualize IT and OT endpoint cyber risks.

Compliance Management

Audit and report on internal and regulatory compliance requirements.

Backup & Recovery

Quickly restore control system operation in a worst case scenario.

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THE NEWS TODAY

BRIEF

OT cyberattacks could threaten human safety by 2025: Gartner

Published July 26, 2021

Saudi Aramco confirmed that some company files were leaked after hackers reportedly demanded a $50 million ransom from the world's most-valuable oil producer.

SOLARWINDS: HOW RUSSIAN SPIES HACKED THE JUSTICE, STATE, TREASURY, ENERGY AND COMMERCE DEPARTMENTS

Bill Whitaker reports on how Russian spies used a popular piece of software to unleash a virus that spread to 18,000 government and private computer networks.

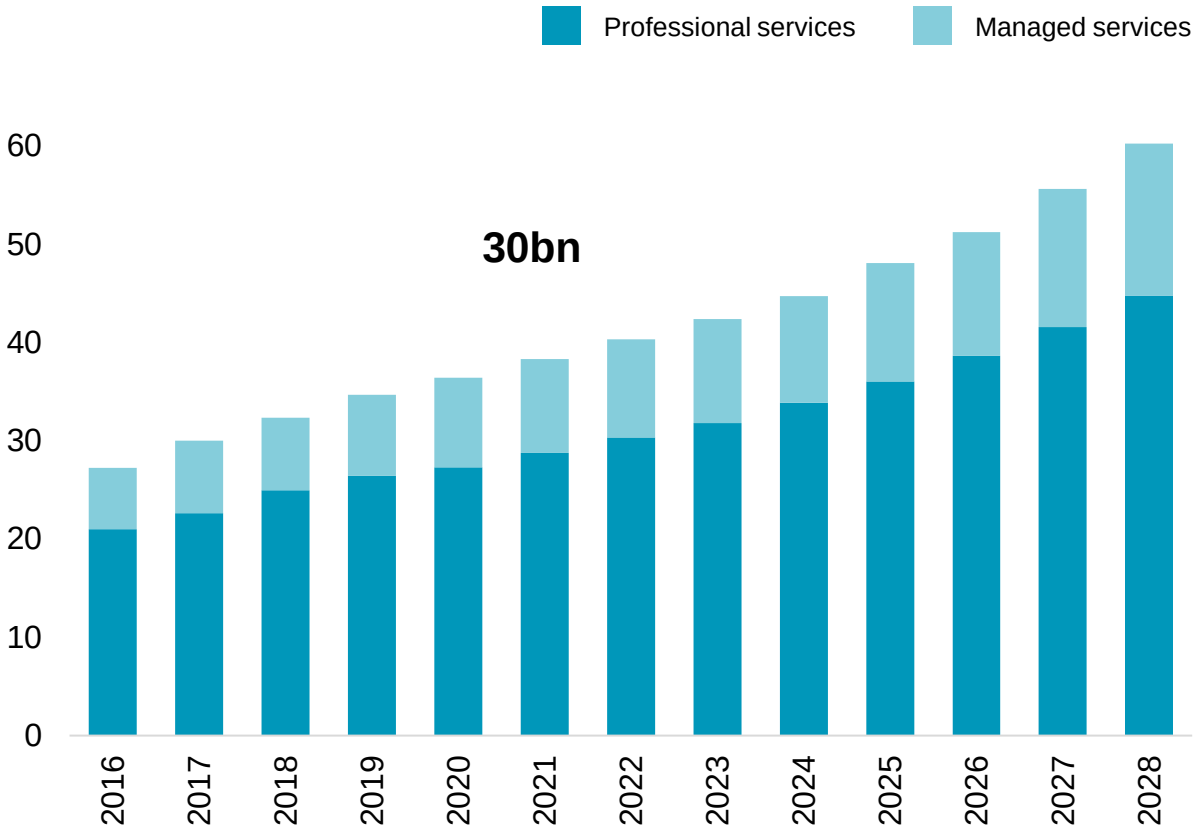
Colonial hack: How did cyber-attackers shut off pipeline?

Jul 22, 2021, 09:17pm EDT | 536 views

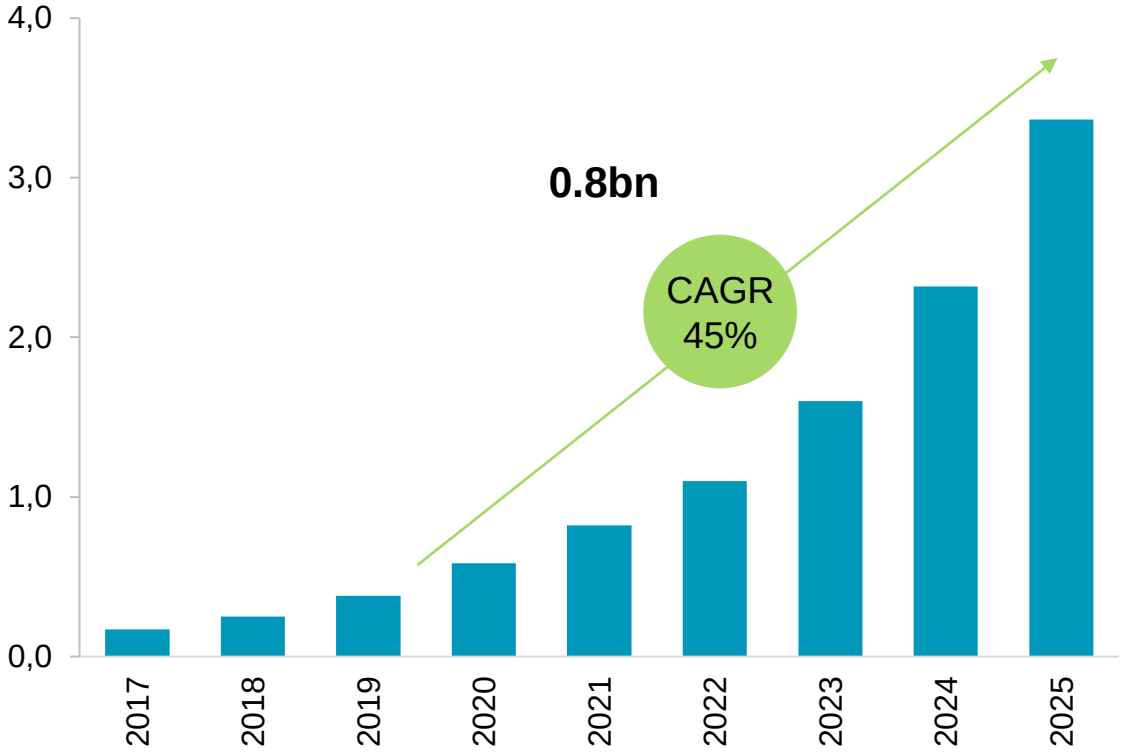
Government Calls On Pipeline Companies To Step Up Defenses Against Cyber Attacks

IT Cyber Market vs. OT Cyber Market Size

U.S. IT cyber security market size, by service, 2016 – 2028 (USD Billions)

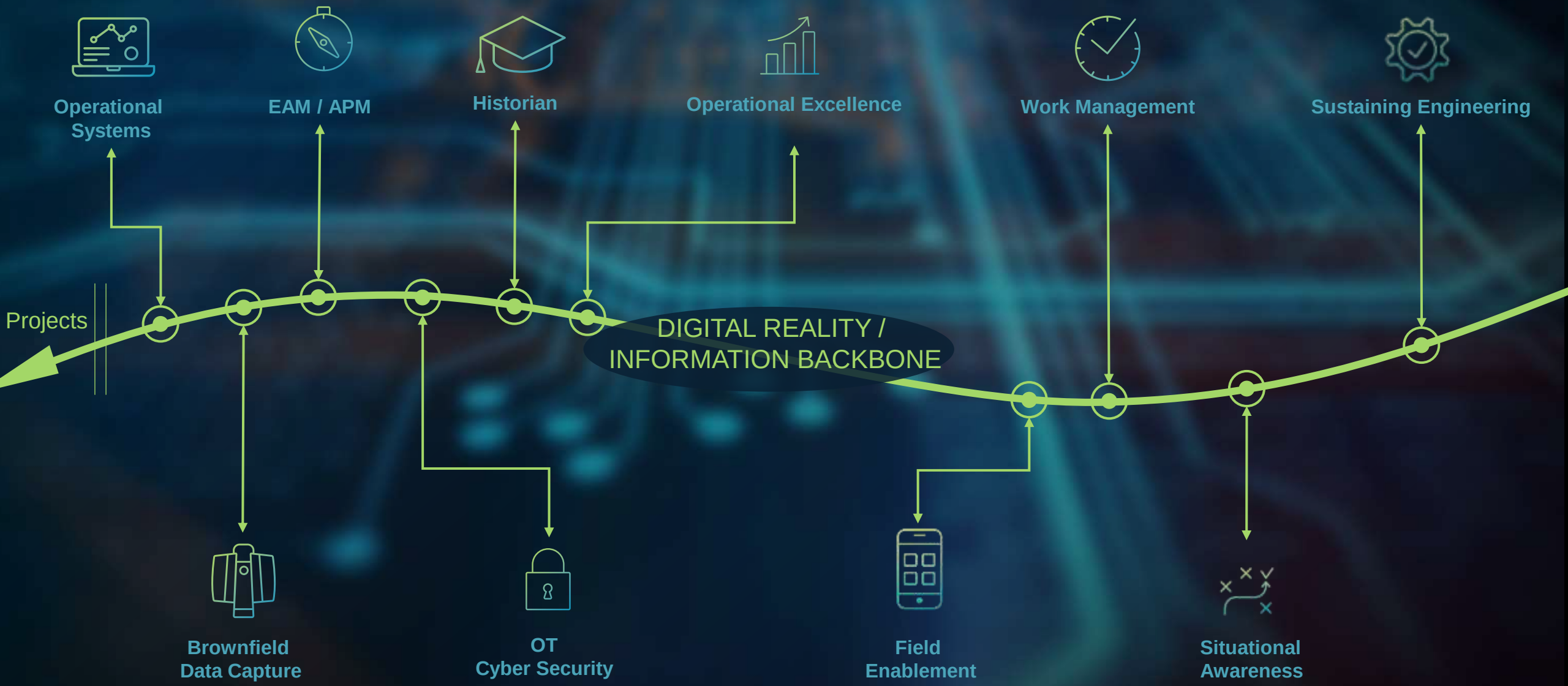


Global OT security market USD Billion (2017-2025)



