Digital Enterprise

Daniel Hao Tien Lee

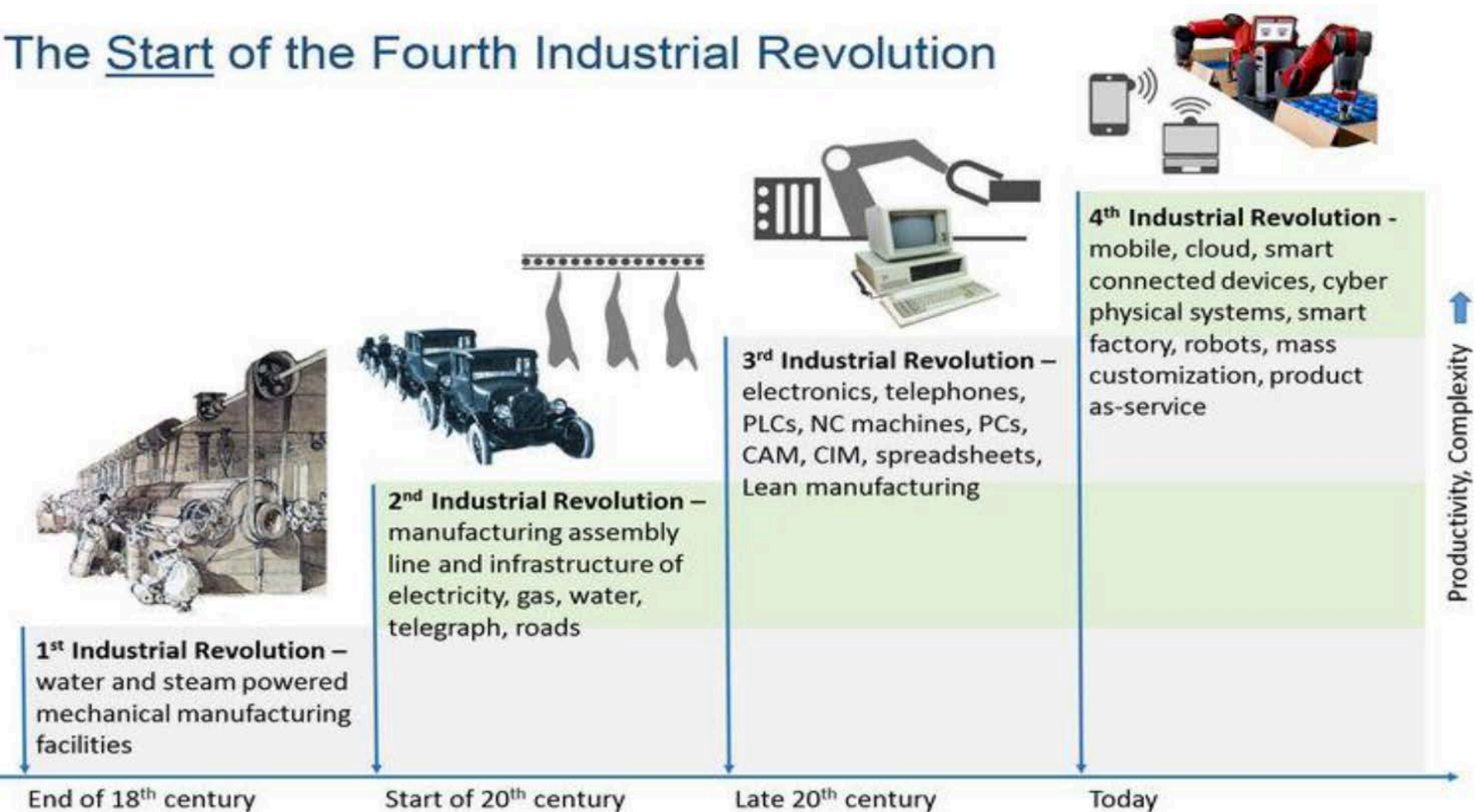http://danieleewww.yolasite.com/2018-mgb070.php
danieleewww@gmail.com

ref.
https://www.youtube.com/nvidia
http://www.uilabs.org/innovation-platforms/manufacturing/

The Fourth Industrial Revolution

The Start of the Fourth Industrial Revolution

1st Industrial Revolution – water and steam powered mechanical manufacturing facilities

2nd Industrial Revolution – manufacturing assembly line and infrastructure of electricity, gas, water, telegraph, roads

3rd Industrial Revolution – electronics, telephones, PLCs, NC machines, PCs, CAM, CIM, spreadsheets, Lean manufacturing

4th Industrial Revolution - mobile, cloud, smart connected devices, cyber physical systems, smart factory, robots, mass customization, product as-service

Productivity, Complexity

End of 18th century   Start of 20th century   Late 20th century   Today

Digital Enterprise

Digital Thread

Digital Organization
- Digital Leadership (Digital Transformation Change Mgmt., Digital ROI/Business Cases/Deployable Funding, Digital Pace)
- Digital Enterprise Content Management
- Digital Community (Collaboration, Shared Ownership)
- Digital Ethics

Data Utilization (Enterprise Level)
- Enterprise Management: ERP

Product Lifecycle Management
- Design: PDM
- Manufacturing: MOM, MPM, MES
- Product Usage and Feedback
- Supply Chain: MRP

Enterprise Risk Management
- Business Continuity & Resiliency
- Disaster Recovery
- Data Continuity
- Data Recovery
- Risk Registry / Impact Analysis

Research
- Materials
- Processes
- Technologies
- Partnerships
- Innovation Labs

Digital Product Definition (Thread Plan/Curation)
- Data Sources • Data Definitions • Authors & Consumers
- System & Feedback Models • Legacy Data Management
- Communities of Practice and Data Grouping

Data Pathways
- Communication Protocols
- Network Architecture
- User Devices • Gateways
- Storage Systems
- Transmitting Systems

Security
- Device Cybersecurity
- Software Cybersecurity
- Information Cybersecurity
- Data Transfer Security

Data Management
- Business/Data Reqs. & Definition • Data Mining
- Data Modeling • Data Architecture • Data Fusion
- Data Model Management • Data Life Cycle
- Cloud • Data Integrity Data Cost Modeling

Cognitive Systems
- Embedded • Cognitive Environments

Digital Design MBSE: Part/Assembly/System

Product Design & Simulation (Behavior)

Product Design Segments
- **Mechanical** • Part & Assembly Design & Simulation
- **Electrical** • Electrical System Design & Simulation
- **Software & Embedded Systems**
  • Product Software Systems (High Level)
  • Product Embedded Systems (Low Level)

Product Design & Simulation Tools
- Concept Development • Digital Sketch/Render • CAD
- VR/AR • FEA/M • CFD/E • Multiphysics Simulation
- Rapid Prototyping • Design for Manufacture/Assembly
- Design for Cost • Design for Service

Product Definition (Context)
Model Based Product Definition Package (DP2 or TDP)
- Geometry • Material Definitions • Contextual Definitions
- Design Intent • Surface Finish Requirements • GD&T
- Part vs. Assembly Definition • BOMS

Product Reliability (Improvement)
- Product Testing and Internal Feedback Systems
- External Product Feedback Systems

Supply Network

Digital Manufacturing

Manufacturing System Monitoring
- Sensors • Connected Equipment • Predictive Maintenance
- Asset Performance Monitoring and Management
- Digital Metrology (CMM, connected gauges)
- Digital Assembly Tools (driver/torque wrenches)

Manufacturing System Control
- Controllers (PAC, PLC, Drive Controls) • CNC
- Robotic Systems • Automated Systems

Manufacturing System Support
- Digital Work Instructions (Device, Wearable, VR/AR)
- Worker Support Tools (pick-to-light, smart work stations)
- HMI

Manufacturing Simulation & Methods
- CAM • ICME • Process Simulation • Assembly Simulation
- Discrete Event Simulation (Assembly, Line, System)
- Motion System Simulation

Infrastructure
- Building Control Systems • Building Security Systems
- SCADA, plant systems • Shop Floor OT Systems

Digital Product

Product Lifecycle Data
- Usage • Environment Conditions
- Performance • Alarms • Location

Product Customer Services
- Performance Monitoring & Optimization (product)
- Maintenance Planning (scheduled and analytic)
- Asset Tracking • Community Tech Support
- End-of-Life Decommissioning

Product Lifecycle Feedback
- Performance Optimization (concurrent)
- Reliability Improvement
- Customization to Market (Sales Engineering)
- Business-side Services ("Rent/Buy" price/adjustments, etc.)

Connected Inventory
(External)
- Material In-Transit Sensing
- Material In-Transit Tracking
- Fleet Management (Plan, Track, Idle Services)

(Internal)
- Inventory Tracking (RFID, GPS, Vision)
- Automated Storage & Retrieval Systems

Supply Chain Risk Management
- Design: Design Alternatives (parts, materials, packaging)
- Manufacturing: Supplier Qualification & Capability Analysis, Supplier Visibility, Inventory Planning
- Logistics: Discrete Event Simulation (Channel or Event Impact Analysis)
- Legislative Impacts (Import/Export Regulations)

Automated Material Handling
- AGVs (Tape Based and Adaptive Path Planning)
- Mobile Robotics
- Delivery Planning and Station Response Systems

Enterprise Virtualization

- Value of Pursuing Digital Excellence

- Digital Transformation

- Digital Twin
  https://www.youtube.com/watch?v=RaOejcczPas
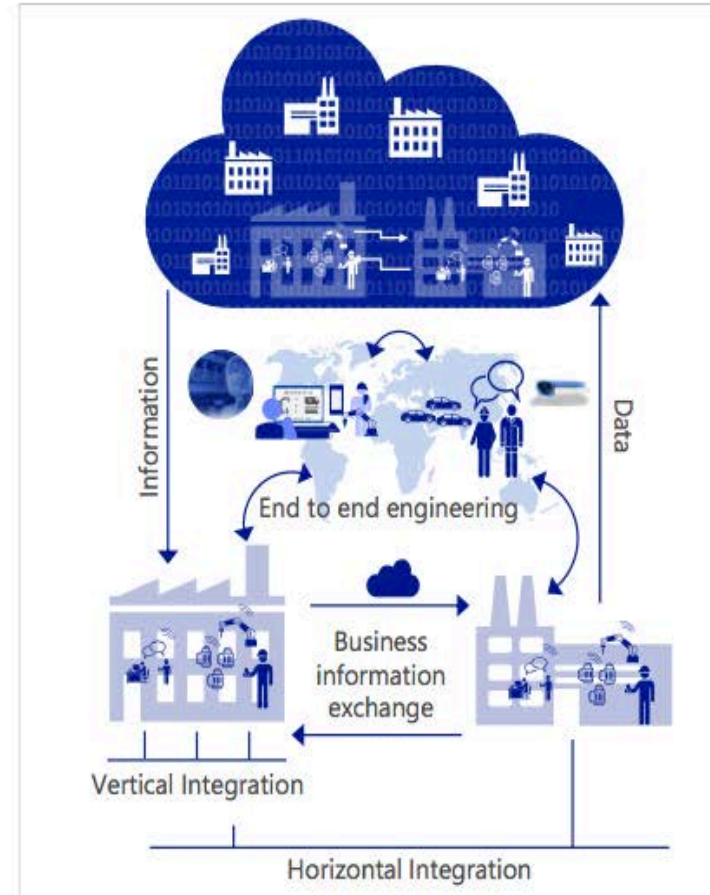 https://www.youtube.com/watch?v=5pduzVtpIPI
  https://www.youtube.com/watch?v=Ri0TD7kYsIQ

- Digital Thread
  https://www.youtube.com/watch?v=rkachfbskKU
  https://www.youtube.com/watch?v=ULFKLHzsA4E
  https://www.youtube.com/watch?v=TIEkYVaijgc
  https://www.youtube.com/watch?v=CFo9OE-f9Ws

- Digital Workplace

- Digital Workforce

The Value of Pursuing Digital Excellence

Leading manufacturers have mastered operational and manufacturing excellence.

