Industry 4.0: Limitations and Possibilities
Chris Richards, EEF – the manufacturers’ organisation
Industry 4.0 / 4th Industrial Revolution: Limitations and Possibilities

Chris Richards
EEF, the manufacturers’ organisation
www.eef.org.uk/fourthindustrial
Twitter: @EEF_Economists
EEF - OUR WORK TO DATE

• EEF exists to champion manufacturing and manufacturers in the UK

• We’ve worked closely with our members, partners and wider stakeholders to develop our understanding of the changes taking place within the sector. That work has been centred around four questions:
  1. Is 4IR hype? Or do manufacturers need to take this seriously?
  2. Is the UK manufacturing sector up for this?
  3. What are the tangible things that manufacturers can do?
  4. What else do manufacturers need to do?

These questions and the resulting narrative has been informed by our work to date: focus groups, surveys, manufacturing forums and discussions with government, European partners and others.

www.eef.org.uk/fourthindustrial
The 4th Industrial Revolution (4IR) is real [and will bring benefits]

It’s a journey [and not a big bang change]

Success is more dependent on company culture [and less about making huge investments in technology]
What is Industry 4.0 / the 4th Industrial Revolution?
IN MANUFACTURERS' OWN WORDS – WHAT IS 4IR?

Connectivity and Communication
Next step in optimisation and efficiency
Information flow and exchange
Information and knowledge from data
Real time information availability
Speed of change is the difference
An enabler of ambition
Quicker innovation
Ability to provide answers more quickly
ABOUT CAPTURING INSIGHTS FROM DATA

96% of manufacturers agree that the 4th industrial revolution will be about connectivity and communication.

99% of manufacturers agree that the 4th industrial revolution will be about getting actionable insights from data.

87% of manufacturers say they will have to invest in new technology to meet customer expectations.

EEF Business Environment Survey 2016
Is 4IR real?
DRIVING FACTORS

Extract commodities

Make goods

Deliver services

Provide outcomes or experiences
HAPPENING GLOBALLY

4IR IS HAPPENING ACROSS EUROPE

Known by other terms in Europe and around the world. This is a global revolution.
3 PHASES TO THE TRANSFORMATION

Conception

Evolution

Revolution

What is this?

What difference can it make?

How are others taking advantage?

Current practice

Optimisation

Step change

What is my company’s strategy and ambition?
ABOUT MAKING MANUFACTURING SMARTER

SMARTER PRODUCTS / PRODUCTION / SUPPLY CHAINS

PREDICTIVE MAINTENANCE
DIGITISING QUALITY MANAGEMENT
DIGITISED WAREHOUSE – RFID TRACKING OF INVENTORY
POTENTIAL BARRIERS

Not sure what this can deliver

Interoperability of data and platforms

Security of data sharing

Digital infrastructure

Can’t quantify a return on investment

Ownership of data
**LIMITS**

| Data can only tell you so much | • Company culture and ambition perhaps more important  
  • The end goal of all this is informed decision making on more critical issues |
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Relies on unprecedented and multifaceted levels of trust</td>
<td>• Trusting suppliers, trusting customers, trusting networks, trusting machines, trusting employees</td>
</tr>
<tr>
<td>The political and economic environment</td>
<td>• This isn’t taking place in a vacuum</td>
</tr>
</tbody>
</table>
NOT ALL ABOUT TECH – OTHER THINGS TO DO

Foster a culture of innovation
- Enable staff to develop tests and fail early, fast and often

Visionary leadership
- Recognise need to move from day to day management to having a clear vision and direction of travel

Role of IT
- Re-enable IT department, integrate them in your business planning, encourage to collaborate and seek knowledge externally
Benefits
4IR can bring benefits, manufacturers see these as delivering greater customer value, productivity improvements and remaining competitive.

- 74% say will fundamentally change customers’ expectations
- 87% say will have to invest in new technology to meet customer expectations
- 61% say they could be using digital technologies more to boost their productivity
The 4th Industrial Revolution (4IR) is real [and will bring benefits]

It’s a journey [and not a big bang change]

Success is more dependent on company culture [and less about making huge investments in technology]
Questions?

