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Ingenuity for life

“Model Based (x) – Sparking a Systems Engineering leading practice for Innovative Project, Plant and Process Development”

Topics of Discussion

Trends and challenges in Product and Process Development

Emerging Best Practices - Digitalization

Model Based (x) Definition. Enterprise and Manufacturing…

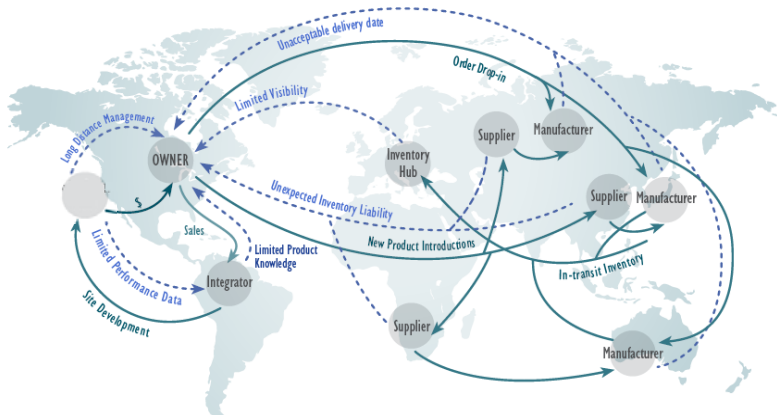
Final Thoughts

Next-Generation Smart Products and Plants built by Smart Processes
Complex systems require a new approach

New Era of Manufacturing

"The new era of manufacturing will be marked by highly agile, networked enterprises that use information and analytics as skillfully as they employ talent and machinery to deliver products and services to diverse global markets."

– ***McKinsey & Company**, "Manufacturing the Future"*



"Manufacturing operations should function as part of an agile supply system that is integrated and connected to demand"

– ***Gartner***

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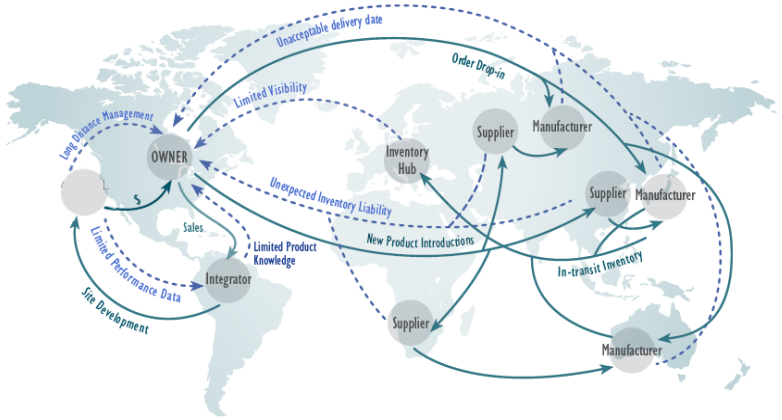
Addressing The Challenge

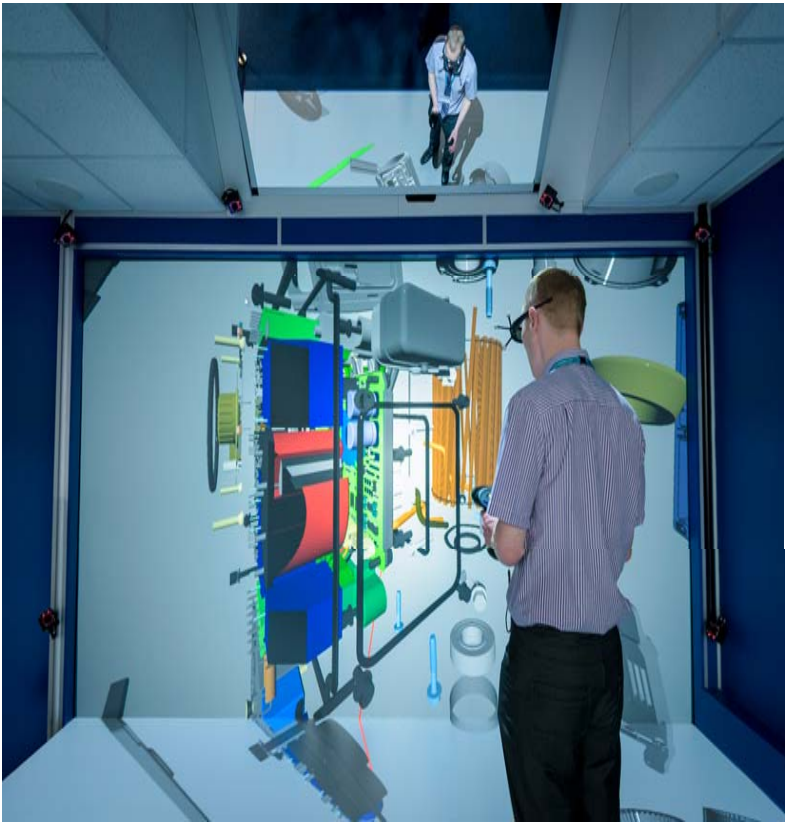
The reality is that the challenges facing global and high-growth innovation manufacturing enterprises are not trivial

- Complex products and processes
- Rapid innovation cycles
- Detailed traceability requirements
- Regulatory requirements
- Complex genealogy
- Massive documentation requirements



The solutions for the enterprise that wins in this environment require a fundamentally new approach, with new technology architected to meet these demands

Topics of Discussion



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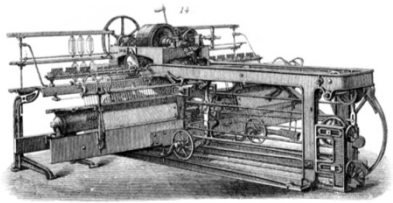
The history of the industrial revolution