Now, is the time to differentiate by mastering on digital excellence as well.

- An Automotive Value Network
- An Industrial Equipment Value Network
- Digital Factories
- The Field and Engineering Service Economy
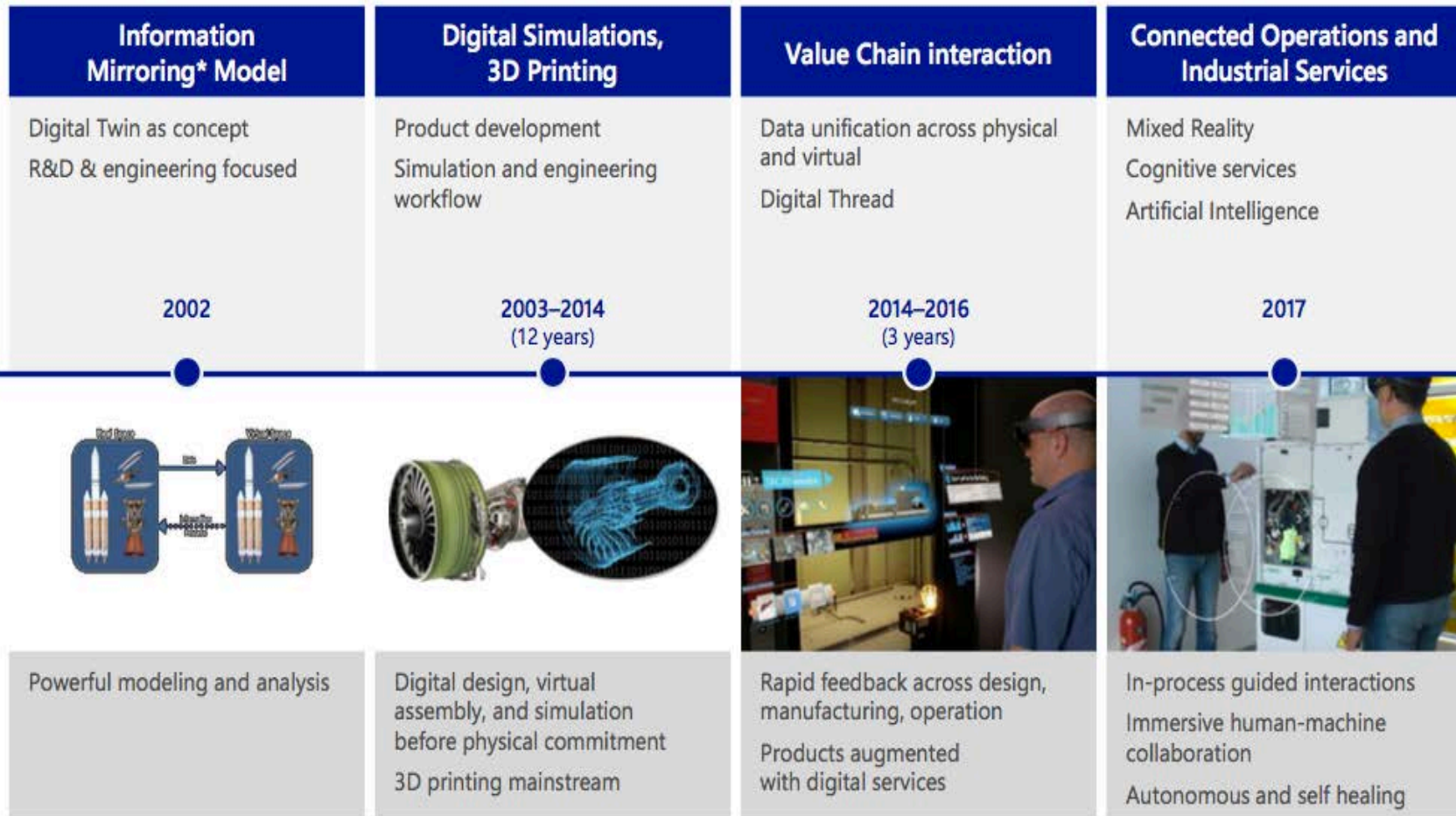- Immersive Experiences Delivering Business Value

Information

Data

End to end engineering

Business information exchange

Vertical Integration

Horizontal Integration

Courtesy of Microsoft 2017

Excellence in Digital Manufacturing, Today

Accelerate value creation and drive sustained improvement through immersive human-machine interaction and innovative partnerships, using a trusted cloud platform

Digital Excellence strategic framework

IIoT Ecosystem | Platform | Security

Transform Process & Business Model

ENGAGE YOUR CUSTOMERS
to service efficiently

EMPOWER YOUR EMPLOYEES
to respond productively

OPTIMIZE YOUR OPERATIONS
to achieve excellence

TRANSFORM YOUR PRODUCTS
to unlock new revenue opportunities

Mixed reality | Cognitive & Intelligent Equipment | Value Network Collaboration

Courtesy of Microsoft 2017

A New Class of Digital Twin

Information Mirroring* Model	Digital Simulations, 3D Printing	Value Chain interaction	Connected Operations and Industrial Services
Digital Twin as concept R&D & engineering focused	Product development Simulation and engineering workflow	Data unification across physical and virtual Digital Thread	Mixed Reality Cognitive services Artificial Intelligence
2002	2003–2014 (12 years)	2014–2016 (3 years)	2017

Digital Twin evolution →

Powerful modeling and analysis	Digital design, virtual assembly, and simulation before physical commitment 3D printing mainstream	Rapid feedback across design, manufacturing, operation Products augmented with digital services	In-process guided interactions Immersive human-machine collaboration Autonomous and self healing

*Dr. Michael Grieves and John Vickers – University of Michigan

Courtesy of Microsoft 2017

Digital Twin: A virtual instance of a customer's smart connected physical product

Courtesy of Microsoft 2017
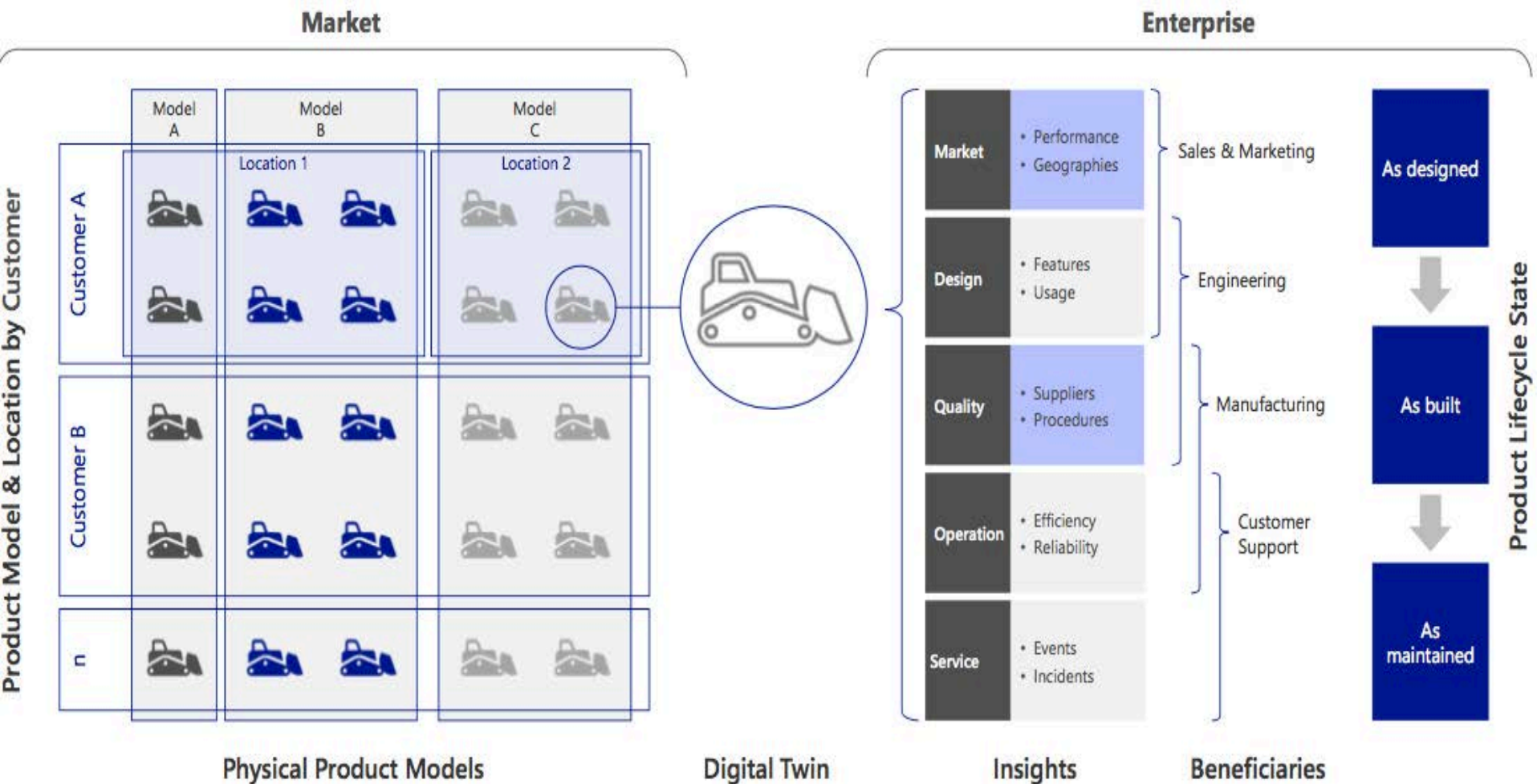
Digital Twin Solution Architecture