Chris Richards
EEF, the manufacturers’ organisation
www.eef.org.uk/fourthindustrial
crichards@eef.org.uk
INDUSTRY 4.0
AND THE FUTURE OF THE PLASTICS INDUSTRY

Steve Brambley
Jun 2017
Representing the Instrumentation, Control, Automation and Laboratory Technology industries in the UK

- **200+ Members**
- **Industry turnover**: £6.9b
- **Export value**: £3.7b
- **40,000 Industry employees**
- **Standards committee representation**: 100+
- **75% GAMBICA member industry representation**

Ranked 2nd by BSI
Industry 4.0

Networking of human beings and smart objects

Convergence of the physical world and virtual world

Collaboration
Benefits of automation

Automation

Delivers

- Productivity
- Throughput
- Quality
- Repeatability
- Energy Efficiency
- Safety
- Reliability
- Control
Benefits of Industry 4.0

Connected and autonomous

Manufacturing Systems
Business Systems
People

Delivers

Increased Flexibility
Customised Products
Localised Manufacturing
Shorter Lead Time
Through-life connected products

Design → Manufacturing → Use → Dispose/Recycle

- Design
- Manufacturing
- Use
- Dispose/Recycle

- Maintenance
- Production Planning
- Resource Planning
- Safety Systems
- Quality Systems
- Energy Management
- Logistics
- Human Resources
Benefits of Industry 4.0

Connected and autonomous

Manufacturing Systems

Business Systems

People

Delivers

Increased Flexibility

Customised Products

Localised Manufacturing

Shorter Lead Time
Increased Flexibility

Quick reactions to breakdowns and unexpected events

Rescheduling based on supply chain availability and delivery

Autonomous maintenance scheduling and spares ordering based on condition monitoring

Flexible employee work patterns
**Benefits of Industry 4.0**

**Customised Products**

- Multiple variants on the same machines, lines, cells
- Bespoke designs, mass-customised
- Customer design tools
- Unique product variants in small batch sizes
Benefits of Industry 4.0

Localised Manufacturing

Distributed manufacturing in locations close to market

Contract manufacturing locations – Uber factories

Mobile manufacturing on customer site
Benefits of Industry 4.0

Shorter Lead Time

Modelling and simulation of products and manufacturing process

Design to Manufacture time shortened

Quicker set up / product change cycles
Several aspects

Green Paper

Challenge Fund

Digital4Industry

Industrial Digitalisation Review
A REVIEW OF INDUSTRIAL DIGITALISATION HAS BEEN COMMISSIONED TO INFORM THE UK’S INDUSTRIAL STRATEGY

Digital technologies are transforming our world, disrupting business operations and driving new value propositions. Whether known as Industrie 4.0, the Industrial Internet of Things or Smart Manufacturing, the future of manufacturing is already being shaped by this revolution.

Keeping the UK competitive in this fast moving landscape is vital. As part of developing a UK Industrial Strategy, the Government has commissioned a Review of Industrial Digitalisation, led by Juergen Maier, UK CEO of Siemens.

“Our review is about defining how the UK can best adopt radical new technologies that will boost productivity and create new high tech jobs across manufacturing and industry”

Juergen Maier
The proposal is for the UK to create and utilise 3 regional Smart Manufacturing Living Laboratories with a focus on:

- Improving productivity
- Inspiring ambition
- Developing skills
- Developing capability

The project budget is for £30m over 5 years, using a matched funding model – 50% from industry, 50% from government.
Events and Publications

15-16 Nov 2017
Liverpool

28 Feb 1 Mar 2018
Manchester
Making the Connection:
Real-time Manufacturing Execution Systems (MES) and Industry 4.0

Andrew Jewell – MES Consultant
Industry 4.0 creates what is or can be called a "smart factory". Within the modular structured smart factories, cyber-physical systems monitor physical processes, create a virtual copy of the physical world and make decentralized decisions.