Mechanical loom

End of 18th century

1. Industrial revolution

Introduction of mechanical production plants using **water and steam power**

Siemens single-phase generator

End of 19th century

2. Industrial revolution

Introduction of production based on the division of labor using **electrical energy**

1970

Programmable Logic Controller

3. Industrial revolution

Use of electronics and IT to increase the level of automation

2015-2020

Industry 4.0

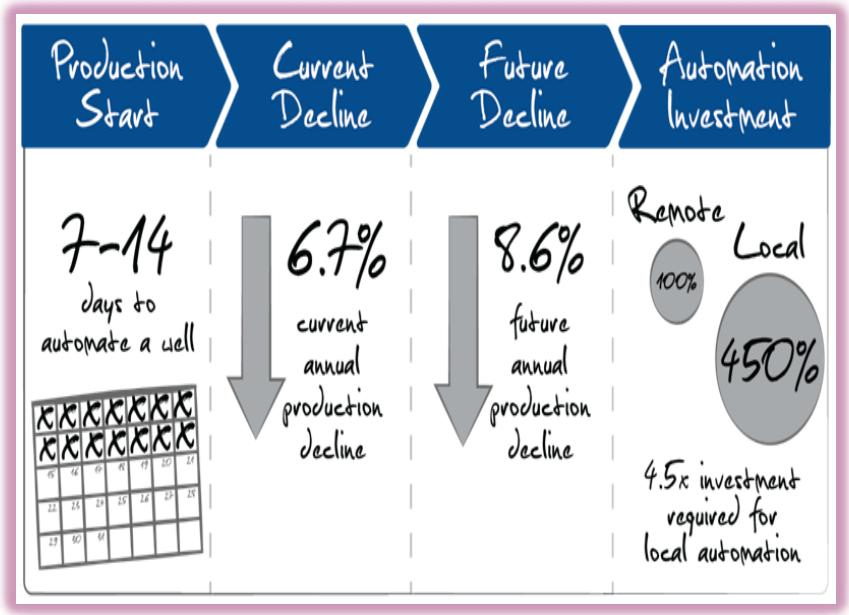
4. Industrial revolution

Intelligent automation and integration of physical & virtual world

- **Cyber Physical Systems (non existent in Industry 3.0)**
- **Interoperability (not provided in Industry 3.0)**
- **Automation Pyramid (does not exist anymore in Industry 4.0)**

An industrial revolution was always driven by new enabling technologies

Constraints and Barriers

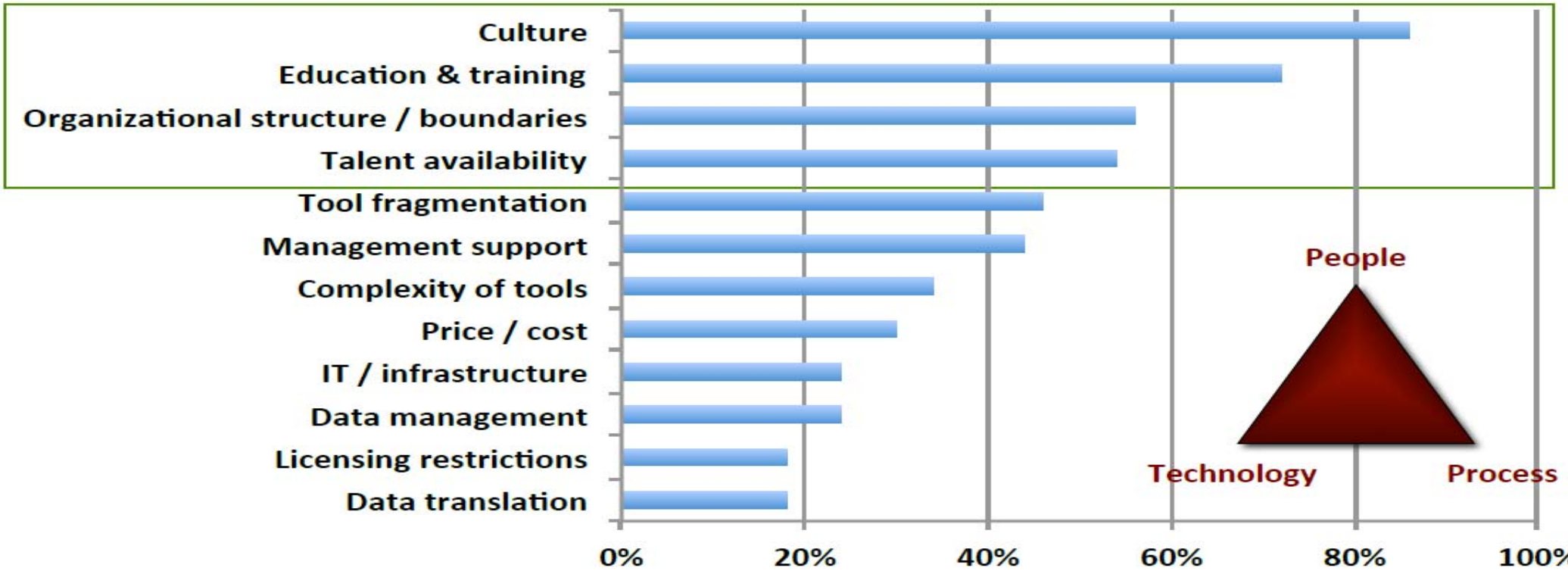


- **Uncertainty in project demands and quality of deliverables.**
- **New and constantly changing requirements and regulations,**
- **Product, Plant and Process complexity along with rapidly changing technology**
- **Digital data explosion**
- **Product Ideation thru Engineering Alignment and traceability with and through Manufacturing**
- **Globally diverse geographies along with global supply chains**

Barriers To Industry Implementation

What people cited as problems to overcome in adopting & using MBE/MBSE

- It is about people & process—not just technology



A Leading Practice is to Enable Excellent Performance on Every Project

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Critical Success Factors

Fully support a Model Based Enterprise, Digital Twin – Digital Thread to better meet cost, technical and schedule program goals