Source: www.grandviewresearch.com

Leveraging the operational twin – operations & maintenance



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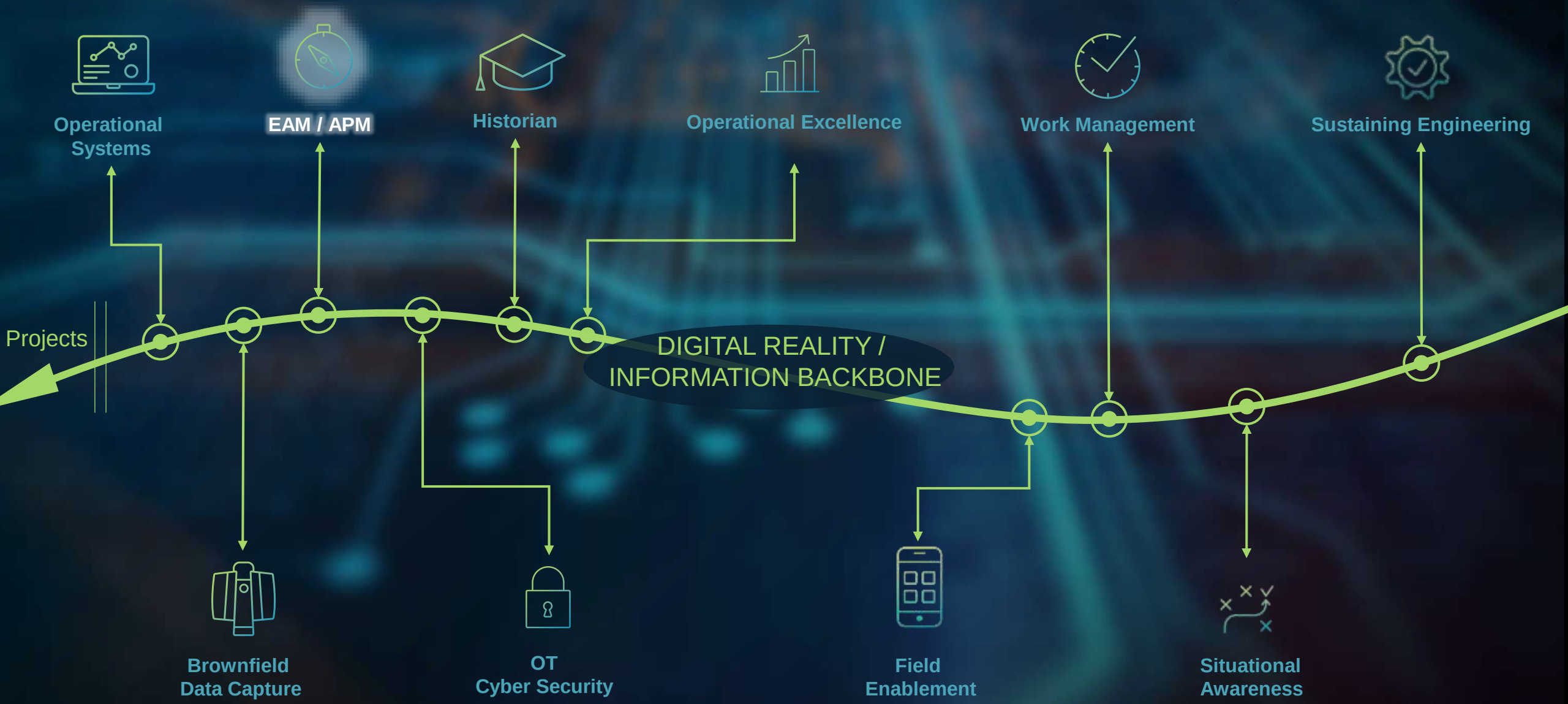
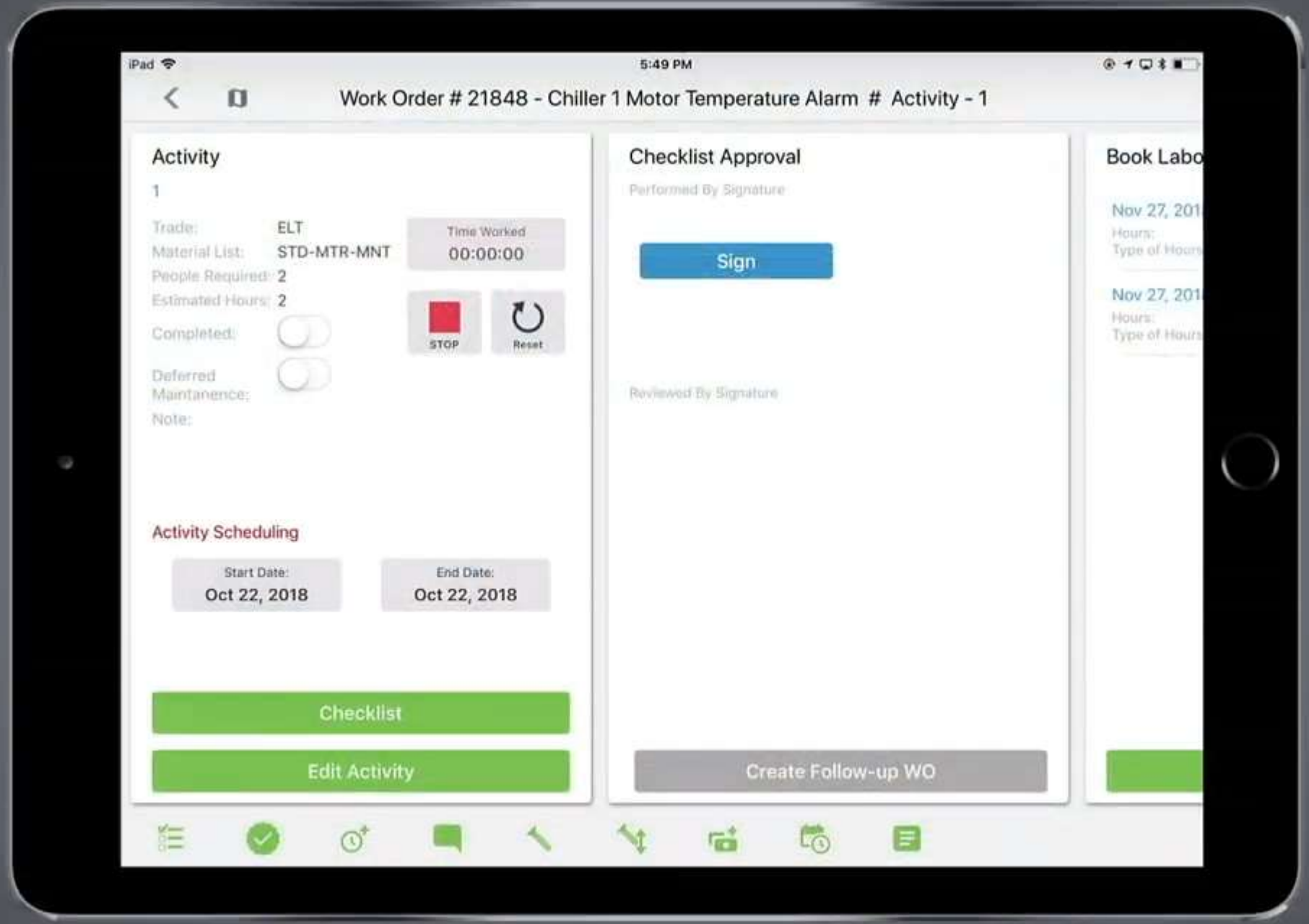


EAM Solution Overview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Work Order # 21848 - Chiller 1 Motor Temperature Alarm # Activity - 1
Activity
1
Trade: ELT
Material List: STD-MTR-MNT
People Required: 2
Estimated Hours: 2
Completed:
Deferred Maintanence:
Note:
Time Worked
00:00:00
STOP
Reset
Activity Scheduling
Start Date:
Oct 22, 2018
End Date:
Oct 22, 2018
Checklist
Edit Activity
Checklist Approval
Performed By Signature
Sign
Reviewed By Signature
Create Follow-up WO
Book Labo
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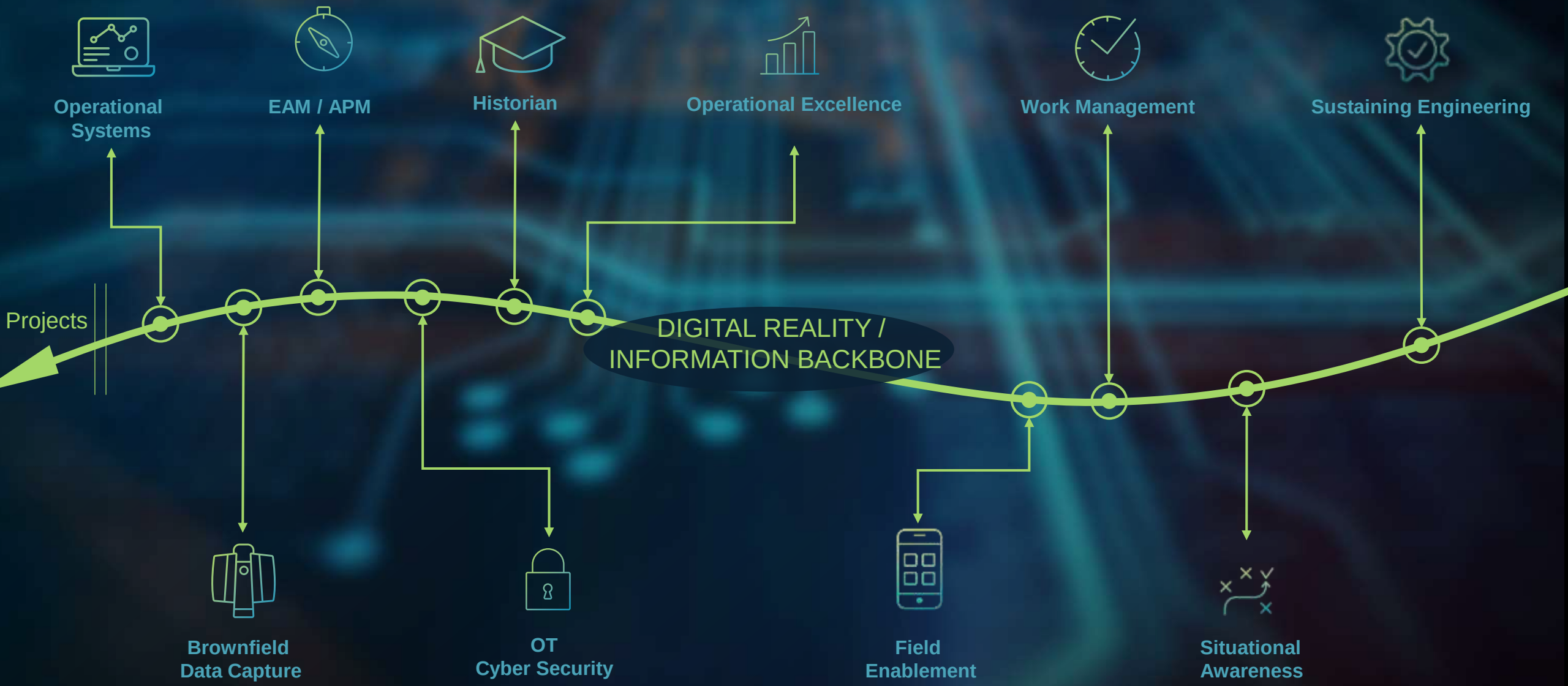
Leveraging the operational twin – operations & maintenance