Over the Internet of Things, cyber-physical systems communicate and cooperate with each other and with humans in real time, and via the Internet of Services, both internal and cross-organizational services are offered and used by participants of the manufacturing value chain (Wikipedia).
What is the objective of “Industry 4.0”? 

• **Inter-operability**: The ability of machines, devices, sensors and people to connect and communicate with each other via the Internet of Things (IoT) 

• **Transparency (of Information)**: Real-time transmission of key raw sensor and machine data to higher level (and higher-value) information systems i.e. shop-floor to top-floor/manufacturing to global enterprise systems… sensor to eventual Enterprise ERP and BI 

• **Technical assistance**: Easy to interpret information for allowing individuals to make more well-informed decisions and solving urgent problems in real-time. Also, to support people by conducting a range of tasks that are repetitive, mundane, exhausting, unsafe and so on 

• **Decentralized decision-making**: Localised controls and systems make/take local decisions (as far as possible). Exceptions are interference and conflicting goals (that require higher level computer and/or human input).
How does this translate into (real-world &) real-time MES?

The basic principle of Industry 4.0 is that by connecting sensors, machines and software systems (including people), businesses are creating more intelligent and quicker networks along the entire value chain that can more automatically and autonomously control each other and create “added value” (increased productivity/profitability) in the process.

Example: Software/machines that can predict a failure and trigger a maintenance process autonomously (prior to an unscheduled/catastrophic failure).

Production, machines, equipment and people will become more and more networked until everything is inter-linked with everything else.

In an Industry 4.0 scenario, the boundaries of individual factories will most likely no longer exist. Instead, they will be lifted in order to inter-connect multiple factories across multiple geographical regions.
We calculate OEE how many different ways???

Why are our machines not running consistently well?

Production problems cause schedule conflicts.

SPC/SQC…what’s the best way to tackle it?

Let’s do something to avoid recalls.

New machine or different maintenance schedule?

Why are some shifts better than the others?

We're [not] capacity constrained.

Why are our machines not running consistently well?

Production problems cause schedule conflicts.

We calculate OEE how many different ways???

Let’s do something to avoid recalls.

Why are some shifts better than the others?

New machine or different maintenance schedule?

Why are some shifts better than the others?

We're a “Lean” shop … why aren't we getting better?

What’s the real story on efficiency and utilisation?

Why are we always shipping orders “last minute”?

What can we do to boost quality and on-time orders?

We can’t take on more business unless we buy more machines.

...but the ERP system says we can do all these orders today...

We *have* data … why does it take so long for answers?

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Why are we always shipping orders “last minute”?

What can we do to boost quality and on-time orders?
Applicable Industries & Verticals - Discrete Manufacturing

- Plastics and rubber
- Automotive components/parts
- Electronic boards
- Medical devices/mouldings
- Printing
- Assembly operations
- Containers (Plastic/Paper/Card)
- Food
- Pharma
- Packaging
- Fabricated metals, metal parts
- Injection moulding
- Thermo-forming
- Metal-forming
- High-speed print
- Extrusion
- Blow-moulding
- Die-casting
- Metal extrusion
- Cable manufacturing
- CNC machining (Computer Numerical Control)
Collecting Machine and Shop Floor Data?

Current adopted methods

• Manual/paper based time-sheets
• ERP - MES functionality
• Scanning bar-codes
• Direct from sensors/machines/equipment
Key Requirements – Automated Manufacturing Execution System

- Production monitoring
- Process monitoring
- Real-time plant-floor scheduling/planning
- Real-time & historical reporting and analytics: Plant and Enterprise
- Energy monitoring
- Quality monitoring

- Will provide **real-time, accurate** data
- Allows for **asking** the right **questions**
- The result is **well-informed, timely** decisions to allow human and/or automated adjustment to improve the current situation i.e. improve productivity and profitability
Real-time MES

- Data directly from equipment (via electronic & computer interfaces)
- Monitor machines automatically, analyse production and performance 24x7
- Operators provide additional input. Easily add/retrieve data

**Translates into:**
Increased production in the same (available) time, with the same (or a lesser) quantity of machines, labour and/or energy
Real-time MES solves manufacturing/shop-floor problems...