Provide pre-configured technology to focus on the automation of specific Mfg value streams to provide a potential competitive advantage

Leverage the smart innovation Portfolio to enable product knowledge & definition to be shared to improve performance in production, support and future bids

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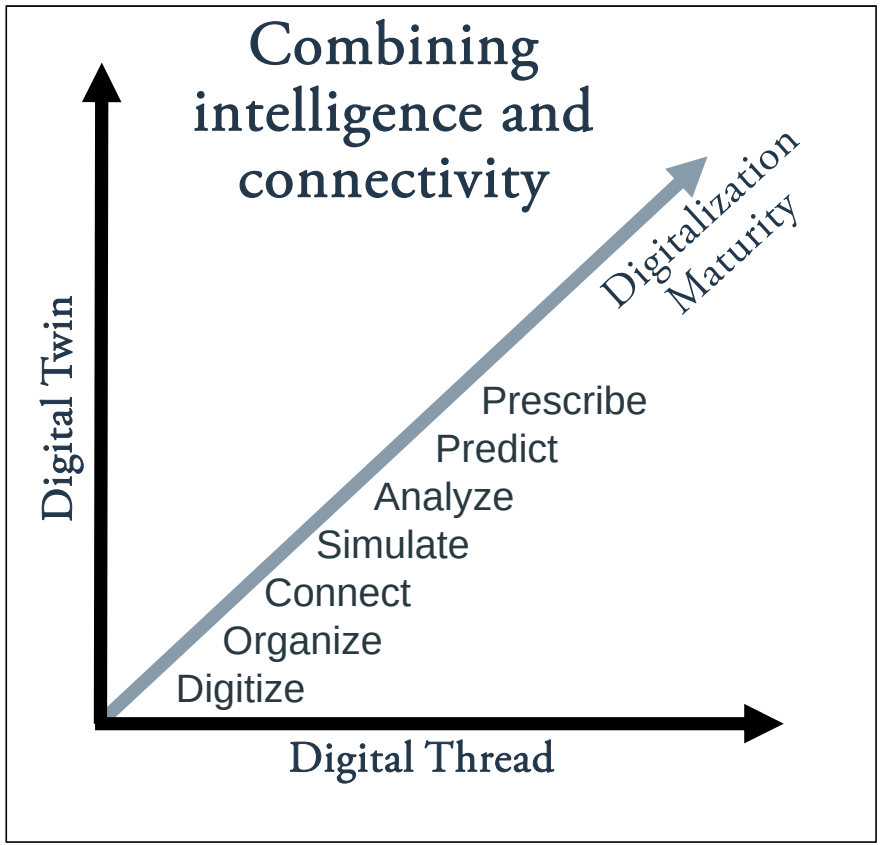
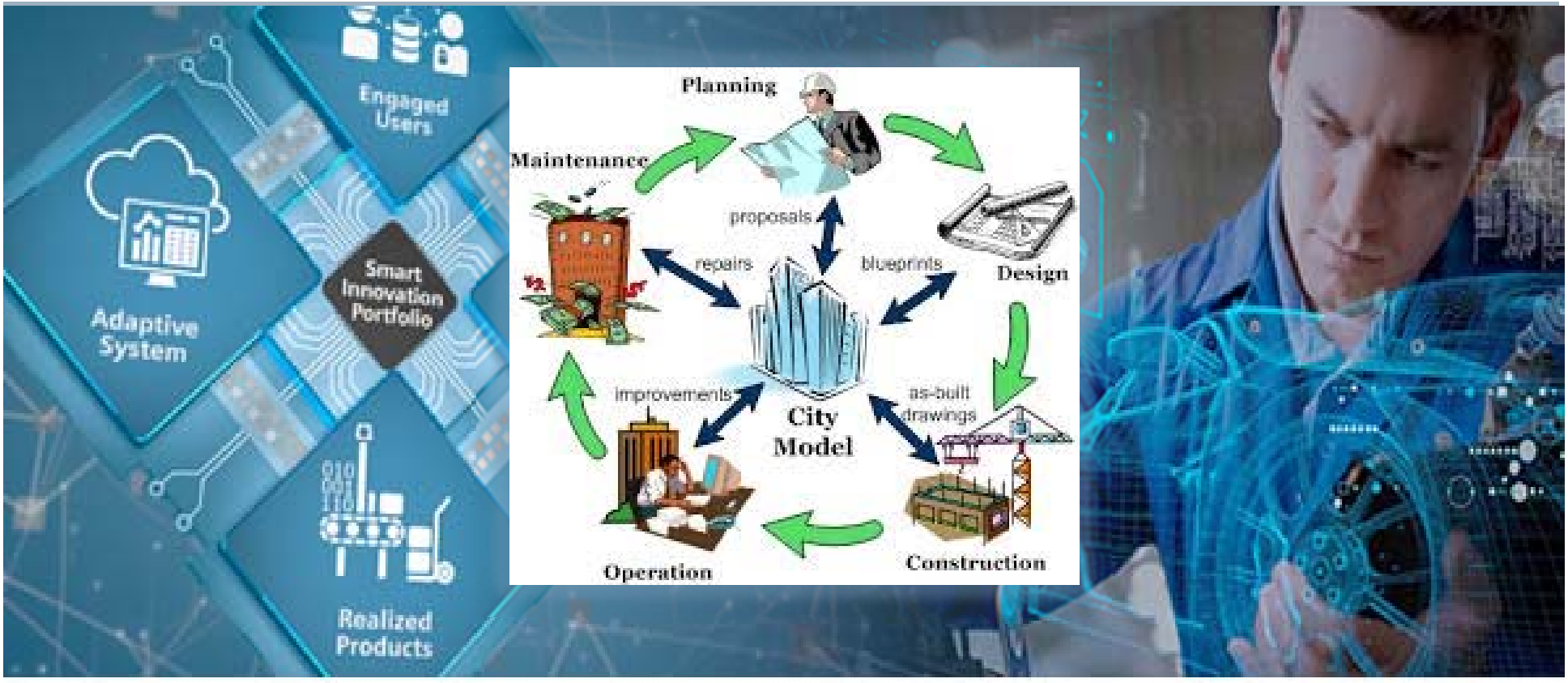
Digitalization is supported by a Model Based Strategy

Digitalization makes the digital thread a proactive agent to drive new business opportunity.



