

INDUSTRY 4.0: How the New Interaction Between Man and Machine in Smart Factories Will Help Create More Intelligent Products in the Aerospace Industry ?



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Industry 4.0: Fact or Fiction ?



- **Industry 1.0 (1784)**

Steam power – Mechanical production

- **Industry 2.0 (1870)**

Electric energy – Mass production – Assembly line

- **Industry 3.0 (1969)**

Electronics – IT – Automation

- **Industry 4.0 (2005 - Germany)**

Cyber-Physics-Production-Systems (CPPS)

Digital-Virtual-Smart Factory



Smart-Virtual-Digital Factory

Smart Factories:

- Goal:
More automation, better control & optimisation of factory processes
- Means:
Software, lasers & intelligent devices embedded in machines & factory infrastructure

Factory productivity

- Less waste & energy use
- Increased efficiency
- Fast turnaround
- Better quality

Virtual Factories:

- Goal:
To manage supply chains; to create value by integrating products & services
- Means:
Software to holistically interconnect & manage distributed factory assets; new business models & value propositions

Supply-chain productivity

- High-value products
- Jobs
- SC transparency
- IPR security
- CO₂ footprint

Digital Factories:

- Goal:
To "see" the product before it is produced
- Means:
Software for the digital representation & test of products & processes prior to their manufacture & use

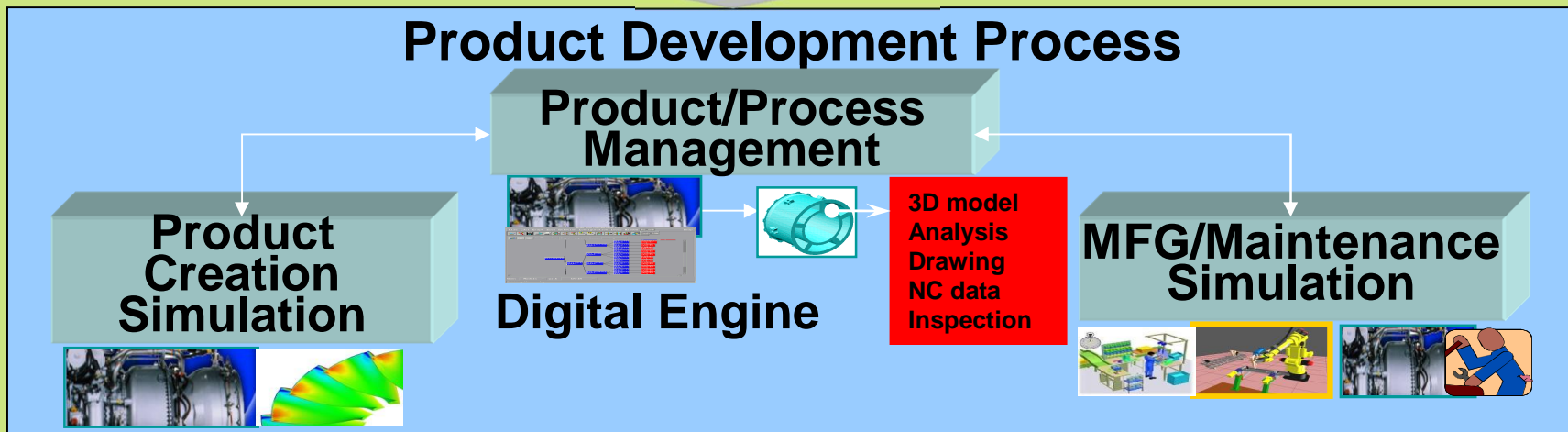
Design productivity

- Less design errors
- Better & efficient products
- Less waste + rework
- Faster time-to-market



Digital-Virtual Enterprise (Pratt & Whitney Canada)

Common Architecture



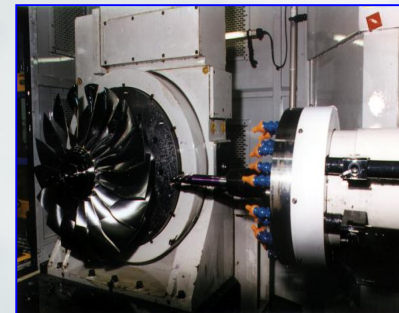
As Sold, As Designed, As Planned, As Produced, As Maintained