Courtesy of Microsoft 2017
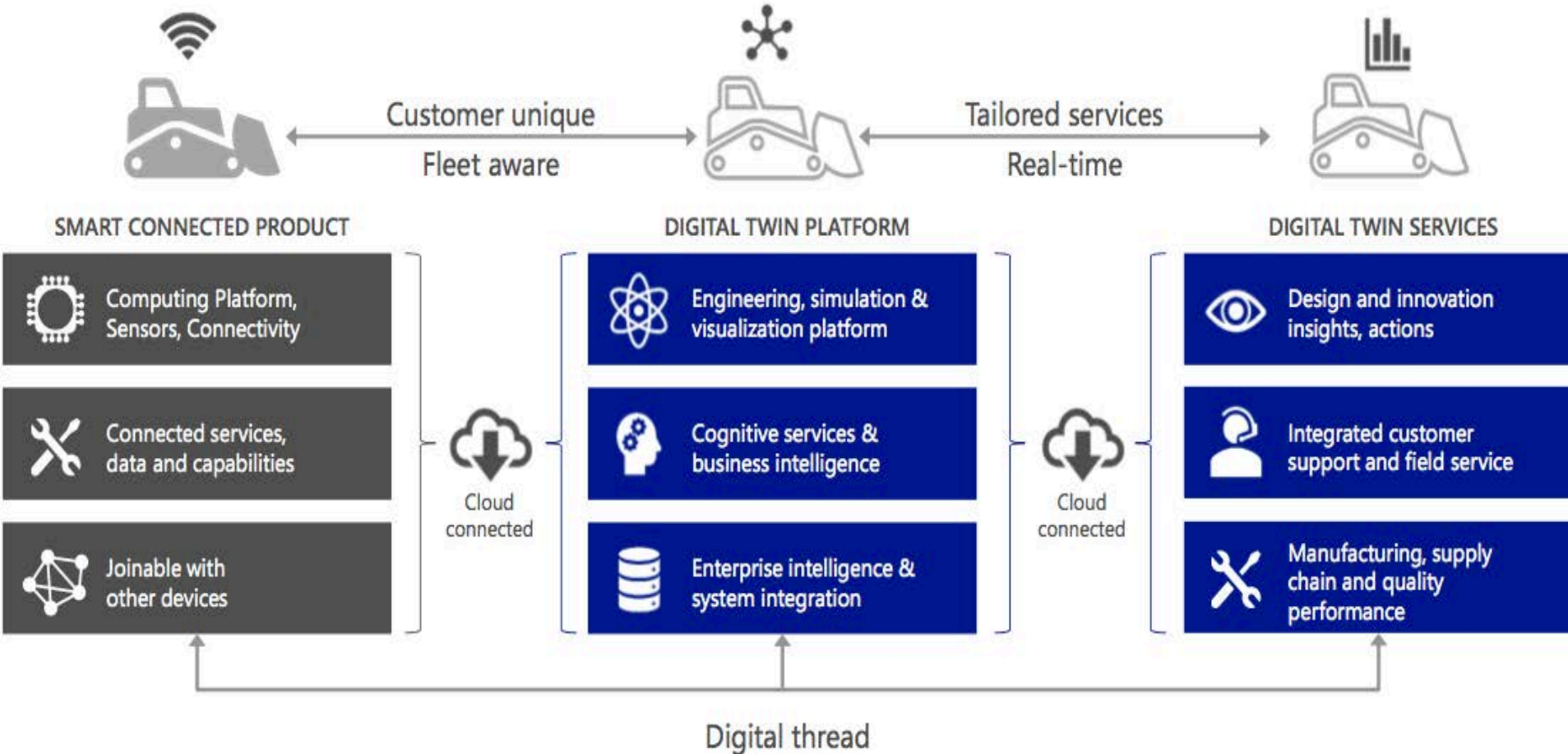
Digital Twin System Architecture
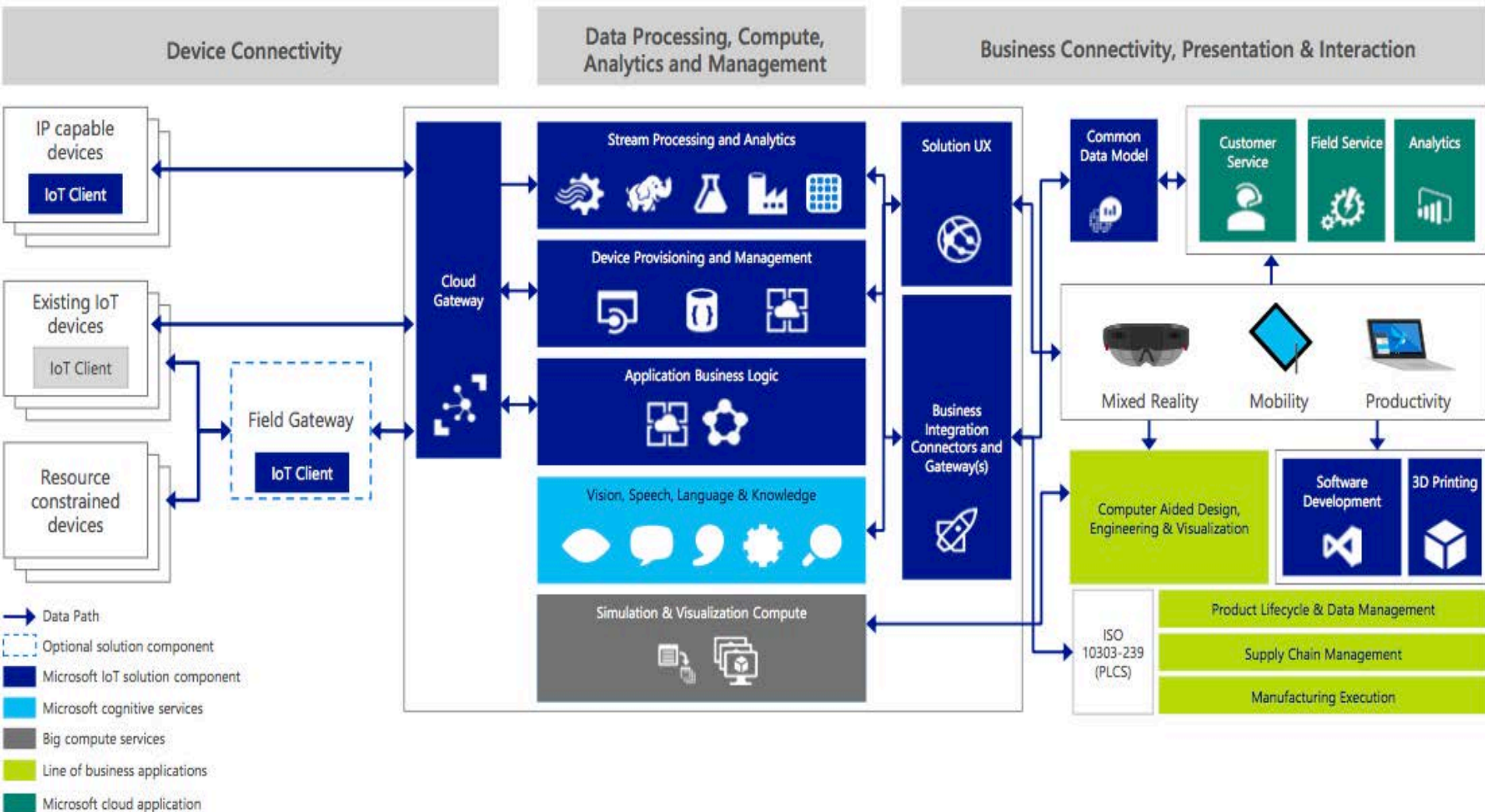
Courtesy of Microsoft 2017

Digital Twin is a Strategic Journey
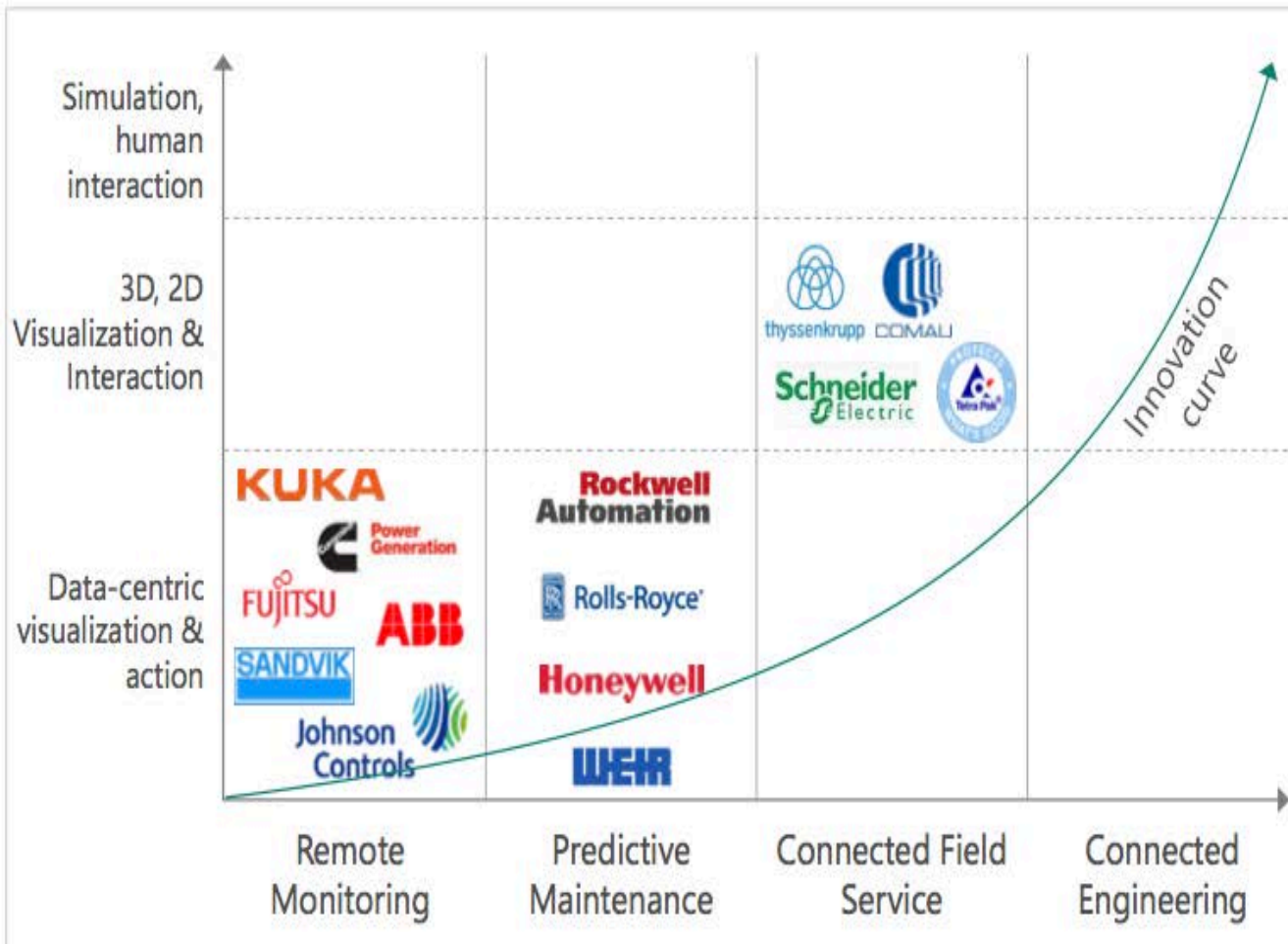
Courtesy of Microsoft 2017

Digital Transformation: An Imperative

40% of operational processes will be self-healing and self-learning by 2022[2]

70% of manufacturers will put operations at the forefront of digital transformation projects by 2020[1]

I4.0 Digital First Movers simultaneously achieve new revenue and cost reduction

30% revenue

30% Operational cost

Only 4% of digital first movers that integrate vertically, horizontally and with Customers. The average digital company improves 2.9% p.a. revenue and reduces 3.6% p.a. cost[3]

Mastering digital up to **15% revenue increase** and simultaneous **reduction in cost to serve of more than 20%**[4]

48% manufacturers are ready for new forms of human-machine interaction[5]

77% CEOs see agility as a growing source of competitive advantage[6]

Forces driving digital manufacturing

I4.0 Design Principles
Vertical integration | Horizontal integration | End-to-end engineering

Digital Twin
A virtual representation of a product, process, or service

2002   2003 – 2014   2014 – 2017   Future

Evolution of Digital Twin

Courtesy of Microsoft 2017

Digital Twin

- A digital twin is a dynamic digital representation of an industrial asset, that enables companies to better understand and predict the performance of their machines and find new revenue streams, and change the way their business operates.