Delivering the Smart Innovation Platform



Model Based Strategy's Defined

TREND: Innovation

Product development projects are underway, each with slightly different goals, mostly related to Technical Data Packages and Data Rights. ***Model Based Systems Engineering (MBSE) and Model Based Definition (MBD)*** enables Creativity and capture of key definition data

TREND: Innovation

MBSE - System Modeling functions performed with sysml/UML… and are usually abstract models utilized early in the system/product development phase ensuring the Systems / products meet the performance and behavioral requirements of the desired end state.

TREND: Innovation

MBD - Focuses on a high-fidelity predictive modelling platform. MBD provides all the facilities needed to perform and define utilization targets within a powerful modelling and solution engine capable of generating the high-accuracy predictive information on which key design and operating decisions are based.

Model Based Strategy's Defined

IMPLICATION: Realization

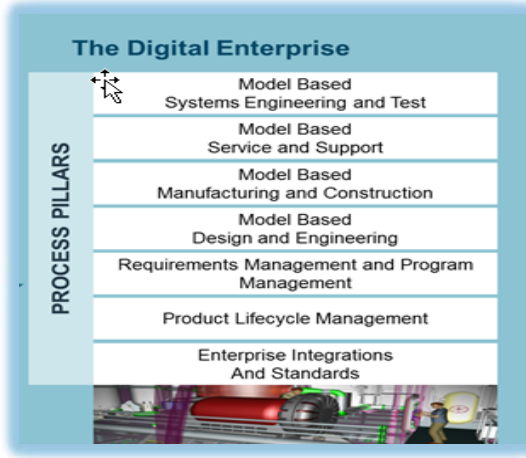
Executives and the Enterprise need a higher level of definition to get desired and defined results – operational suitability at lowest total ownership cost. (Enabled by ***Model Based Enterprise (MBE)***

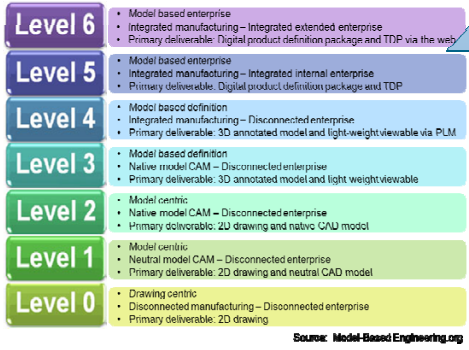
TREND: Innovation

Product development projects are underway, each with slightly different goals, mostly related to Technical Data Packages and Data Rights. ***Model Based Systems Engineering (MBSE) and Model Based Definition (MBD)*** enables Creativity and capture of key definition data

POSSIBILITY: Utilization

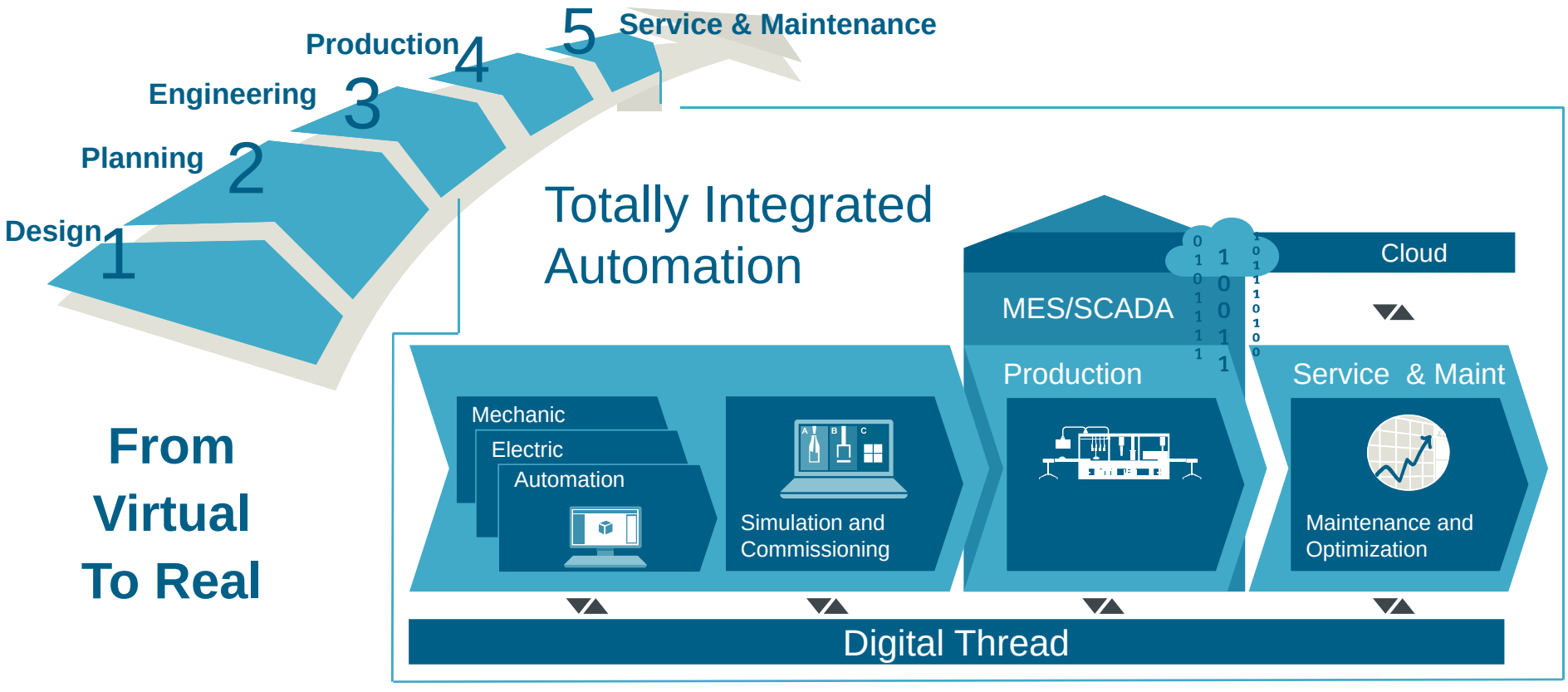
Manage the system lifecycle with PLM tools to optimize end-to-end process starting with the Abstract Ideation through Digital Design through ***Digital Model Based Manufacturing, Quality, Compliance*** … including Digital Sustainment, and end of life.