• More **CAPACITY** without more assets
  Less downtime for more parts and less cost

• Improve **THROUGHPUT**
  Reveal and analyse loss – output speed/cycle-time/line rates

• Improve quality/**REDUCE SCRAP**
  Reveal quality losses and reasons

• Improve Overall Equipment Effectiveness/Efficiency **OEE**

• Improve use of (direct & in-direct) labour – **REDUCE COST**

• Monitor energy consumption – **LESS ENERGY USE**
The old way…

- **PERFORMANCE ANALYSIS**
- **LOSS ANALYSIS**
- **PRODUCTION PLAN**
- **MANUAL ENTRY**
- **ERP**
- **SCHEDULE ADJUSTMENTS**
- **PRODUCT COUNT**
- **SCRAP COUNT**
- **SCRAP REASONS**
- **DOWNTIME CALCULATION**
- **DOWNTIME REASONS**

**SCRAP**
A new approach **and complementing** ERP…
• Data Collection Equipment
• Touch Screen (PC/Tablet) Technology
• Real-time data from any machine via digital and/or analog outputs, OPC and/or direct-to-PLC interfaces
• Real-time insight & data input from machine operators
Achieving system connectivity

- ERP SERVER
- LAN or WAN
- MES SERVER
  - MS WINDOWS SERVER
  - MS SQL SERVER
- QUALITY CONTROL
- ASSEMBLY DEPARTMENT
- PLANT MANAGER
- PRODUCTION CONTROL
- DATA COLLECTION UNIT
- DATA COLLECTION UNIT
- OPC (OPEN PLATFORM COMMUNICATIONS) COMPLIANT PLC
- SHOP FLOOR HMI (SINGLE MACHINE)
- SHOP FLOOR HMI (MULTIPLE MACHINES)
Who uses it and why?
Real-time MES

TOP FLOOR (CORPORATE)
- ENTERPRISE ANALYTICS

PLANT MANAGEMENT
- PLANT ANALYTICS

PLANT OPERATIONS
- PERFORMANCE ANALYTICS
  - REAL-TIME PRODUCTION DISPLAYS
  - SPC & SQC
  - VISUAL, DYNAMIC SCHEDULING
  - ENERGY MONITORING

SHOP FLOOR
- SHOP FLOOR "TOUCH SCREEN" HMI
- PLC, OPC, OPC CONNECTOR
- REAL-TIME PRODUCTION DISPLAYS
- REAL-TIME METRICS

MES

“SHOP FLOOR TO TOP FLOOR (REAL-TIME DATA TRANSFER)”
Real-time Operational Visibility

- Real-time production monitoring (instant data)
- Direct from the machine (fast/accurate data)
- Automatic (eliminate manual intervention)
- Insight (with operator depth and dimension)
- Instant feedback – know the “reality” 24x7
Real-time Planning / Scheduling

Ensure accurate tool – machine – job combinations Identify the right tool for the right job at the right time in real-time

Meet “Promise to Order” Drag and drop reassignment of jobs. Visual highlight of resource & constraints

Avoid resource conflicts Incorporate labour, planned maintenance, materials and planned downtime to optimize production
Ensure Quality - SQC & Process Monitoring

Real-time and flexible
High performance connectivity
Process and SQC tools to achieve “Zero Defects”

Accessible and Intuitive
Operators, Management, Engineering, Process Technicians, Quality
Energy Monitoring

Real-time energy monitoring (instant data)

Direct from individual machines (accurate data)

Automatic (eliminate manual intervention)

Instant feedback – know the “usage” 24x7

Aid reduction in energy usage
Manufacturing Reports & Analytics

**High performing reporting & analytics**
Meeting elevated user expectations
Easy to interpret real-time/historical analysis