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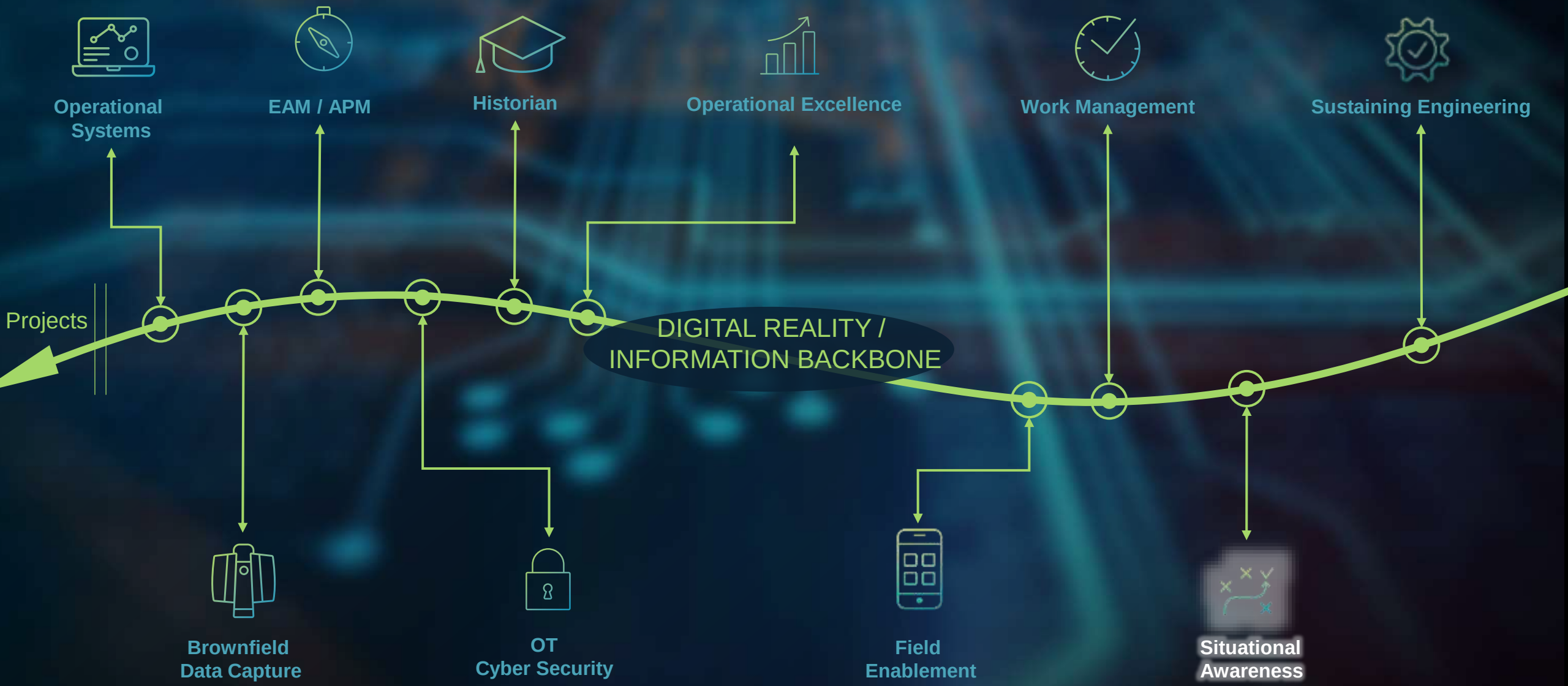
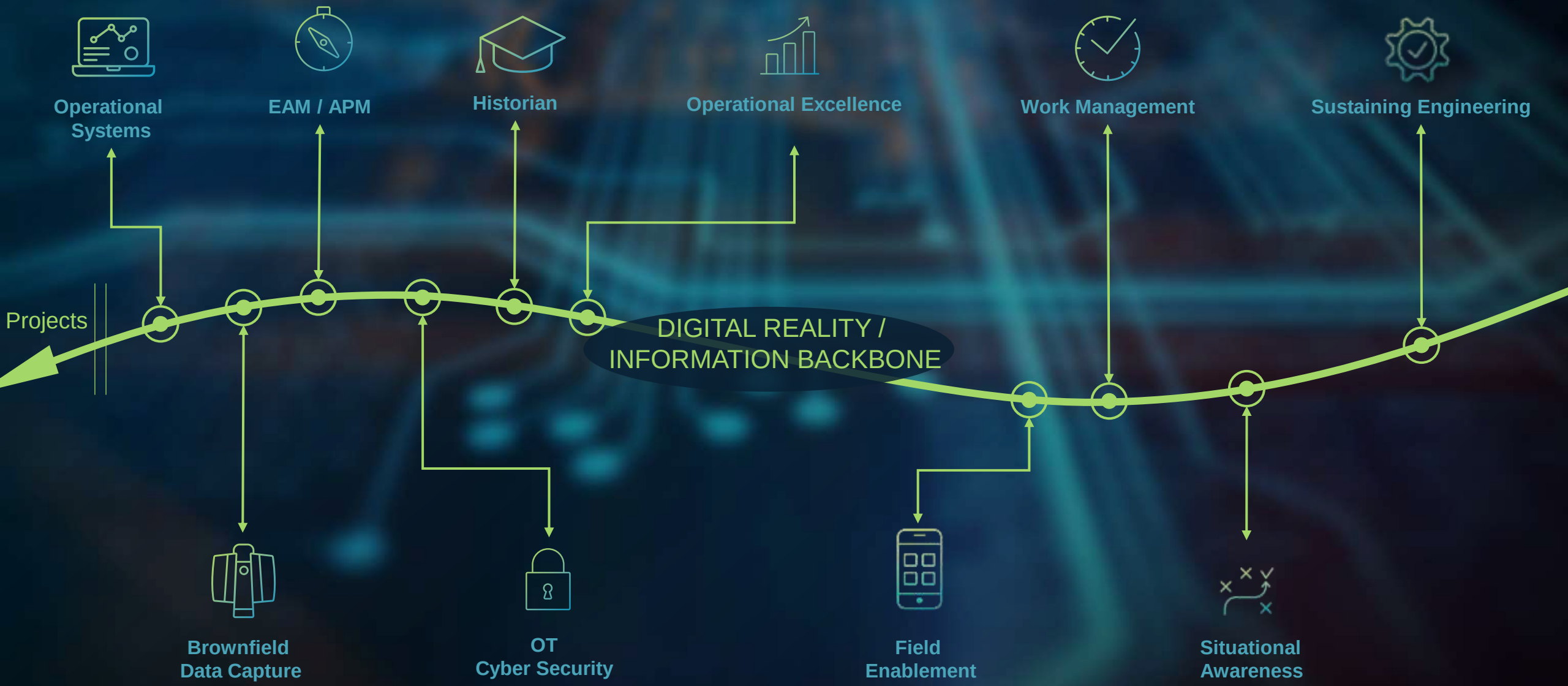



LAYERS
Tracking
Zones
Assets
Plant 2
Plant 1
Tags
Laser Scans
Bing
MEASUREMENT
EFFECTS
Selected Tag:

Leveraging the operational twin – operations & maintenance



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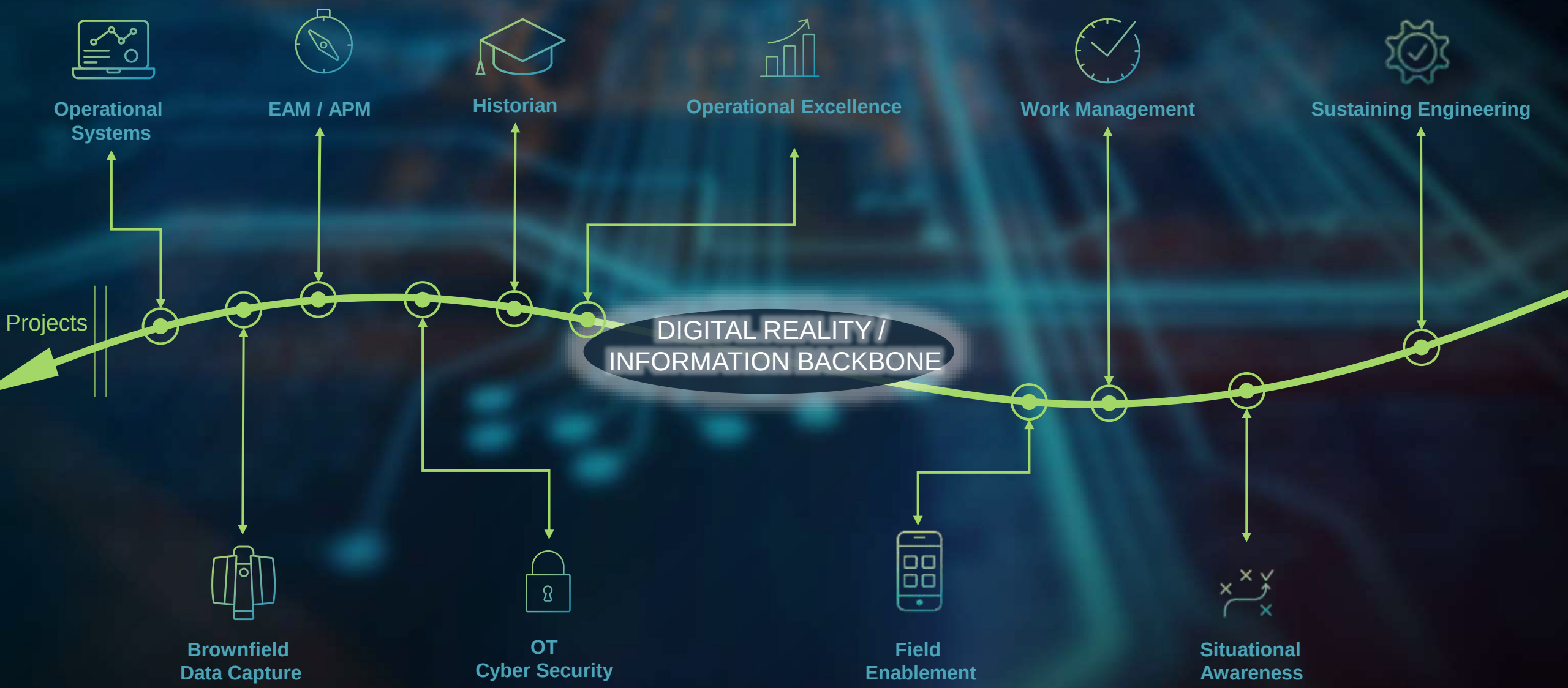

