“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

Road to the Digital Enterprise
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.”


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

– Gartner
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
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Model Based (x) Definition. Enterprise and Manufacturing…

Final Thoughts
The history of the industrial revolution

1. Industrial revolution
   - Introduction of mechanical production plants using water and steam power

2. Industrial revolution
   - Introduction of mass production based on the division of labor using electrical energy

3. Industrial revolution
   - Introduction of electronics and IT to increase the level of automation

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

- Culture
- Education & training
- Organizational structure / boundaries
- Talent availability
- Tool fragmentation
- Management support
- Complexity of tools
- Price / cost
- IT / infrastructure
- Data management
- Licensing restrictions
- Data translation

People Technology Process

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A Leading Practice is to Enable Excellent Performance on Every Project

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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- Emerging Best Practices - Digitalization
- Model Based (x) Definition. Enterprise and Manufacturing...
- Final Thoughts
Digitalization makes the digital thread a proactive agent to drive new business opportunity.
Delivering the Smart Innovation Platform
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.

**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

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.
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

From Virtual To Real

Totally Integrated Automation

Digital Thread

Mechanic Electric Automation
Simulation and Commissioning

Production

Service & Maint

Maintenance and Optimization

Cloud

MES/SCADA
Totally Integrated Automation – the basis for future industrial concepts

Automation Framework

- Automation framework
- Industrial computers
- Intelligent controllers
- Engineering and visualization software
Holistic Model Based Solutions feeding the Digital Enterprise

Product Lifecycle Management

Manufacturing Operations Management

Totally Integrated Automation

Cloud-based, open IoT operating system: MindSphere
fast

flexible

efficient

quality

Digitalized “Value Chain” Thread
For Example – Siemens Amberg

1 per second

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

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

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

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
Real Production

Mfg Execution
The Holistic Approach for the Enterprise

Holistic approach

1. Design
2. Production planning
3. Production engineering
4. Production execution
5. Services and Maint

Suppliers

Digital Twin of the entire value chain

1. Design
2. Production planning
3. Production engineering
4. Production execution
5. Services and Maint
Feeding Back Insights from Realization and Utilization
Makes a Smart and Agile Value Chain
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Final Thoughts
“Lesson Learned” Model Based Definition and Development

- 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

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