Engineering Automation

Value through digitalization with Horizontal and Vertical integration



Totally Integrated Automation –
the basis for future industrial concepts

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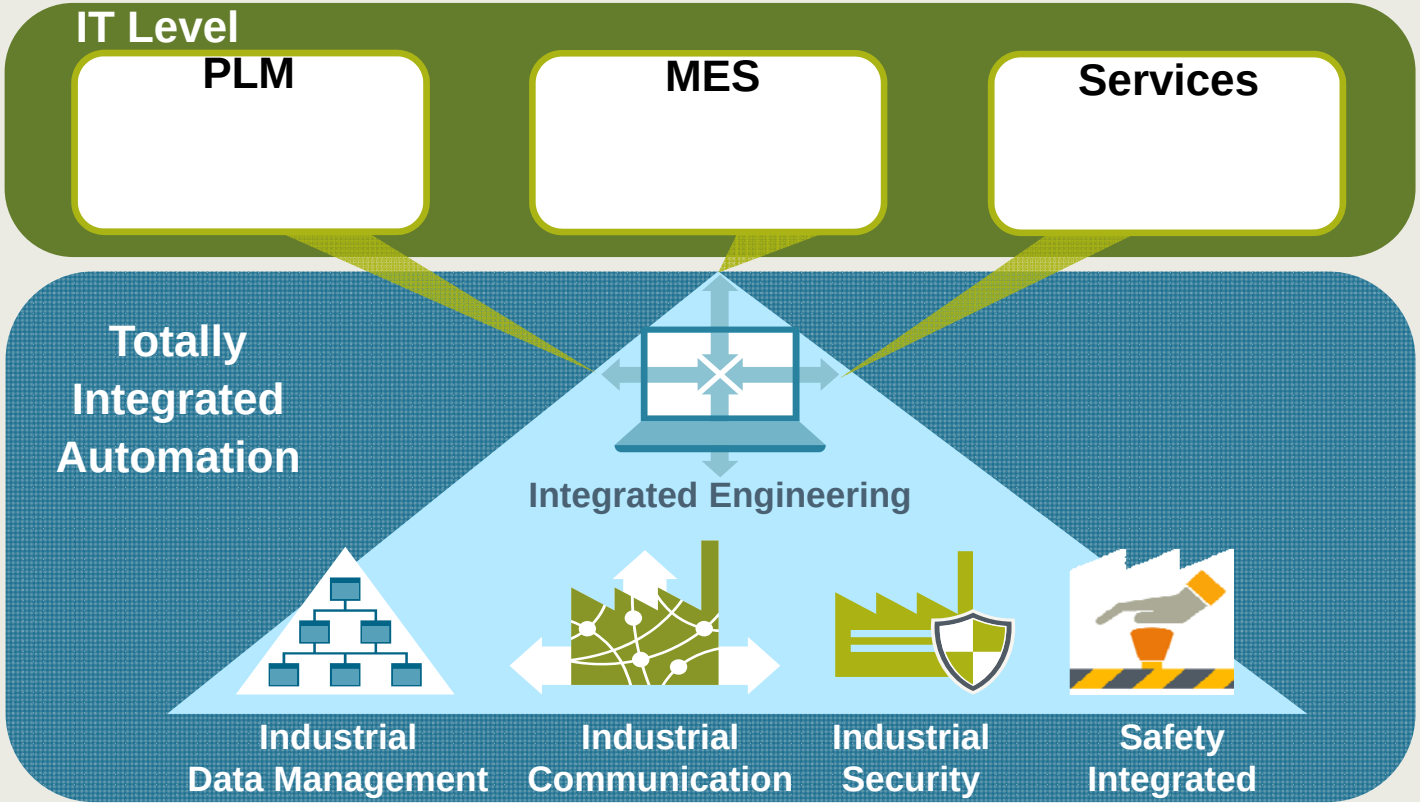
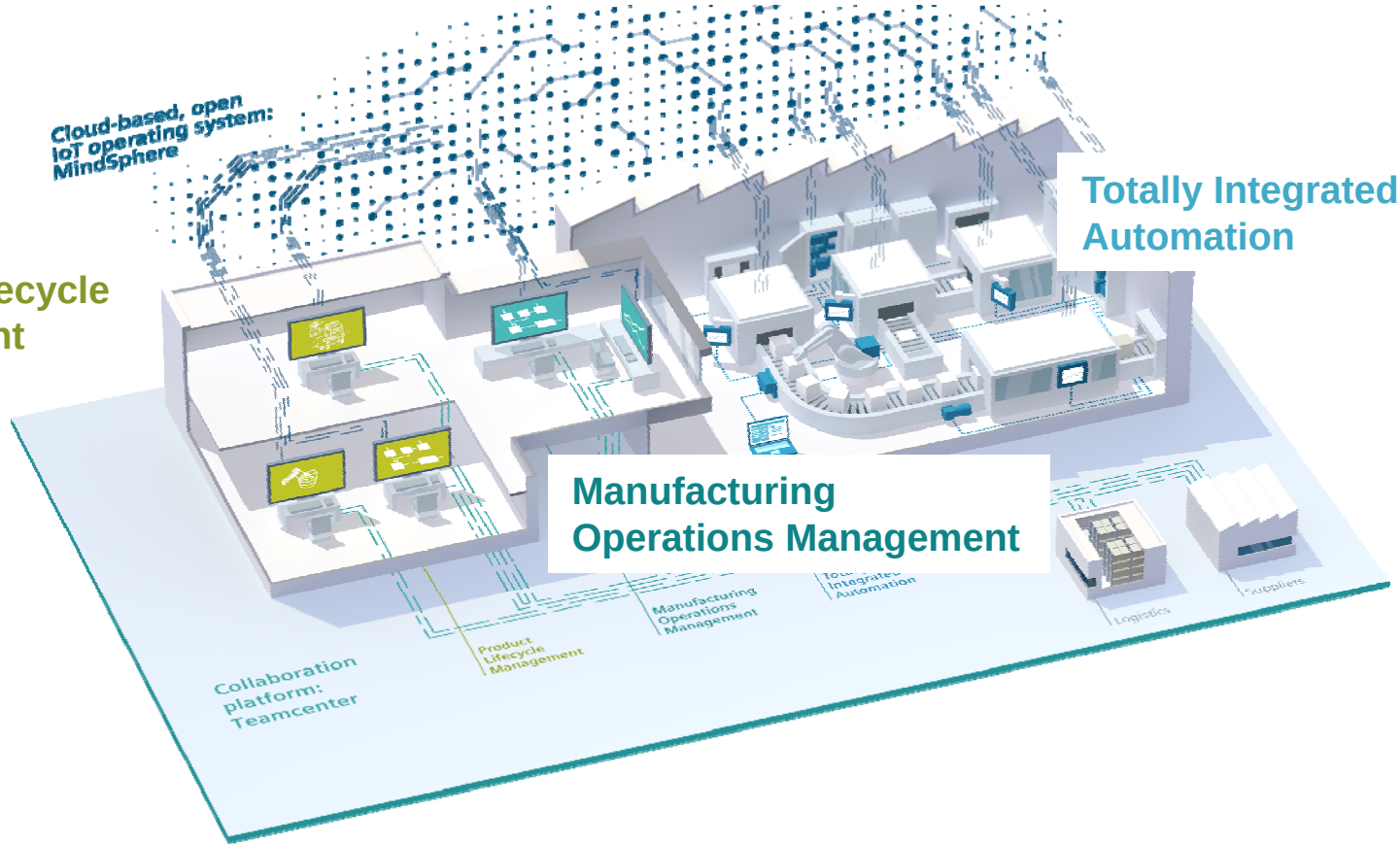
Automation Framework