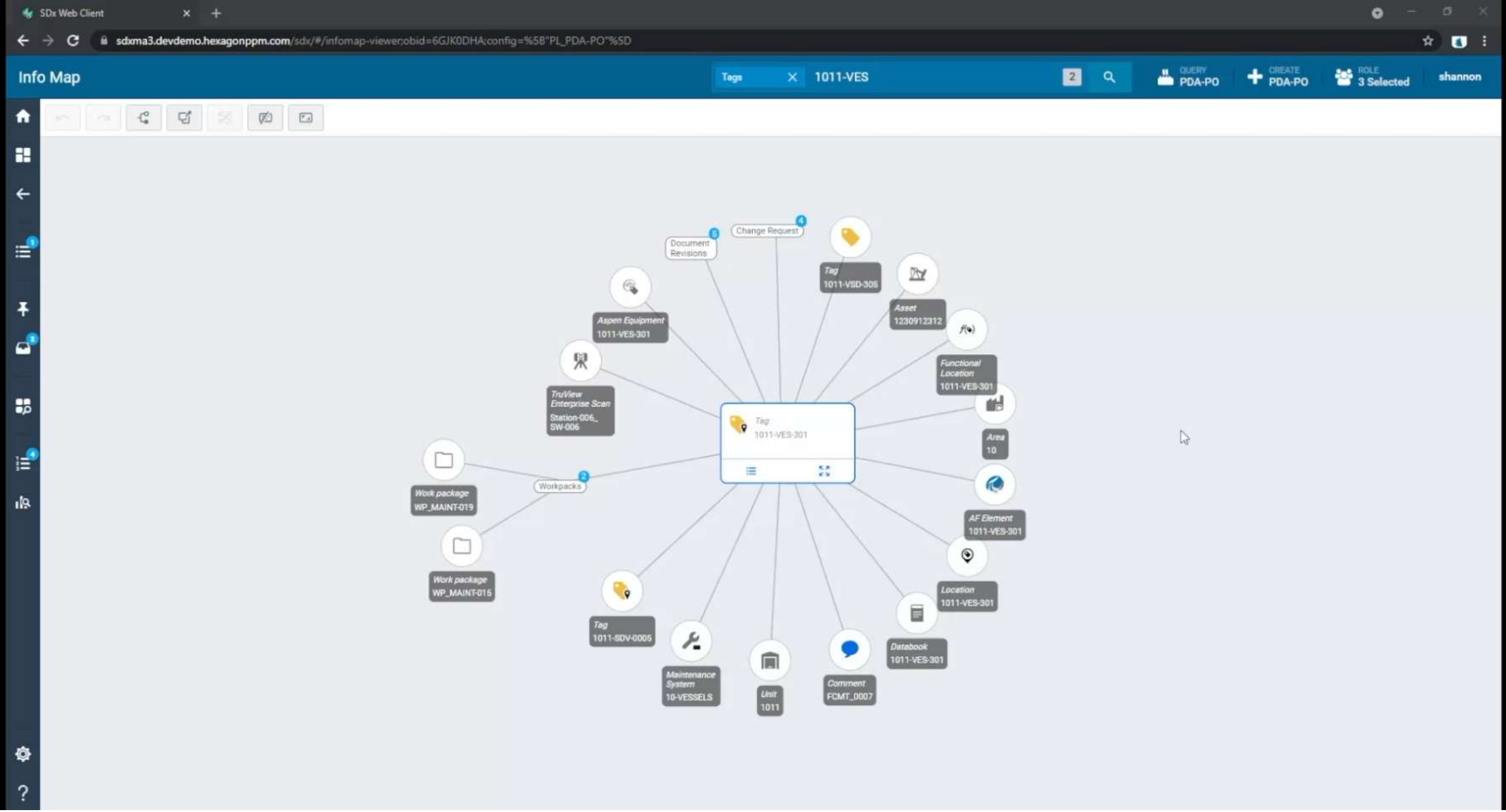
SDx Web Client
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Info Map
Tags
1011-VES
2
QUERY
PDA-PO
CREATE
PDA-PO
ROLE
3 Selected
shannon
Document Revisions
5
Change Request
4
Tag
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Asset
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Aspen Equipment
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Functional Location
1011-VES-301
TruView Enterprise Scan
Station-006_SW-006
Tag
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Area
10
Work package
WP_MAINT-019
Workpacks
2
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Work package
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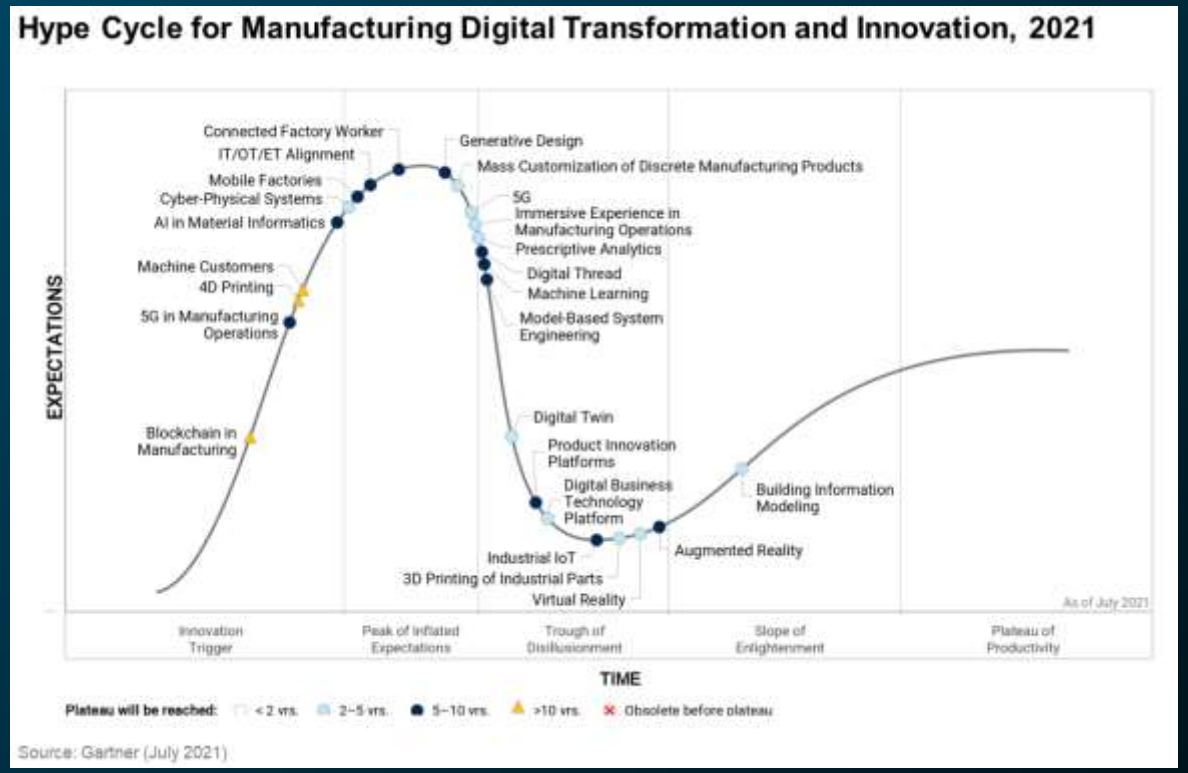
Databook
1011-VES-301
Maintenance System
10-VESSELS
Unit
1011
Comment
FCMT_0007

Is industry adopting this technology?