EU Factory of the Future (EFFRA 2010)



- Sustainable Manufacturing
- High Performance Manufacturing
- Exploiting New Materials Through Manufacturing
- ICT-Enabled Intelligent Manufacturing



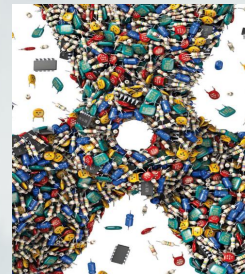
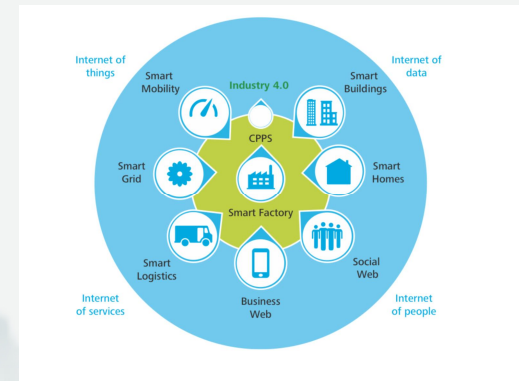
Industry 4.0 *(Deloitte, 2015)*

Digital Transformation

- Vertical Networking
- Horizontal Integration
- Through-Engineering
- Acceleration Through Exponential Technologies

Age of Disruption

- Artificial Intelligence
- Advanced Robotics
- Collaborative Connected Platforms
- Networks
- Advanced Manufacturing



Industry 4.0 Factories



Germany Smart Factory

Siemens Digital Factory

GE Brilliant Factory

P&WC Advanced Manufacturing Centre – Digital Enterprise

EU Factory of the Future

USA National Network of Manufacturing Innovation

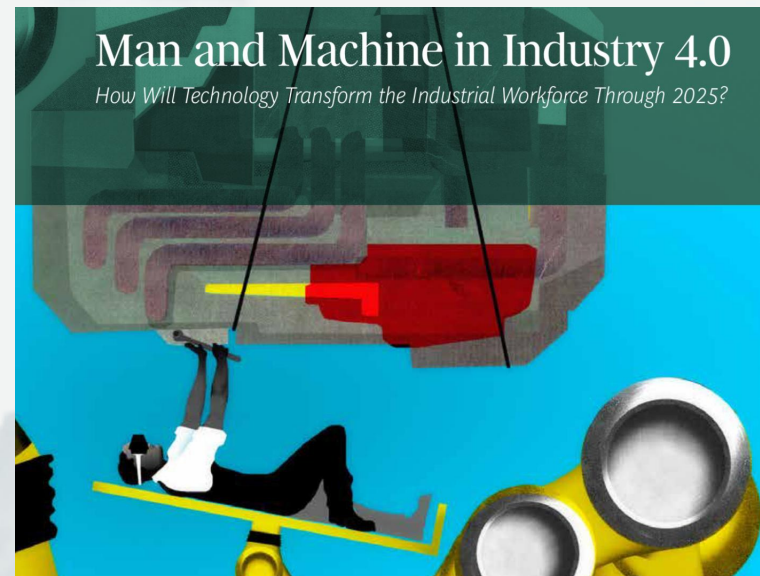
➤ **Canada: A More Intelligent Factory**



From Labor to Capital Intensive From Offshoring to Reshoring



- Big-Data-Driven Quality Control
- Robot-Assisted Production
- Self-Driven Logistics Vehicles
- Production Line Simulation
- Smart Supply Network
- Predictive Maintenance
- Machines as a Service
- Self-Organizing Production
- Additive Manufacturing of Complex Parts
- Augmented Work, Maintenance and Service



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- **Dr. Dan Schumacher**, Director of the Science and Technology Directorate at NASA/MSFC
- **Mr. Stephan Biller**, Chief Scientist for Manufacturing, General Electric
- **Mr. Simon Weeks**, Chief Technology Officer, ATI (Aerospace Technology Institute)