- https://www.youtube.com/watch?v=2dCz3oL2rTw

- https://www.youtube.com/watch?v=r_2GRLxAsEs

- https://www.youtube.com/watch?v=0ccMF5G5L5w

The Fourth Industrial Revolution:
Digital Manufacturing and Design (DMD)

IoT – Industrial Internet of Things

Smart Factory

Data-driven factory of the future

Manufacturing 4.0

Digital Thread

Industry 4.0

Intelligent Factory

Factory of the Future

"Digitizing the shop floor"

The Fourth Industrial Revolution

What forces are driving the digitization of manufacturing operations?

Challenges

- **Separation of designers and makers** has slowed innovation

- **Barriers for Sharing Data and Information** including: technology, skills, incentives, security, trust, IP, standards

- **Increasing cost of labor globally,** skills gap

- Rising costs of materials and **supply constraints**

Opportunities

- **Digital link** between designers and makers

- **Digital connections to physical assets** machines, factories, and supply chains

- **Data aggregation and analysis** to do more with existing resources

The Fourth Industrial Revolution

Traditional Product Lifecycle

Product or System Life Cycle
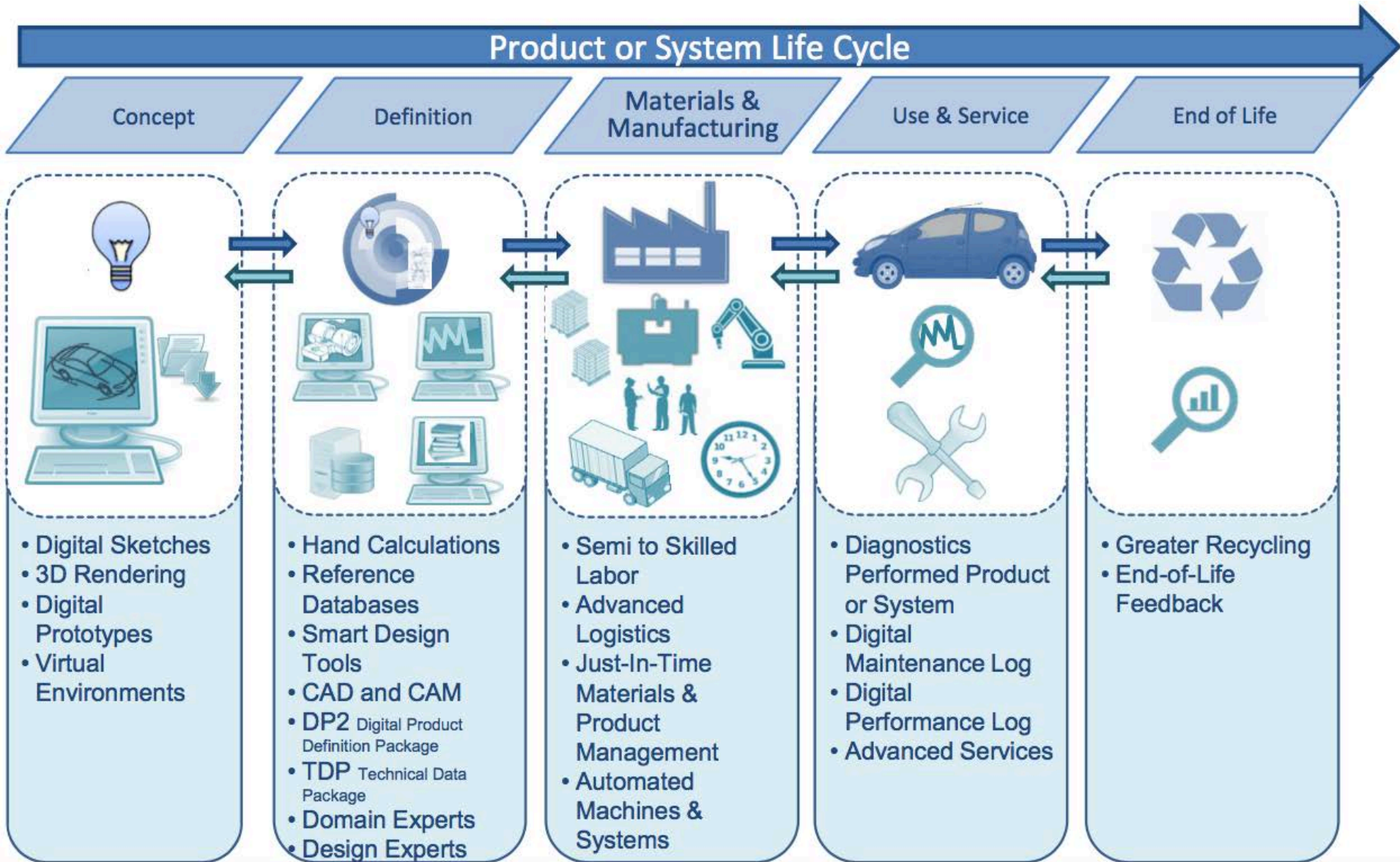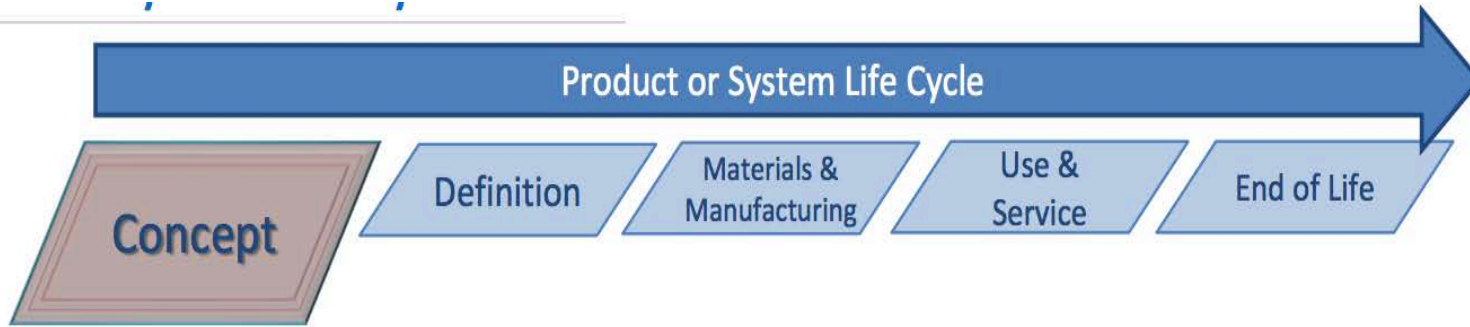
Concept	Definition	Materials & Manufacturing	Use & Service	End of Life
• Hand Sketches • Hand Sculpting • Mechanical Prototypes	• Hand Calculations • Reference Books • Hand Drafting • Paper Blueprints • Domain Experts • Design Experts	• Broad Labor Force • Basic Logistics • No Just-In-Time Materials & Product Management • Manual Machines • Basic Machine Automation • Manual Assembly • Paper Travelers	• Diagnostics Performed by Technicians • No Maintenance Log • No Performance Log	• Basic Recycling • No End-of-Life Feedback

DM&D Product Life Cycle

Product or System Life Cycle

Concept	Definition	Materials & Manufacturing	Use & Service	End of Life
• Digital Sketches • 3D Rendering • Digital Prototypes • Virtual Environments	• Hand Calculations • Reference Databases • Smart Design Tools • CAD and CAM • DP2 Digital Product Definition Package • TDP Technical Data Package • Domain Experts • Design Experts	• Semi to Skilled Labor • Advanced Logistics • Just-In-Time Materials & Product Management • Automated Machines & Systems	• Diagnostics Performed Product or System • Digital Maintenance Log • Digital Performance Log • Advanced Services	• Greater Recycling • End-of-Life Feedback

Product or System Life Cycle - Traditional and DMD

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Product or System Life Cycle - Traditional and DMD

Product or System Life Cycle

Concept | Definition | Materials & Manufacturing | Use & Service | End of Life

- Broad Labor Force
- Basic Logistics
- Manual Machines
- Basic Machine Automation
- Manual Assembly
- Paper Travelers

- Semi to Skilled Labor
- Advanced Logistics
- Just-In-Time Materials & Product Management
- Automated Machines
- & Systems
- Automated & Mixed
- Assembly
- Digital Travelers and Work Instructions

Product or System Life Cycle - Traditional and DMD

Product or System Life Cycle

Concept | Definition | Materials & Manufacturing | **Use & Service** | End of Life

- Diagnostics Performed by Technicians
- No Maintenance Log
- No Performance Log

→

- Diagnostics Performed Product or System
- Digital Maintenance Log
- Digital Performance Log
- Advanced Services

DMDII

Product or System Life Cycle - Traditional and DMD

Product or System Life Cycle

| Concept | Definition | Materials & Manufacturing | Use & Service | **End of Life** |

- Basic Recycling
- No End-of-Life Feedback

→

- Greater Recycling
- End-of-Life Feedback
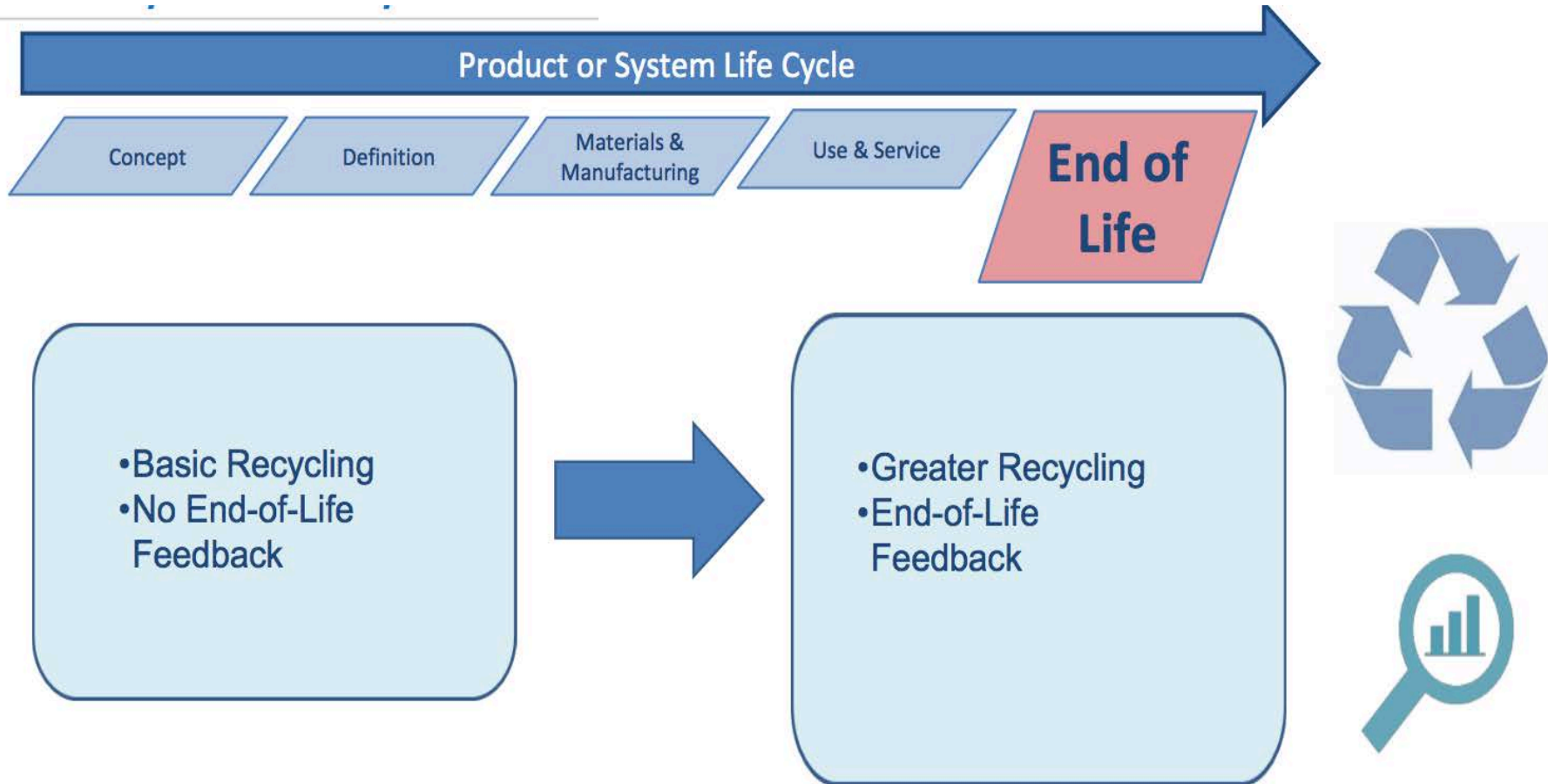
Digital Thread: Heart of Digital Manufacturing