Gartner Hype Cycle Manufacturing DT



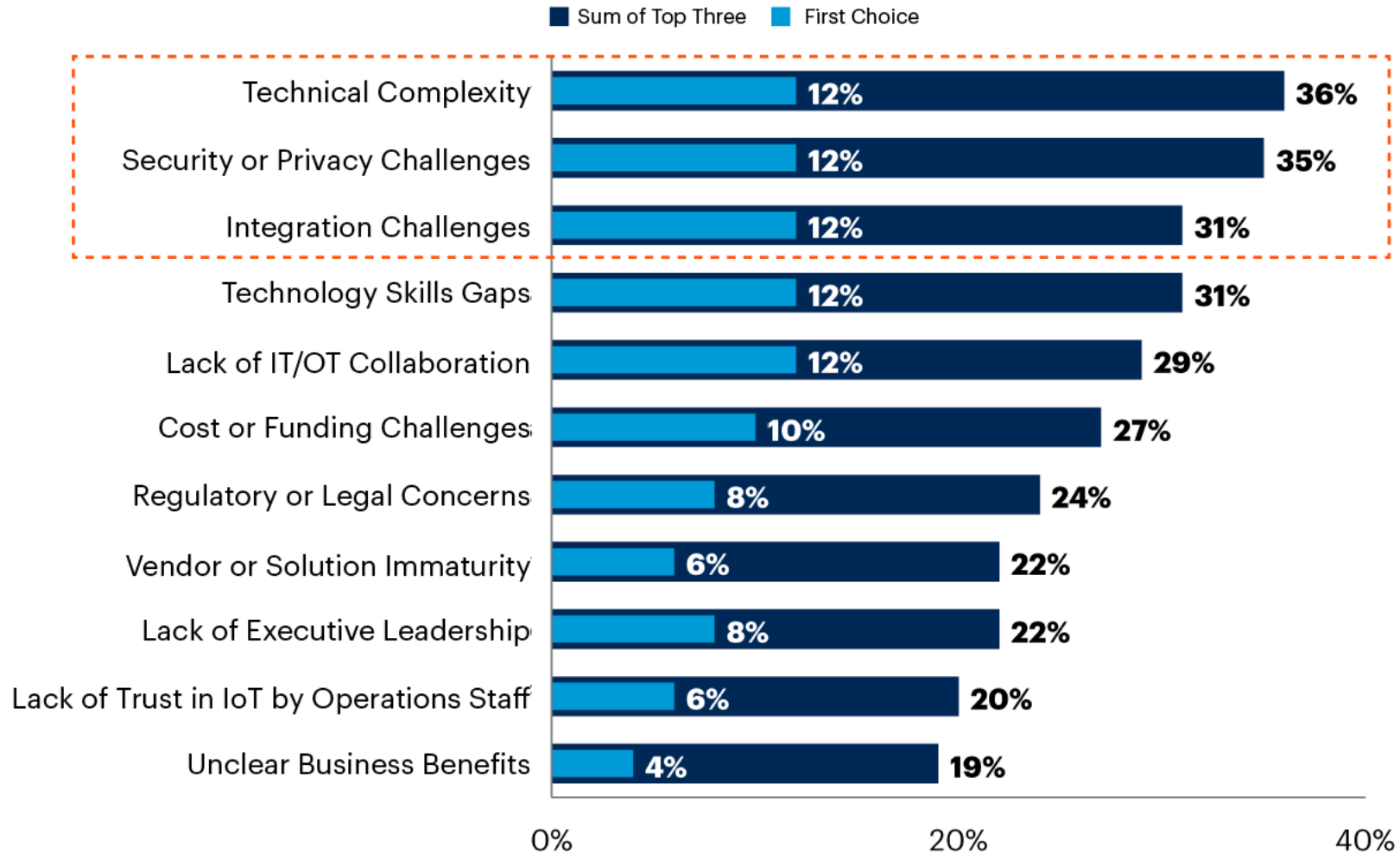
Source: Gartner (July 2021)

Just **4%** of companies implementing Internet of Things (IoT) projects have already implemented digital twins and another **83%** are currently in Process of or planning to within the next 3 years according to a recent **Gartner** survey.

Prior to implementing a Digital Twin, companies first must get their complex IT landscape organized through a variety of IoT projects.

Customers are working diligently on **laying the foundation** that the Digital Twins of the future will be built on.

Top Three Barriers to Success



n = 400; all respondents; excludes “don’t know”

Q: What are the top three barriers to the success of scaling up IoT activities throughout your business unit or organization?

Source: Gartner (October 2020)

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Technology is typically forced to fit existing processes

Rather than altering existing processes to take full advantage of the offerings of technology

What’s the case for change?

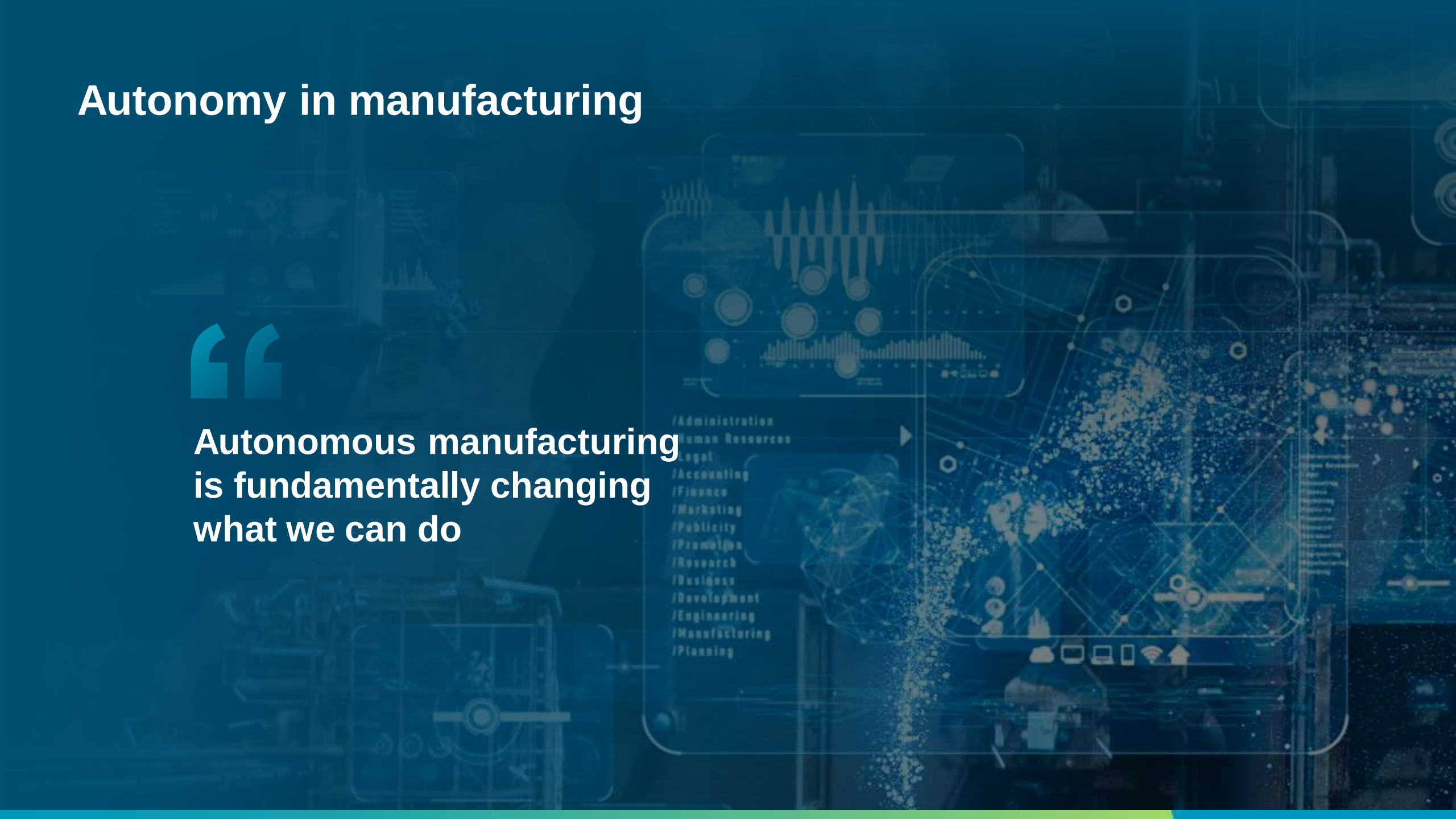
1/3 OF COMPANIES WILL NOT SURVIVE THE NEXT