- Automation framework
- Industrial computers
- Intelligent controllers
- Engineering and visualization software



Holistic Model Based Solutions feeding the Digital Enterprise

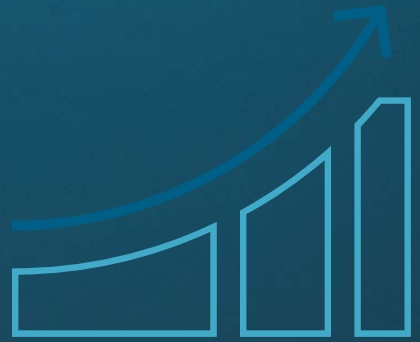


fast

flexible

efficient

quality



For Example – Siemens Amberg

Speed

1 per second

We produce more than 1 million products per month – one per second.

Flexibility

A growing portfolio of **1300** products digitally designed for 60,000 different customers.

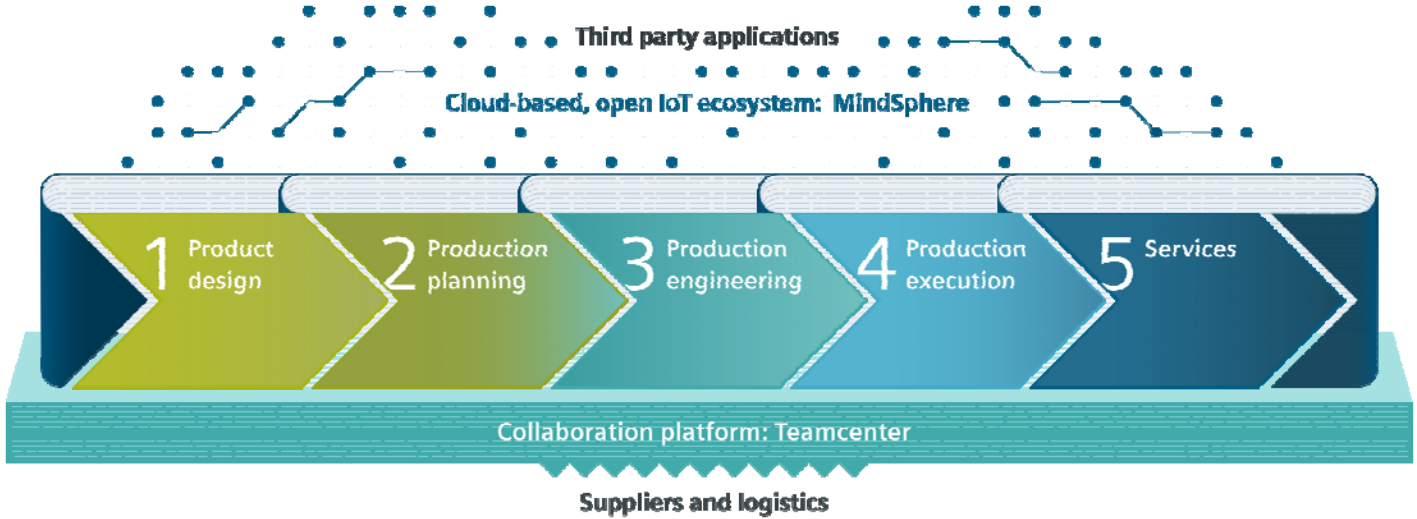
Quality

Quality level of **99.99885%**

or 11.5 defects per million.