- The digital thread is a single, seamless flow of information that connects a series of data-driven events and stretches across the 5 phases of the product life cycle (PLC) below:
  - 1) CONCEPT - Requirements Development (Customer Requirements),
  - 2) DEFINITION - Design and Analysis (Product Technical Data Package [TDP]),
  - 3) MATERIALS & MANUFACTURING - Manufacturing and Assembly (Process/Production Planning),
  - 4) USE & SERVICE - Repair/Maintenance
  - 5) END OF LIFE – Recycle and Disposal

Digital Thread

- https://www.youtube.com/watch?v=iGtM8VGLn5M

- https://www.youtube.com/watch?v=Mjzg5nku5Lg

- https://www.youtube.com/watch?v=hLJ8be4I1Bs

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Driving the Digital Enterprise

Smart products are transforming every industry

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Smart products	Smart factories
Level 4 autonomous vehicles	**Autonomous machine behavior**

Big data
Gain Insight

Siemens PLM
Software

"Digital is the main reason just over half of the companies on the Fortune 500 have disappeared since the year 2000."

Pierre Nanterme
CEO Accenture

WORLD ECONOMIC FORUM

COMMITTED TO
IMPROVING THE STATE
OF THE WORLD

Technologies enabling the digital twins

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Compresses the innovation lifecycle…

Changing the way products come to life
IDEATION

Changing the way products are realized
REALIZATION

Changing the way products evolve
UTILIZATION

GE... E... SYSTEMS OF SYSTEMS

LE... URIN ADVANCED ROBOTICS

TE... GE ATIO BIG DATA ANALYTICS

Siemens PLM
Software
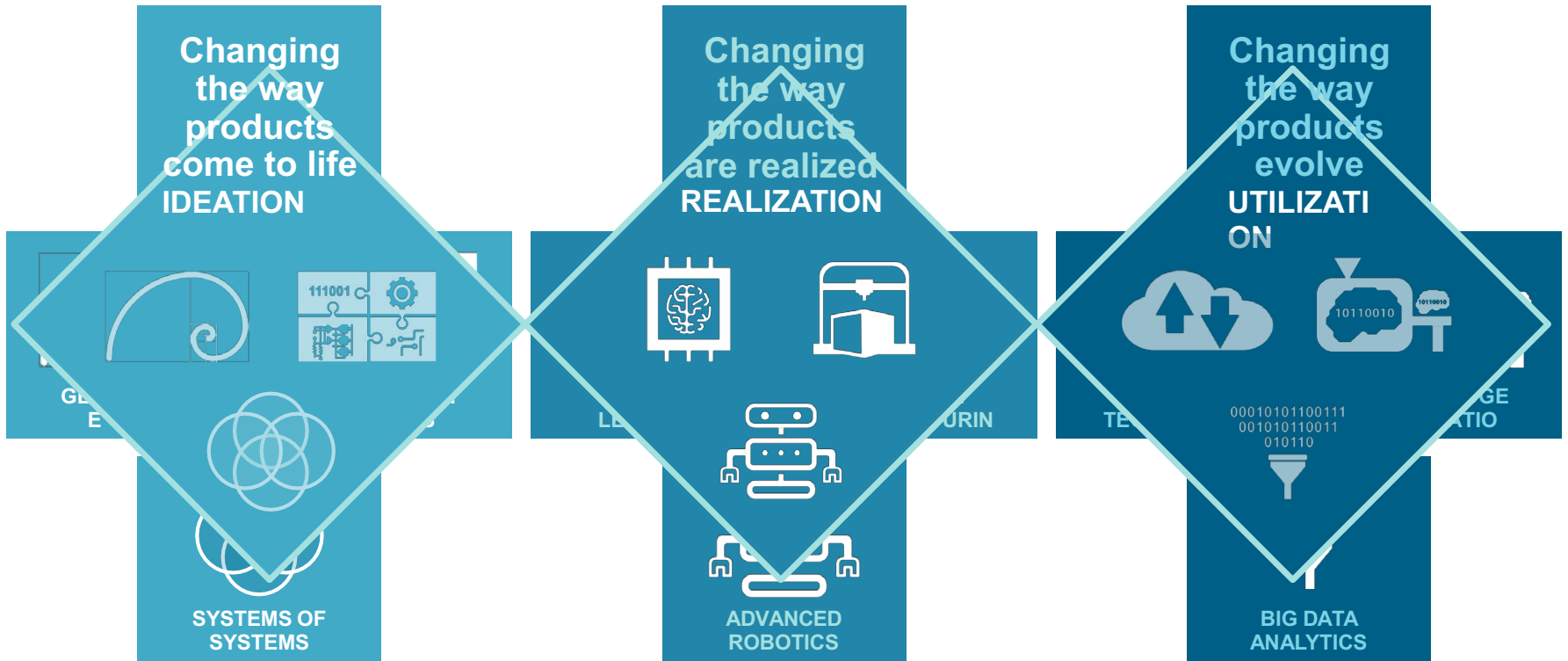
Siemens Digital Enterprise Software Suite
Tools enabling the digital twins

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MECHANICAL DESIGN
NX **Fibersim** **Solid Edge** **Syncrofit** **Catchbook** **Mastertrim**

ELECTRONICS AND SOFTWARE DESIGN
Mentor Graphics **Polarion**

PREDICTIVE ANALYTICS
NX **Nastran** **Simcenter** **Imagine.Lab** **Star-CCM+** **Virtual.Lab HEEDS** **Test.Lab**

MANUFACTURING ENGINEERING
Tecnomatix **Intosite** **NX CAM**

Design

Control

Simulate

Build

Connect

Analyze

Service

Automate

Execute

PERFORMANCE ANALYTICS
Omneo **Mindapps**

SERVICE LIFECYCLE MANAGEMENT
Siemens Services

FACTORY AUTOMATION
SIMATIC **SIMOTION** **SINUMERIK**

MFG EXECUTION
SIMATIC IT **Preactor** **IBS QMS** **Production** **WinCC** **Systems**

COLLABORATION
MindSphere **Teamcenter**

Digitalization …

Digital Product

Holistical Digital Product Twin

Digital Performance

What problems do they solve?
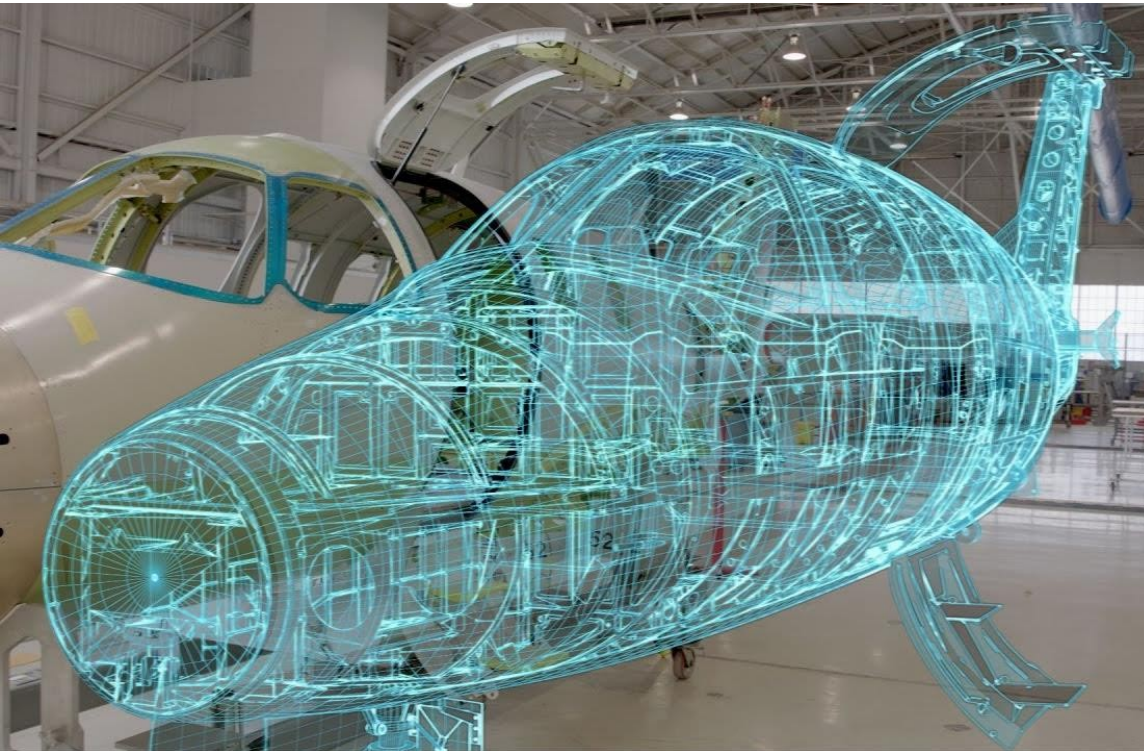
Product Twin – Predict
- Physical appearance and attributes
- Performance characteristics
- Environmental Response
- Failure modes

Production System Twin – Predict
- Physical layout and attributes
- Production capacity and utilization
- Optimize throughput

Performance Twins - Insight
- Optimize in-service operation
- Predictive maintenance
- Validate "as designed"

Enable excellent performance on every program

Program Execution Excellence

Improve program cost, technical and schedule performance through a *Model Based Enterprise, Digital Twin – Digital Thread*

Gain competitive advantage by employing a pre-configured technology to *focus on the automation of specific A&D value streams*

Increase performance in production, support and future bids by *sharing product knowledge & definition within a unified system*

Program Execution Excellence
Value Stream Solutions Generate Competitive Advantage

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Program Execution Excellence
Value Streams on the Digital Innovation Platform

Systems Driven Product Development	Integrated Prog. Planning and Execution	Product Engineering & Design	Supplier Source Selection and Management	Verification Management	Product Realization	Product Support Planning and Management
OPTIMIZATION & INNOVATION	**MEETING COST, SCHEDULE AND TECHNICAL REQUIREMENTS**	**EFFICIENT FIRST TIME RIGHT**	**EFFECTIVE SUPPLIER MANAGEMENT**	**FASTER TIME TO CERTIFICATION**	**MEETING COST & PRODUCTION GOALS**	**INTEGRATE SERVICE WITH THE FACTORY**
A systems driven product development approach leveraging systems engineering and 3D models from idea thru to support.	A systems approach to project planning a fully planned, resourced ,budgeted and executed program management	Design with advanced materials, integrated CAD/CAE, maximize reuse, advanced configuration management.	Enabling traceability from OEM requirements to suppliers. Proactive supplier management.	Enabling traceability from requirements thru virtual and physical test to ensure product verification.	"Shift left" manufacturing planning to ensure cost, schedule & safety goals are achieved with fully integrated factory.	Design for support. Plan for support. Manage service planning. Closed loop support with manufacturing and design.