10 YEARS


WE NEED TWO EARTHS

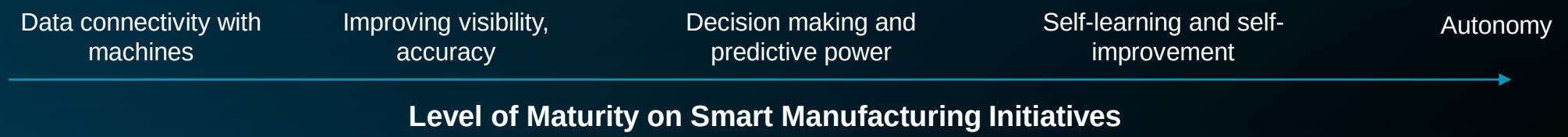
BE TWICE AS GOOD

Autonomy in manufacturing



Autonomous manufacturing is fundamentally changing what we can do

State of manufacturing – the journey towards autonomy



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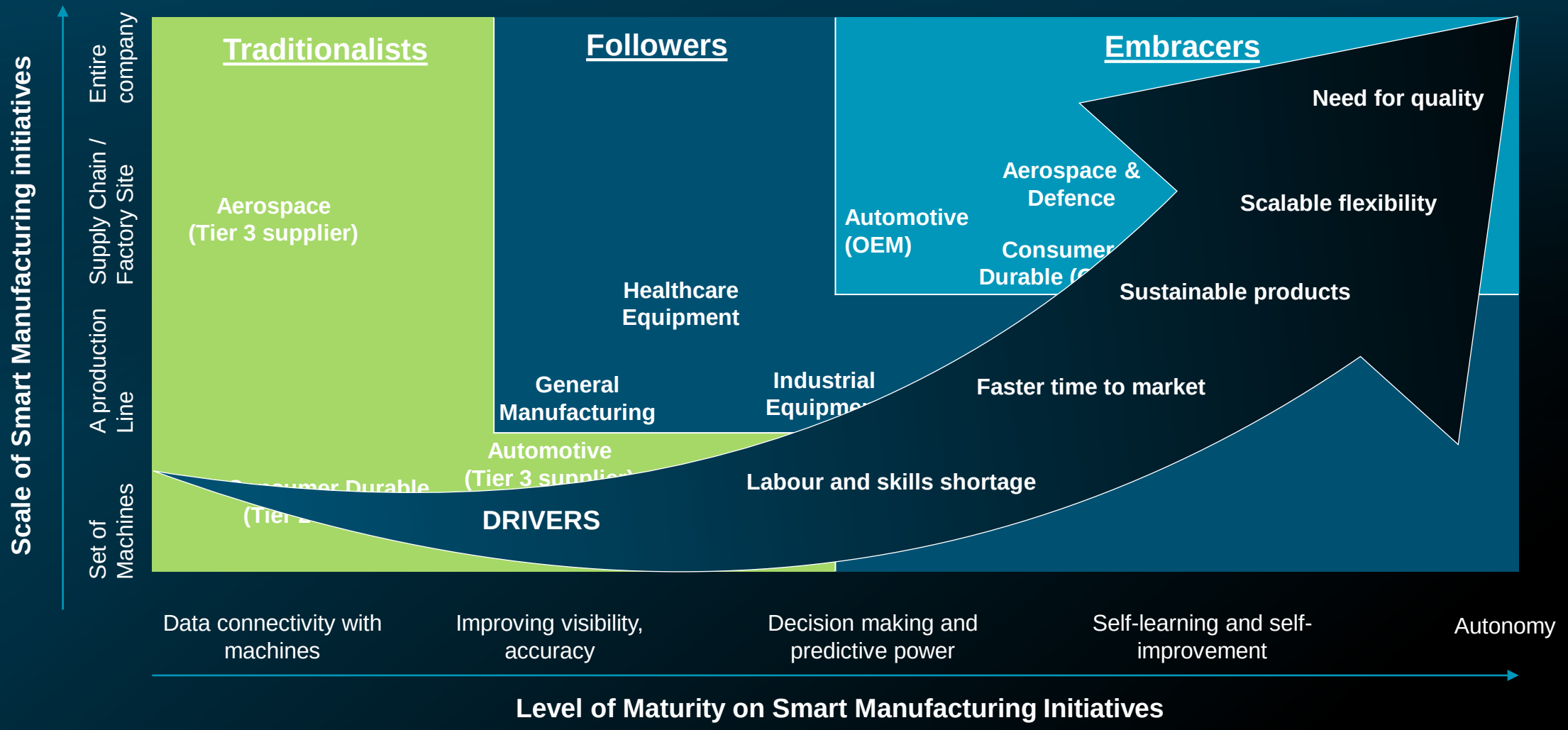
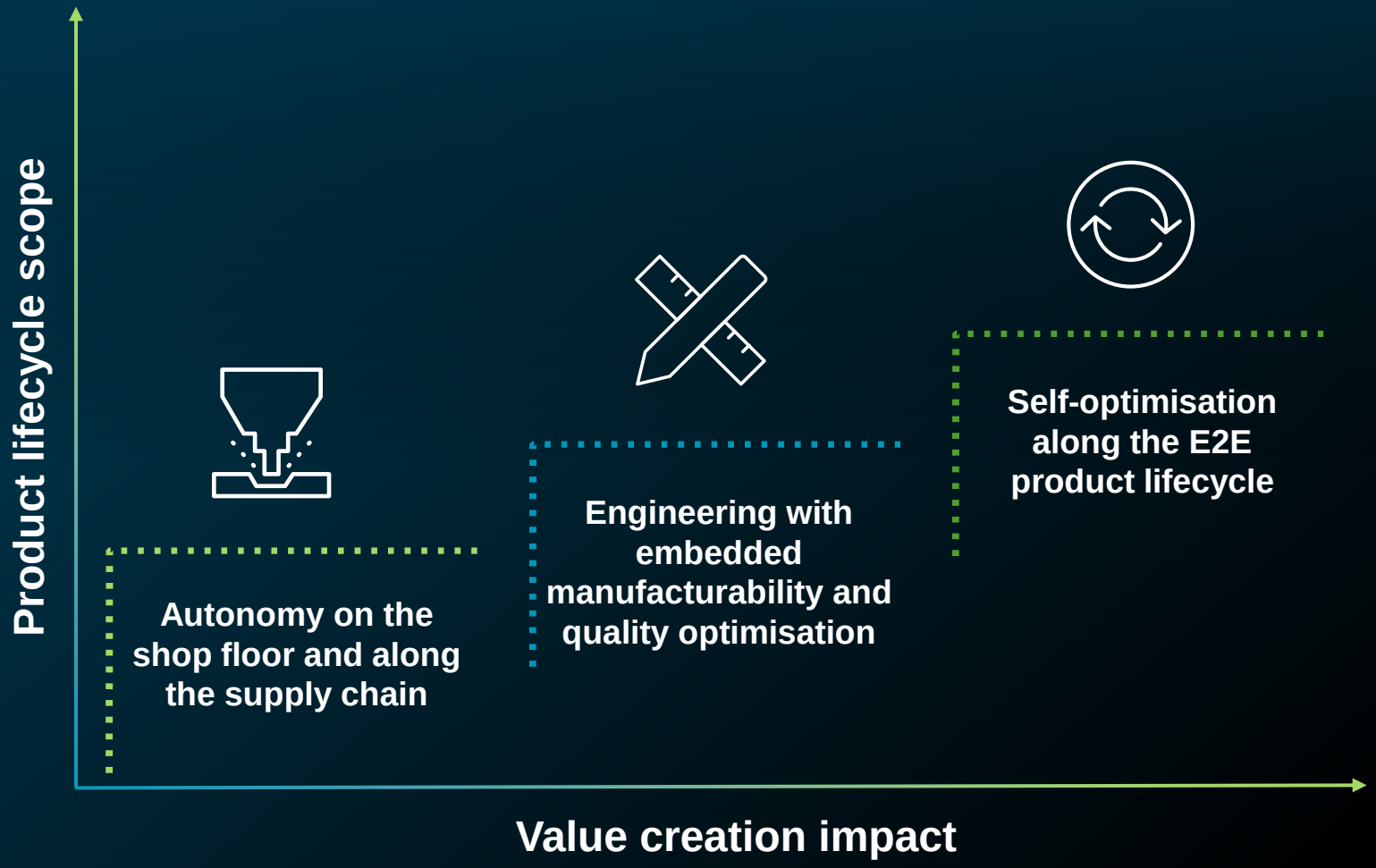


Source: Hexagon analysis

Value creation use cases driven by Smart Digital Realities



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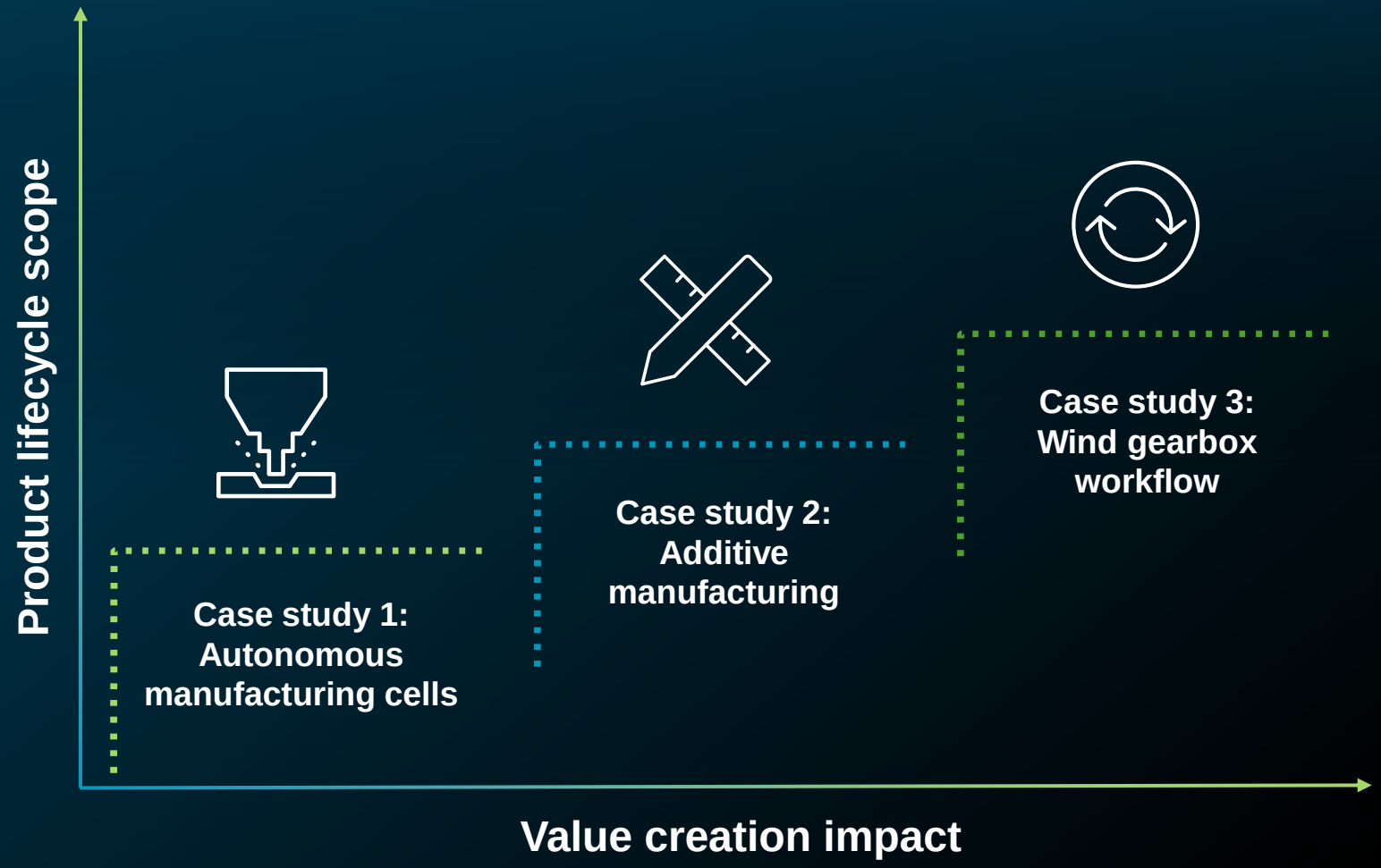


Autonomous shopfloor: the opportunity

100+k factories

Large market of machine shops but 98% of them are smaller than 100 staff with limited investments into systems such as ERP

6% profit margin

Machine shops have limited digitalisation and automation leading to 6-12 week delivery time, 5 days to get a quote, 11% of projects being late and 4% having quality issues

2.4 million jobs missing until 2028

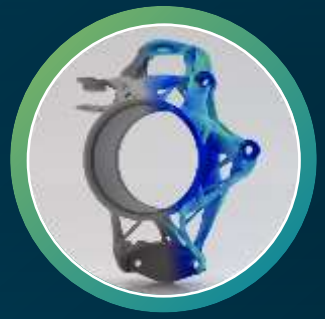
Today 46% of machinists are more than 50 years old and when they retire there will be a significant skill and labour gap

Source: Deloitte skills gap and future of work in manufacturing study

Our footprint

Case study 1: Shop floor autonomy

Machining planning and inspection planning are key steps to optimise for scalable flexibility

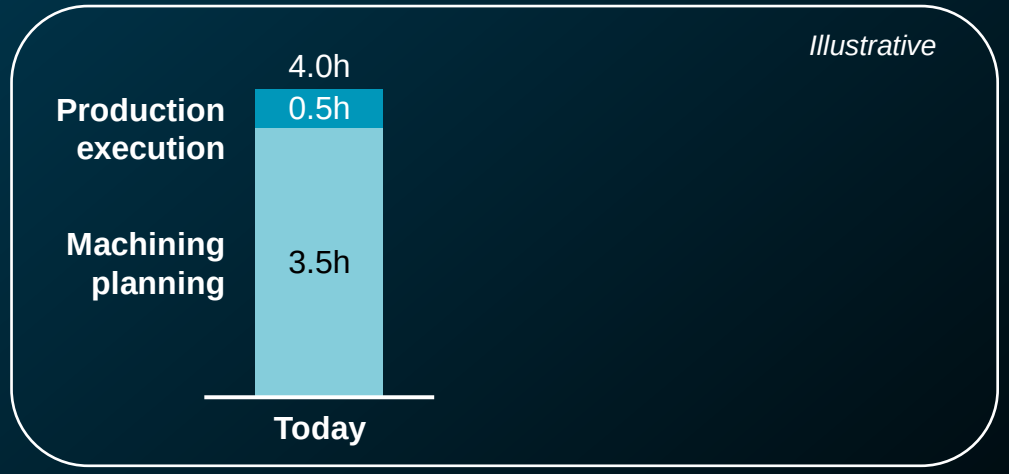
Design	Production		Metrology	Supply chain	
					