1 Product design → 2 Production planning → 3 Production engineering → 4 Production execution → 5 Services

Integrating and digitalizing the entire value chain is key to staying competitive in the future



Digitalized Production Systems

The digital thread extending from design through production

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Pro(x) Definition

Bill of Materials

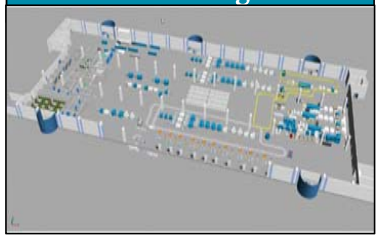
Electronic Work Instructions

Bill of Process

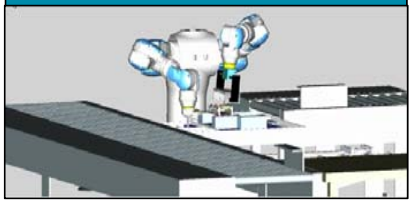
As Built

Common Manufacturing Model

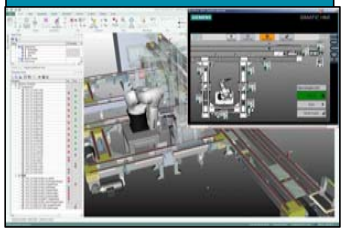
Line Design



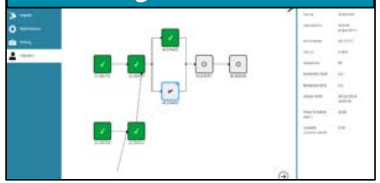
Line and Production Controls



Machine Behavior



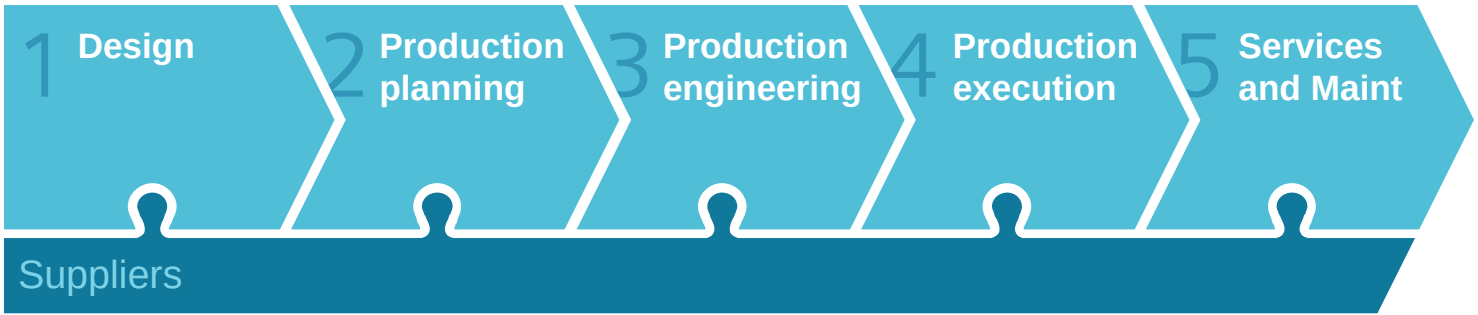
Mfg Execution

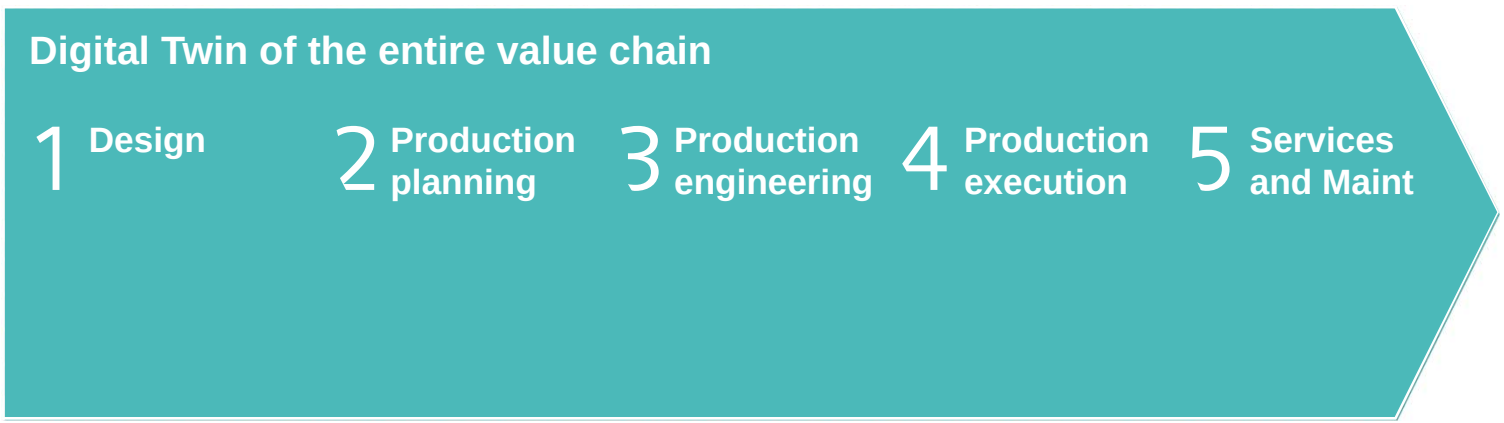


Real Production

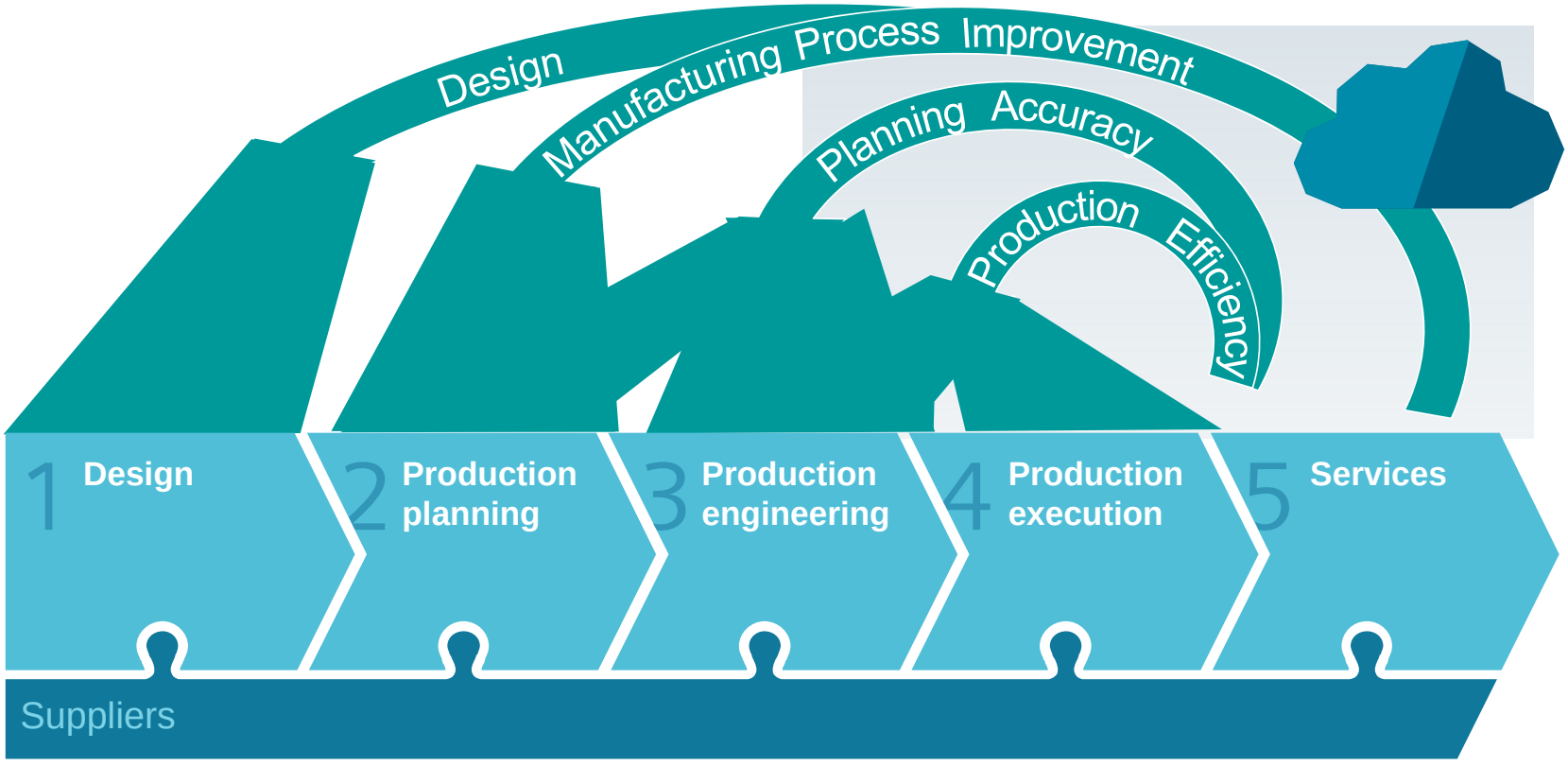
The Holistic Approach for the Enterprise

Holistic approach





Feeding Back Insights from Realization and Utilization