Program Execution Excellence Capabilities Matrix

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Digital Enterprise

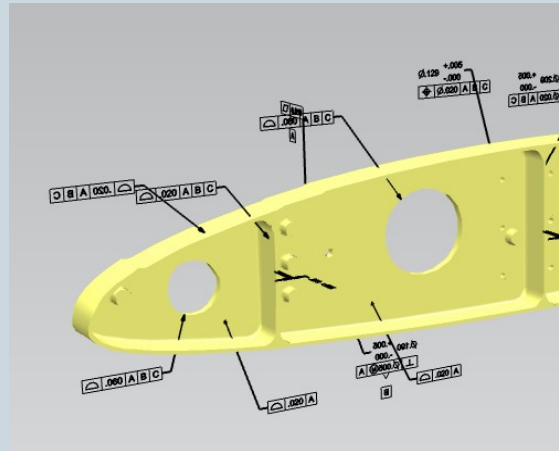**Ideation | Realization | Utilization**

Domain Solutions

As-Designed BOM Management	Requirements Management	Advanced Aero-structures	MBOM & Bill Of Process	CAM, Tooling & Fixtures	Plant Design & Optimization	Technical Publications	Maintenance Planning	Failure Reporting & Corrective Action
Reporting & Analytics	1D / 3D Simulation & Test Management	Reliability & System Safety (RAMS)	Automation Design & Commissioning	End-item Delivery (DD250 or Airworthiness)	Assembly Manufacturing Engineering	Logistics Support Analysis	In-Service Data Management (As-Maintained BOM)	GSE / EGSE Design
Model Based Systems Engineering	Mechanical Design Model Based Definition	Document Management (CDRL/SDRL)	3D Electronic Work Instructions	Material & Compliance Management	Additive Design & Manufacturing	Spares Definition and Condition of Supply	Maintenance Simulation	Service Bulletins
Software Management	Electrical & Electronics Design	Supply Chain Collaboration	Part Manufacturing	Manufacturing Execution Management	Quality Management	Software Maintenance	Maintenance Ergonomic Analysis	Field Experience Feedback
Configuration & Change Management	IP Protection & Export Control	Schedule, Cost & Risk Management	3D Massive Model Visualization	Production Planning & Scheduling	ERP Integration	Obsolescence Management	Manufacturing Optimization	MRO Integration

Value Streams

- Systems Driven Product Development
- Integrated Program Planning & Execution
- Product Engineering & Design
- Supplier Source Selection and Management
- Verification Management Product
- Realization
- Product Support Planning and

Siemens PLM Software

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Ideation			Realization			Utilization		

Domain Solutions

As-Designed BOM Management	Requirements Management	Advanced Aero-structures	MBOM & Bill Of Process	CAM, Tooling & Fixtures	Plant Design & Optimization	Technical Publications	Maintenance Planning	Failure Reporting & Corrective Action
Reporting & Analytics	1D / 3D Simulation & Test Management	Reliability & System Safety (RAMS)	Automation Design & Commissioning	End-item Delivery (DD250 or Airworthiness)	Assembly Manufacturing Engineering	Logistics Support Analysis	In-Service Data Management (As-Maintained BOM)	GSE / EGSE Design
Model Based Systems Engineering	Mechanical Design Model Based Definition	Document Management (CDRL/SDRL)	3D Electronic Work Instructions	Material & Compliance Management	Advanced Manufacturing	Spares Definition and Condition of Supply	Maintenance Simulation	Service Bulletins
Software Management	Electrical & Electronics Design	Supply Chain Collaboration	Part Manufacturing	Manufacturing Execution Management	Quality Management	Software Maintenance	Maintenance Ergonomic Analysis	Field Experience Feedback
Configuration & Change Management	IP Protection & Export Control	Schedule, Cost & Risk Management	3D Massive Model Visualization	Manufacturing Operations Management	ERP Integration	Obsolescence Management	Manufacturing Optimization	MRO Integration

Value Streams

- Systems Driven Product Development
- Integrated Program Planning & Execution
- Product Engineering & Design
- Supplier Source Selection and Management
- Verification Management
- Product Realization
- Product Support Planning and Management

Siemens PLM
Software

Trends

Improve Operational Availability

Model Based Definition Requirement

Aftermarket Service Revenue

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Software

Product Support Planning and Management
'Disconnected' BOMs

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Virtual

Physical

As-Designed BOM
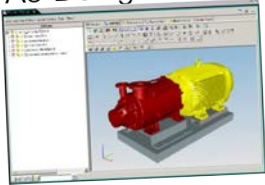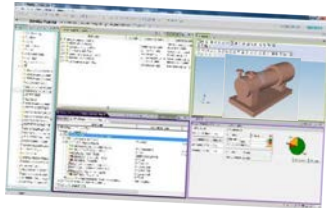
Engineering

As-Planned BOM
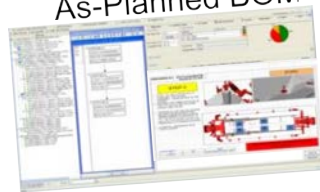
Manufacturing

As-Built BOM
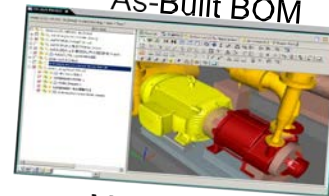
Manufacturing

As-Maintained BOM

Sustainment

Service BOM

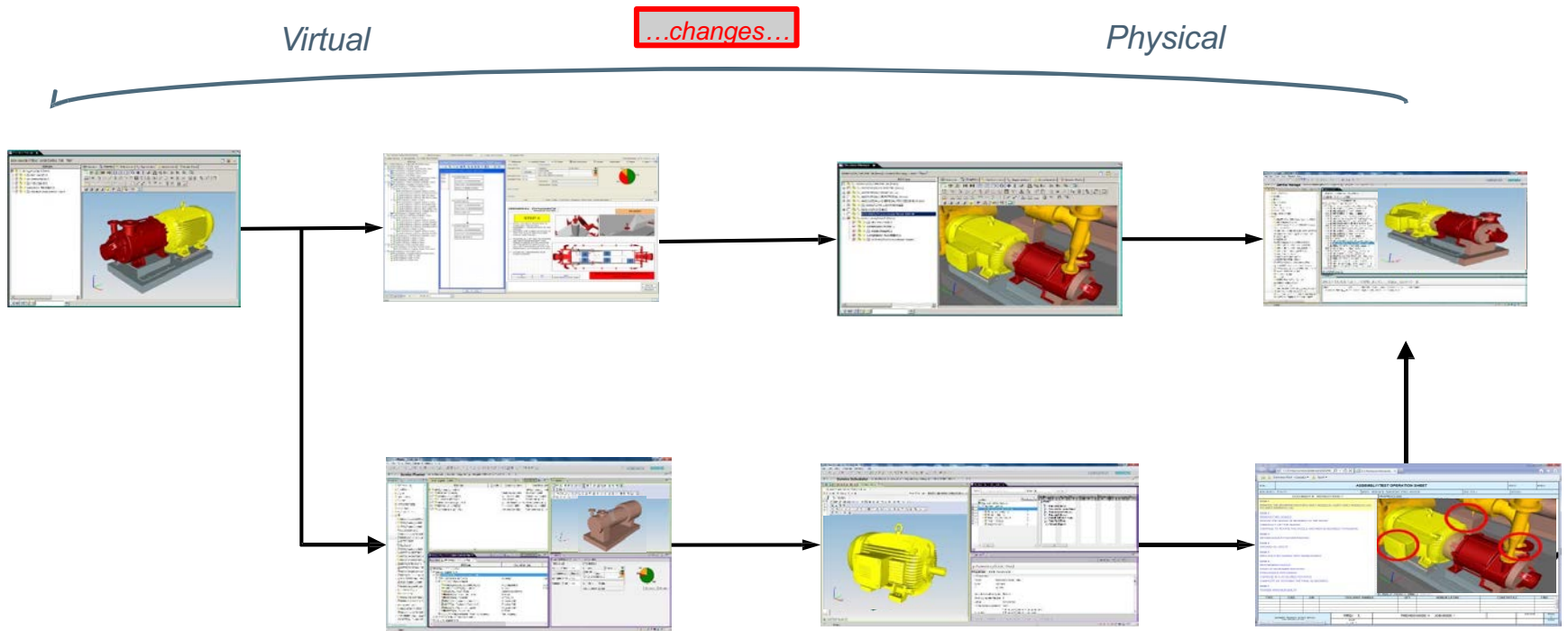Service Planning

…changes…
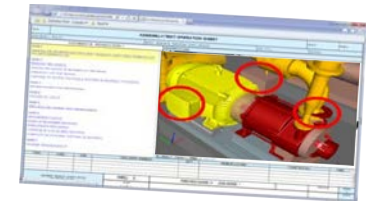
Service Execution

Product Support Planning and Management
Digital-Thread   *for 'Closed Loop' Product Planning & Support*
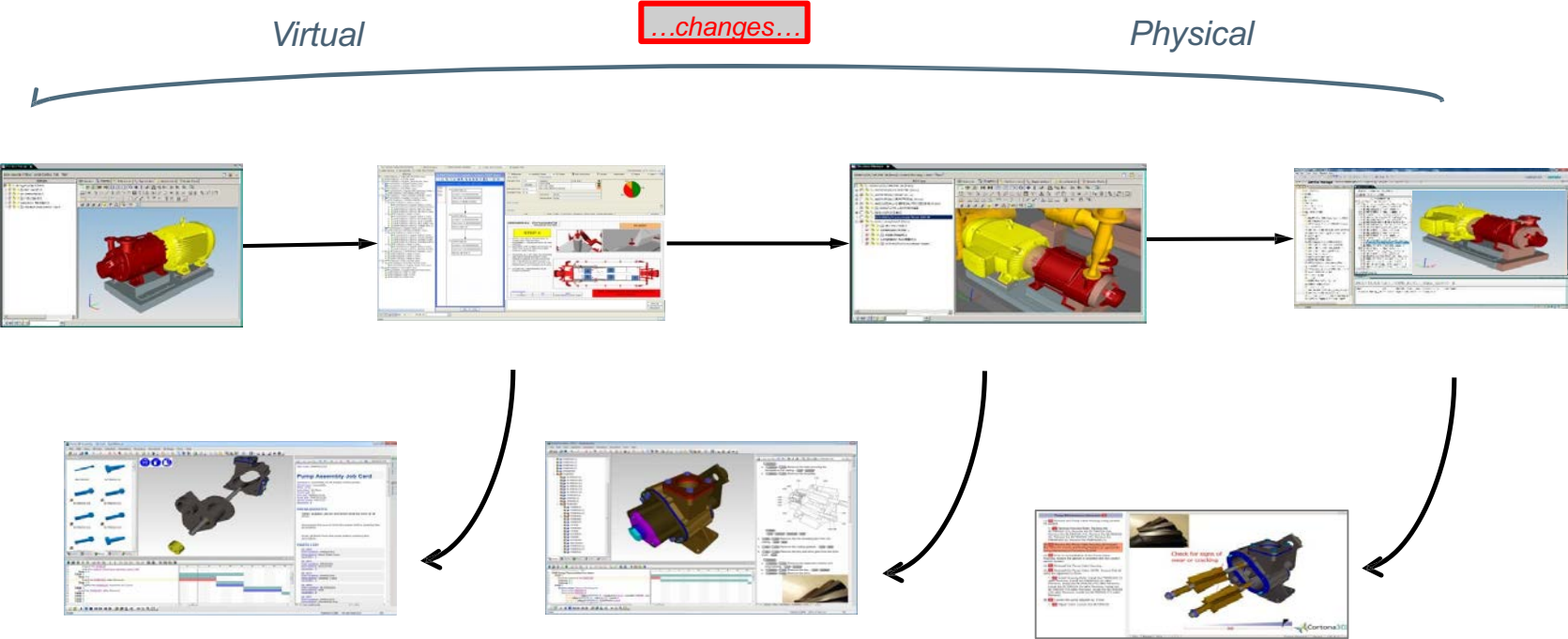
Virtual   **…changes…**   *Physical*