CAD	Machining planning	Production execution	Inspection planning and verification	Incoming verification	Assembly

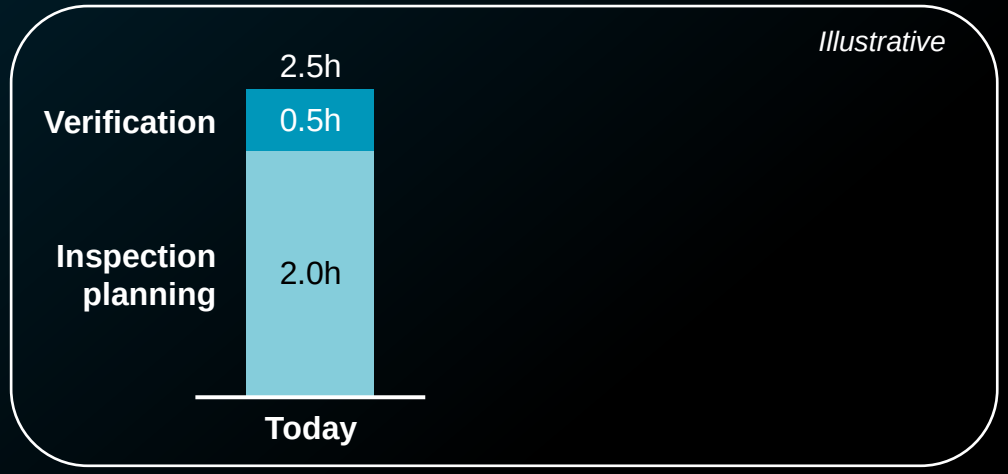
Case study 1: Shop floor autonomy

Machining planning and inspection planning are key steps to optimise for scalable flexibility

Design | **Production** | **Metrology** | **Supply chain**

CAD → Machining planning → Production execution → Inspection planning and verification → Incoming verification → Assembly





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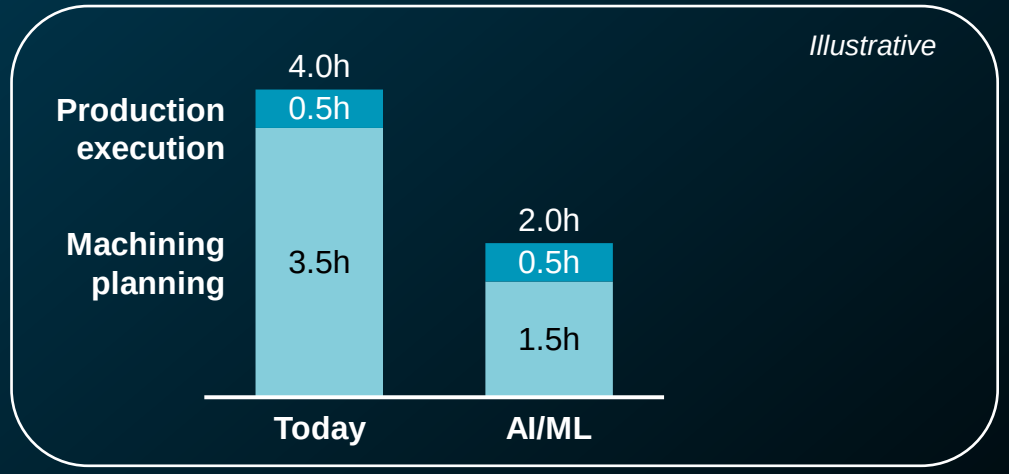

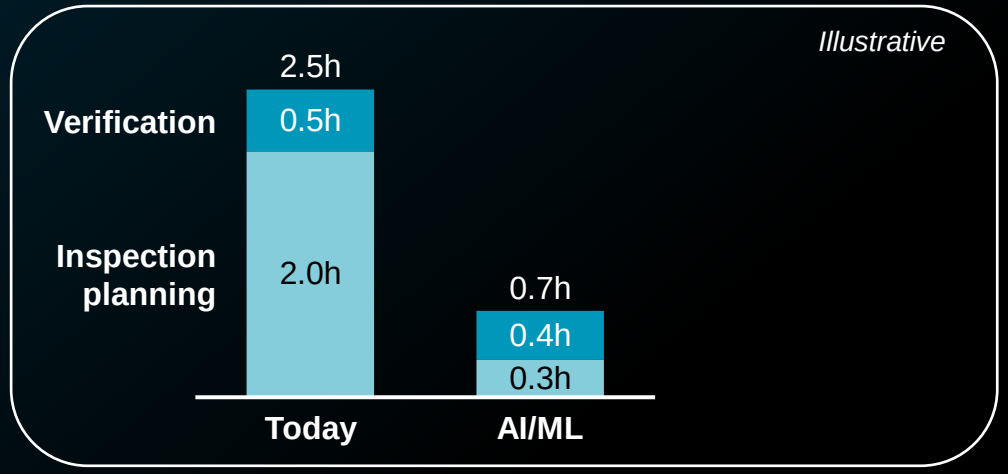

Case study 1: Shop floor autonomy

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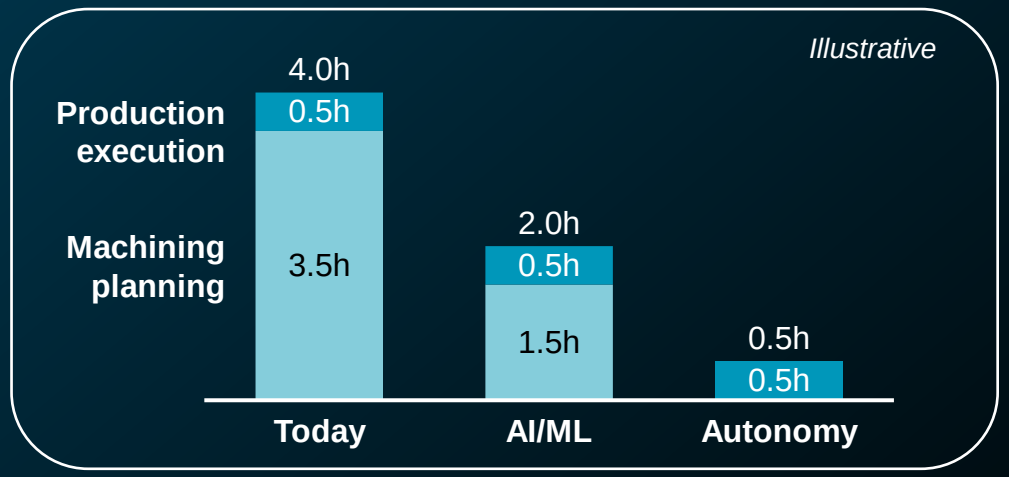
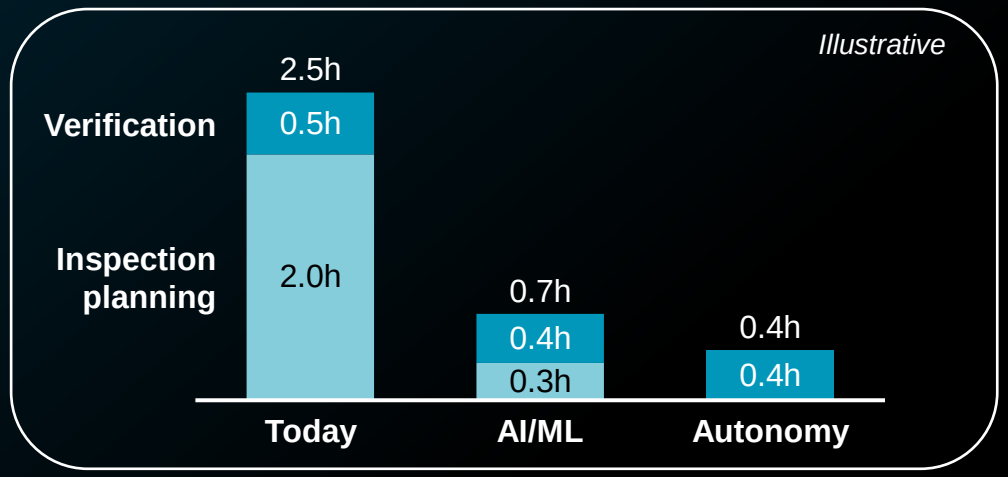




Case study 1: Shop floor autonomy vision

Autonomous manufacturing, digital twin enabled, scalable flexibility

Design | **Production** | **Metrology** | **Supply chain**

CAD → **Machining planning** → **Production execution** → **Inspection planning and verification** → **Incoming verification** → **Assembly**

Shop floor asset management (Infor EAM)

- Asset performance and uptime, tools utilisation
- Associativity between parts, their digital twin and machining tools
- Predictive maintenance and feedback loops delivery
- Visualisation and operator enablement

Supply Chain Collaboration

- Quality validation for suppliers
- Version control and digital validation
- Connectivity across sites and within supply chain

Additive manufacturing: the opportunity

72% prototyping

In aerospace and defence 72% use additive for prototyping, 44% for repair and 43% for R&D

71% lack knowledge

The decision between traditional manufacturing processes and additive is based on the available knowledge for additive

20% growth rate

79% of companies say that they will more than double additive manufacturing of production parts in the next 3 to 5 years

Source: Hubs, The 3D Printing Trends Report; Jabil, A Survey of Printing Stakeholders in Manufacturing