Makes a Smart and Agile Value Chain



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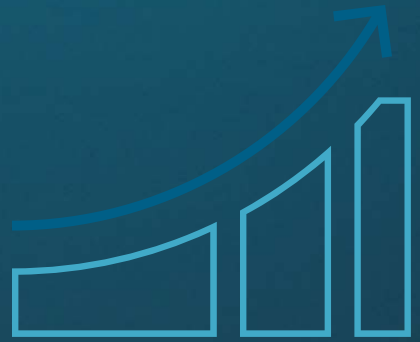

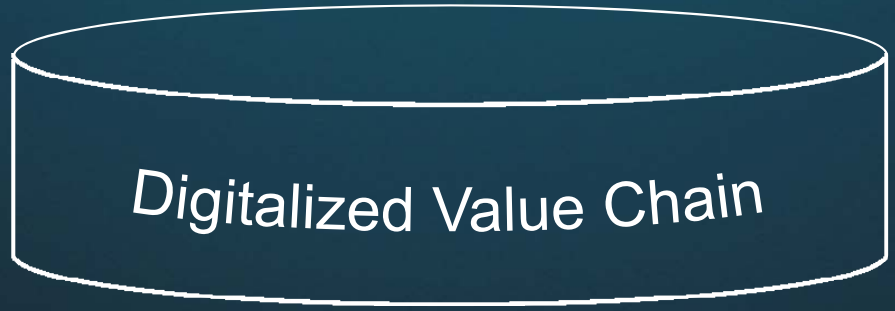

“Lesson Learned” Model Based Definition and Development

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- Master complexity to maximize innovation and minimize risk
- Understand the impact of change early to avoid later lifecycle costs
- Respond directly and immediately to market demand and customer changes
- Develop and produce with maximum flexibility in mind

Siemens' answer to Industry 4.0

Digital Enterprise Software Suite

Siemens answer to Industry 4.0

Siemens' answer to Industry 4.0

Digital Enterprise Software Suite

- Before you can operate a disruptive business model you need a digitalized value chain
- Siemens and other visionary customers have already started their journey
- Siemens has proven that our open platform enables revolution through evolution

Thank You