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Software

Virtual   …changes…   *Physical*

Product Support Planning and Management

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- In-Service Data Management (As-Maintained BOM)
- Maintenance Planning
- Failure Reporting & Corrective Action
- Spares Definition and Condition of Supply
- Service Bulletins
- **Product Support Planning and Management**
- Configuration & Change Management
- Maintenance Simulation
- Technical Publications

Systems Driven Product Development

| Functional Development | Architecture Definition | Architecture Analysis & Simulation | Systems/Software Development | Integrate & Verify | Status & Reporting |

Conduct physics-based analyses for early behavior and performance insight
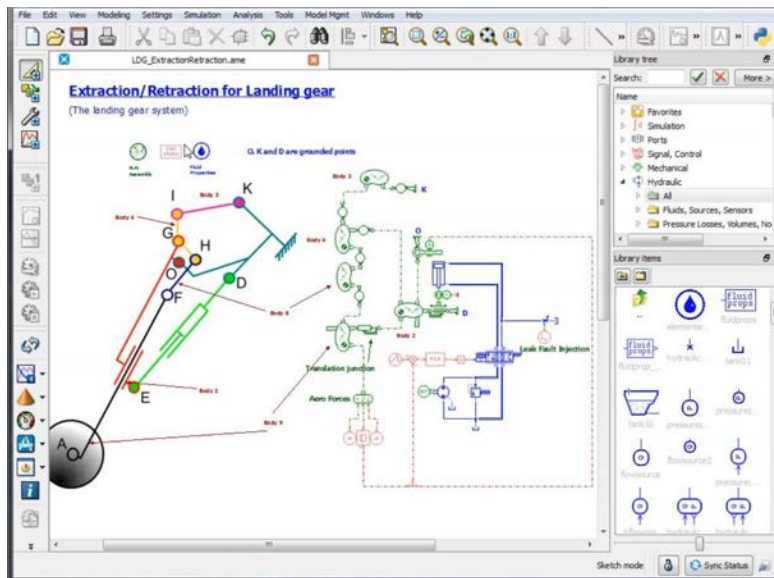
Key Tasks

- Execute behavioural performance simulation

- Pass results to Teamcenter to create derived measurements/requirements

Value

- Early validation of design approach via performance analysis

- Traceability between functions, models, simulations and derived requirements

- Clear change impact visibility

Systems Driven Product Development

Functional Development	Architecture Definition	Architecture Analysis & Simulation	Systems/Software Development	Integrate & Verify	Status & Reporting

Conduct failure mode and fault tree analyses for early behavior and performance insight
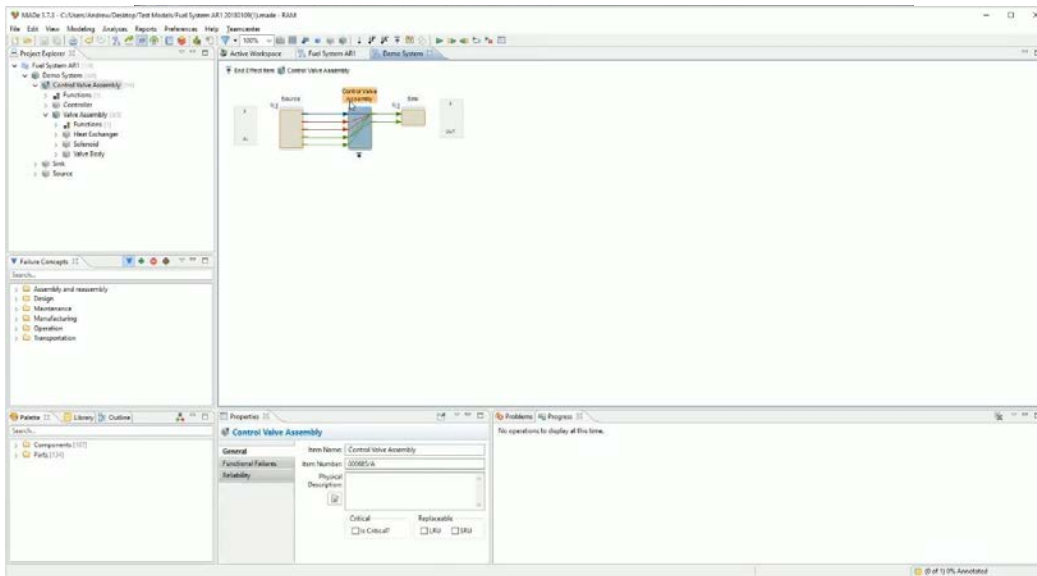
Key Tasks

•Execute behavioural failure mode simulation

•Pass results to Teamcenter to create derived measurements/requirements

Value

•Early validation of design approach via failure analysis

•Traceability between functions, models, simulations and derived requirements

•Clear change impact visibility

What MADe does

Define How and where system will be used	**Model** Identify potential failures and when they will occur	**Validate** Technical analyses	**Analyze / Mitigate** Identify optimal failure mitigation approach	**Calculate** Generate expected maintenance costs for the solution
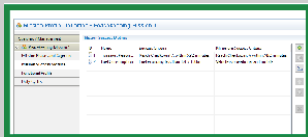
Mission Profile Definition

Functional / Failure Analysis

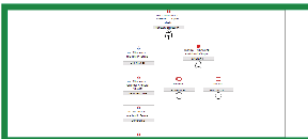FMEA / FMECA
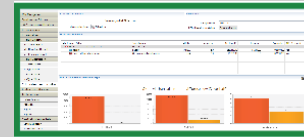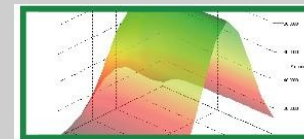
Reliability Centered Maintenance
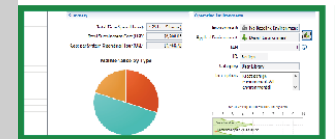
Maintenance Cost Estimate
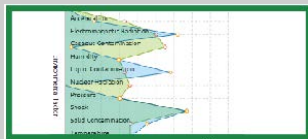
Environment Loading
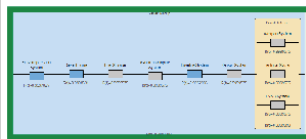
Reliability Analysis

Fault Tree Analysis

CBM Design

Maintenance Action Reports

Product Support Planning and Management

SIEMENS
Ingenuity for life

Design for Maintainability	Service Planning	In-Service Structure Management	Service Scheduling	Service Execution	Closed Loop Deficiency Tracking

Design in safe, quick and easy replacement of components

Key Tasks

- Simulate human maintenance to optimize design
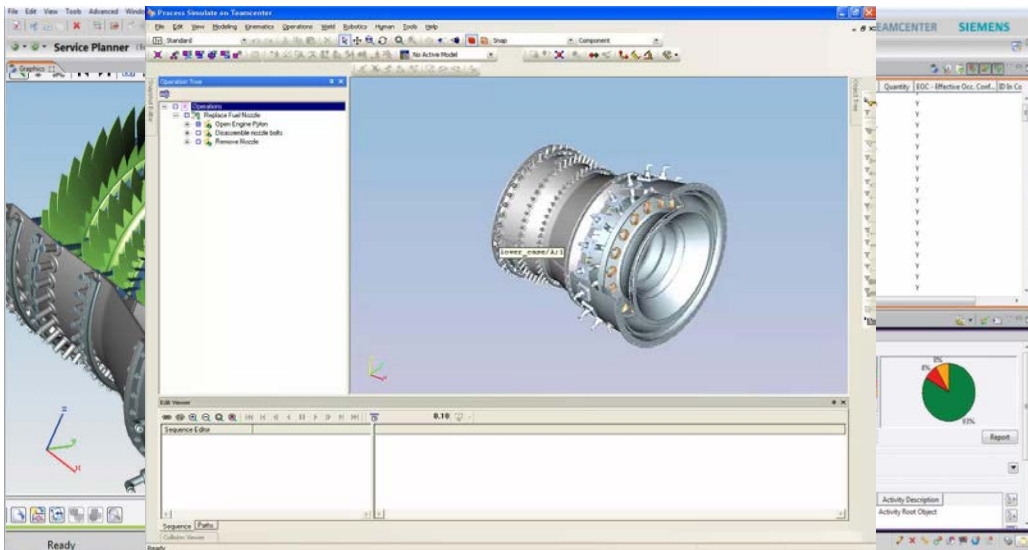- Validate maintainability with virtual reality immersion

Value

- Elimination of physical prototype through earlier consideration of maintainability
- Maintenance costs and downtime reduced through better designs

Product Support Planning and Management

SIEMENS
Ingenuity for life

Design for Maintainability	Service Planning	In-Service Structure Management	Service Scheduling	Service Execution	Closed Loop Deficiency Tracking

Create and Manage Service Plans tied to the Model Based Configuration

Key Tasks

•Develop service plans that support proactive service models such as preventative, condition and reliability-based maintenance as well as platform upgrades.

Value

•Enhance service quality by ensuring that approved service procedures are defined and followed.