Our footprint

Case study 2: Additive further increasing potential from autonomy

From industrialisation to automation to autonomy

Design and engineering | **Production** | **Metrology** | **Service life**

Part design / generative design

Build simulation and validation

Print job planning

Printing process

Quality inspection and analysis

Usage

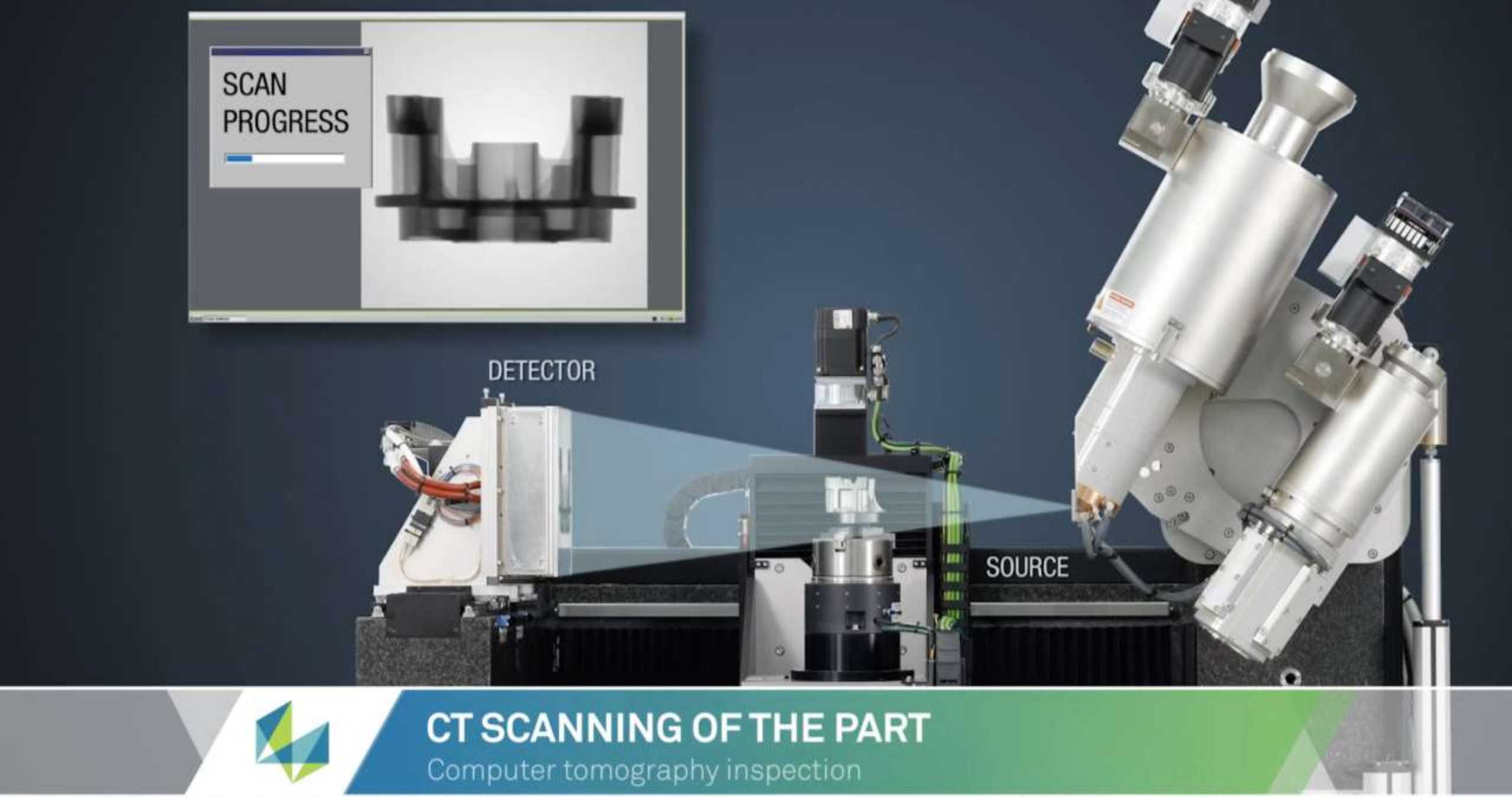
Stress level simulation with CAEFatigue and feedback to design

Modify design based on manufacturability

Performance prediction

Analysis on geometry as well as internal characteristics such as porosity

Benefits: less material and energy, cheap prototyping, faster production, lower cost, better part reliability, lightweight



CT SCANNING OF THE PART

Computer tomography inspection

Offshore wind: the opportunity

2.5 days downtime

Gearbox and generator failure on average results in 2.5 days downtime and are the failures that takes the longest to fix.

66% of downtime

In total gearbox and generator failures account for two thirds of the downtime.

19% growth rate

Over the next 5 years offshore wind energy will be growing very quickly driven by China and Europe.

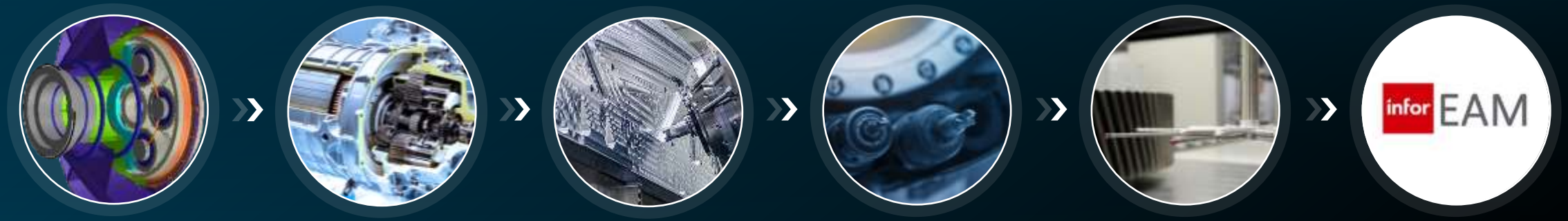
Source: Fortune Business Insights, Offshore Wind Power Market Size, Share and Industry analysis.

Our footprint

Case study 3: Wind workflow optimisation leveraging new technology

Significant opportunities to positively impact the large operational cost through design and EAM

Design and engineering | **Production** | **Metrology** | **Service life**



Wind gearbox design → Wind gearbox simulation → Manufacturing simulation and production planning → Production → Quality inspection → Service life data

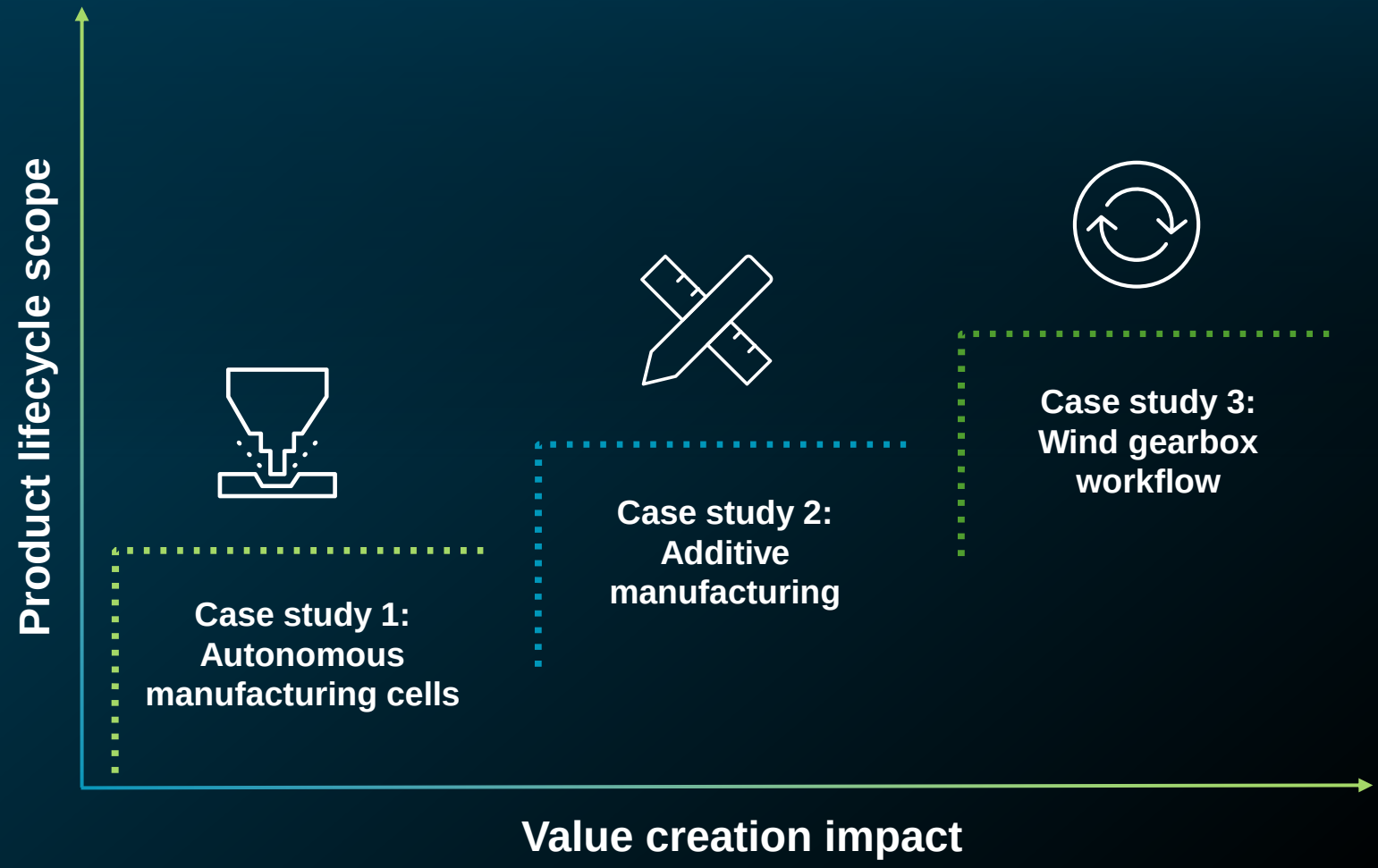
Optimisation of quality and lifetime

AI/Machine learning to optimise design

Improve design based on produced

Autonomous actions based on in service performance (yield, quality, problems, etc)

Value creation use cases driven by Smart Digital Realities



DRIVERS

Need for quality
Scalable flexibility
Sustainable products
Faster time to market
Labour and skills shortage

Autonomy in manufacturing: turning technology into opportunity

Connecting the E2E product lifecycle

- Design & Engineering
- Production
- Inspection
- Asset management

Extensive market reach

Hexagon technology supports the development for:

- 95% of cars
- 90% of aircrafts
- 75% of smartphones
- 80% of orthopedic implants

Value creation opportunities

1. Autonomy on the shop floor and along the supply chain
2. Engineering with embedded manufacturability and quality optimisation
3. Self-optimisation along the E2E product lifecycle