Siemens PLM Software

Product Support Planning and Management

SIEMENS
Ingenuity for life

| Design for Maintainability | Service Planning | In-Service Structure Management | Service Scheduling | Service Execution | Closed Loop Deficiency Tracking |

Build the foundation for all future maintenance activities being tied to the Engineering Configuration
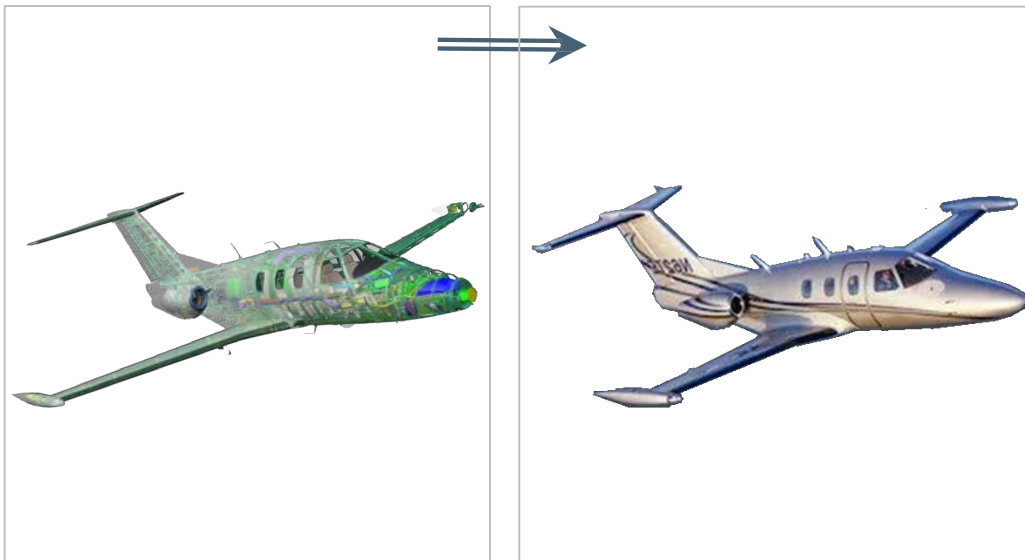
Key Tasks

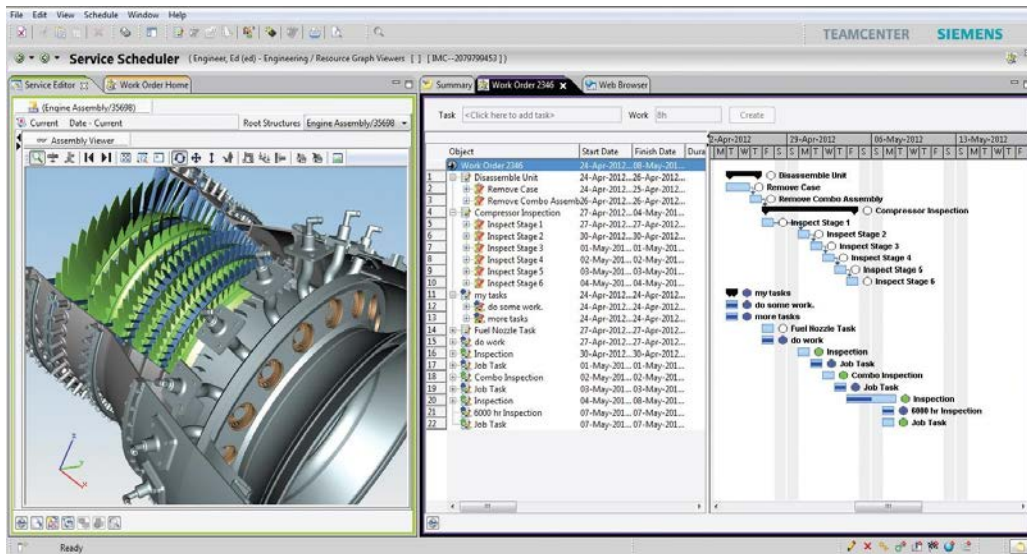•Leverage engineering definition to define physical structure including serialized parts and operational characteristics

Value

•Improves asset tracking and life usage by leveraging fully defined lifecycle bill- of-materials (BOM)

•Service quality improvements

Siemens PLM
Software

Product Support Planning and Management

SIEMENS
Ingenuity for life

Design for Maintainability	Service Planning	In-Service Structure Management	Service Scheduling	Service Execution	Closed Loop Deficiency Tracking

Scheduling Connects Service Planning to Service Execution

Key Tasks

• Define work scope and schedule within the limitations of resources and available qualified personnel.

• Deliver assignments with all the necessary information to execute work.

Value

• Increase service operations efficiency through visibility to schedules of current and future work.

Siemens PLM
Software

Product Support Planning and Management

SIEMENS
Ingenuity for life

| Design for Maintainability | Service Planning | In-Service Structure Management | Service Scheduling | Service Execution | Closed Loop Deficiency Tracking |

Execute the Maintenance from Instructions derived from the Model
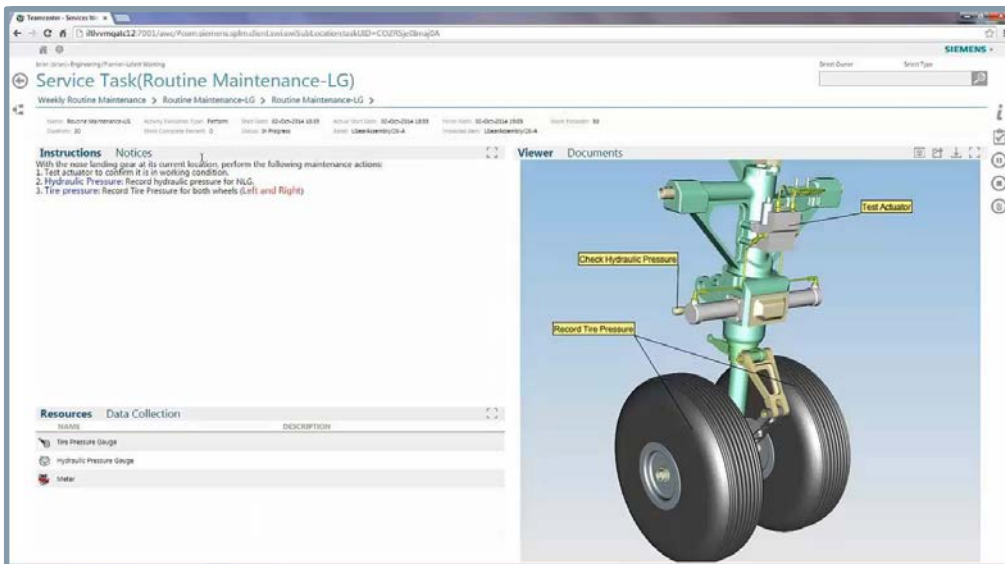
Key Tasks

• Service personnel receive order tasking at the appropriate time.

• View the schedule of current and upcoming tasks

• Capture service results and signoff on work.

Value

• Accelerate service execution.

• Ensure technician is using correct data.

Product Support Planning and Management

| Design for Maintainability | Service Planning | In-Service Structure Management | Service Scheduling | Service Execution | Closed Loop Deficiency Tracking |

Tie deficiencies directly to Engineering and Planning

Key Tasks

• Technician captures failures and corrective actions directly in Service Work Instruction interface.

• Routed directly to responsible supervisor for action

Value

• Enables the non-stop execution of work at the point of service.

• Enhances service and asset performance by retaining and delivering service experience and knowledge at the point of task

What makes Product Support Planning and Management Unique?

Single System Providing Product Support & Planning Digital Thread

Configuration Driven Maintenance
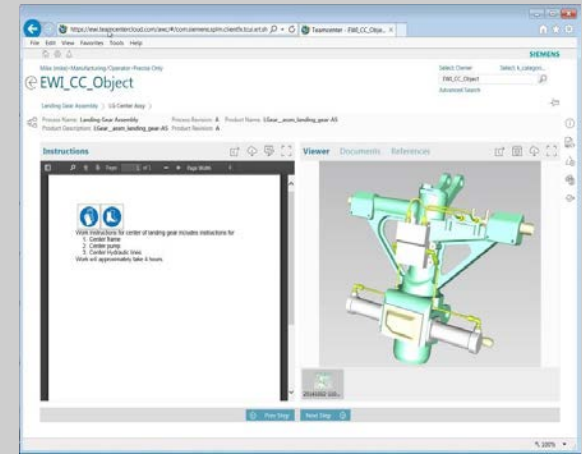
Real-time Visual Reporting and Digital Work Instructions

Summary - Product Support Planning and Management

• Manage the service lifecycle directly from the product definition

• Configuration-driven closed-loop maintenance

• Improve asset availability and reliability: avoid unplanned asset downtime (failures)

• Improved service quality: standardize service best practices in service processes for plans

• Real-time visual reports and Deficiency tracking

Summary
Digital Thread – Digital Twin

Compresses the product lifecycle…

IDEATION

REALIZATION

UTILIZATION

Program Execution Excellence

The Digital Twin – Digital Thread delivering real value
Achieving….. Program Execution Excellence

SIEMENS
Ingenuity for life

Continued investment in the Digital Enterprise

>$6.5 Billion since 2013
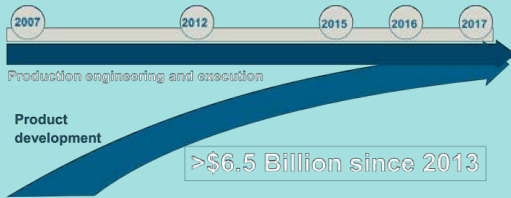
Digitally represent what is real Simulate what is possible

Achieving customer success

Powering
Digital transformation

Integrating
Virtual development with real production

Driving
Successful business outcomes

changes
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Everyth
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Digital Thread for Additive Manufacturing (DTAM)

Siemens Innovation Leadership
Summit March, 2018

Digital Thread
Connecting the Entire Product Lifecycle
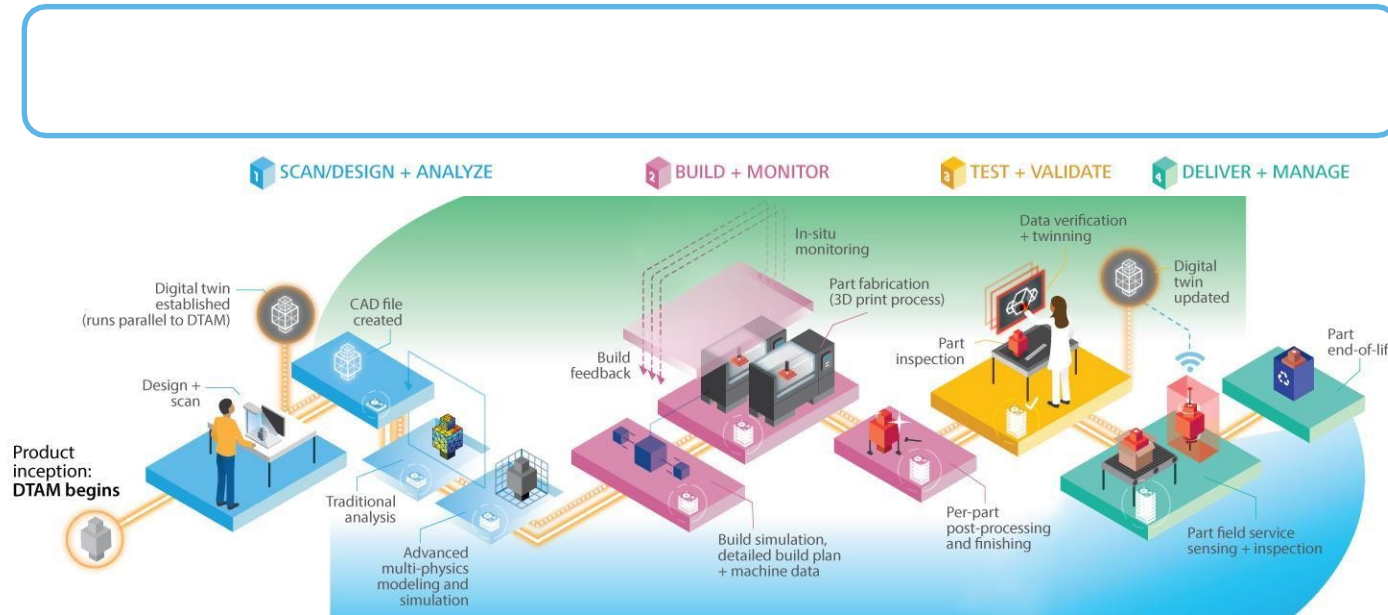
The digital thread enables organizations to design anywhere and build anywhere at scale while unlocking insights into rapid product and process optimization

Deloitte and MIT: "Following the Digital Thread"

8 Part Documentary Series

Developed by Deloitte Insights and MIT Sloan Management Review

The Path Toward the Digital Enterprise

https://sloanreview.mit.edu/tag/following-the-digital-thread/

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