**Collaboration**
Single plant score-card or enterprise
Drill through / drill down analysis

**Out of the box continuous improvement**
Flexible reports & analytics
Out the box score-cards with over 1,000 analysis choices
User/Operator Interface

Real-time Shop-floor HMI
Flexible deployment options
Customisable
Support Mobile / BYOD

Rich Experience
Real-time production and equipment visibility
Alerts and notifications

Accessible and Intuitive
Operators, Process, Quality, Engineering, Management
“Paper-less” Shop-floor Environment

Embedded context-based videos, PDF, Excel, Word etc files

Personalized Information Panels

Additional Workflows
Integration with ERP Systems

Data exported from ERP
- Scrap codes
- Indirect downtime labour codes
- Resources marked as tools
- Manufactured parts
- Production methods and operations
- Production jobs
- Preventative maintenance jobs
- Material BOMs
- Manufacturing employees

Data exported from MES
- Labour details
- Labour completed parts and the quantity completed
- Labour equipment counter associated with reported quantities
- Scheduling parameters including company and job data and production start and end dates

ERP export to MES. Batch process – can be manual or automatic

Output Directory for ERP export batch data

Scheduled ERP import process

Input Directory for MES export data

Scheduled MES automatic data export process

ERP/MES Integration Data Flow
Adopters & Users (Industry 4.0/Real-time MES)

Hanson Building Products
Introduced real-time MES into 6 plants. Original systems were paper based, ambiguous and wasted significant management time analysing the data. Key business decisions can now be made quickly and has resulted in close to a **30% increase in OEE** as a result of using real-time MES.

Plastique Ltd
Plastique runs a 24/7 hour operation, has 2,500 tools in stock and produces 250 new tools each year. Since installing real-time MES, it has **increased annual available time (efficiency) by 2,000 hours**, reducing the need for overtime and allowing Plastique to take on more work in the same time-frame.
Questions?

Thank-you!

Andy Jewell

+44 7769 491 499

andyjewell@intouchmonitoring.com

www.intouchmonitoring.com
BPF Industry 4.0 Seminar

June 6th, 2017
Production of Plastics and Rubber Machinery

*Estimate

Source: VDMA / National Statistical Office
World Export to UK Plastics and Rubber Machinery

* World Exports data for 2016 isn’t complete

Source: VDMA / National Statistical Office
World Exports to UK 2016 (2015)
Plastics and Rubber Machinery

Shares in %

Germany 35.8 (36.0)
Italy 19.4 (16.8)
USA 8.2 (8.7)
France 6.6 (7.1)
Austria 5.6 (7.2)
China 4.6 (3.7)
Luxembourg 3.2 (2.4)
Netherlands 2.3 (0.5)
Switzerland 2.1 (5.5)
Others 12.2 (12.0)

* World Exports data for 2016 isn’t complete
Source: VDMA / National Statistical Office
OECD Leading Indicators

12-months change rate against previous year in percent

Source: OECD, VDMA
Example Kaeser compressors: „Just buy the air you need“

Operator model
Using of collected data for the optimization of compressed air supply
Service/maintenance
4.0-Practical example

Individualised office scissors

- Pointed and round Scissor blades as inserts
- Additive manufacturing of 3D lettering
- Injection moulding of scissor handles for left and right hands
- Unique part identification with DM code
Monitoring of one machine
Monitoring of several machines
Monitoring of many machines
Networked monitoring by central computer/mobile access
Networking of machines from different manufacturers?

→ Possible with standardised interfaces!
OPC UA as Basis

Standardised information model for the exchange of data and services

Open manufacturer independent standard

Modular (object-oriented) structure

Extensive possibilities of data exchange
  » Reaction on value changes
  » Definition of Events/Alarms
  » File transfer

Extensible

Information model + Services
  → OPC UA
  + Companion Specifications

Network protocols
  → TCP/IP

Physical network
  → Ethernet / WiFi / 5G
OPC UA interfaces for plastics and rubber machines

OPC UA Specification (IEC 62541)

Companion Specification for Device Integration

Companion Specification for Industry

CS for Plastics and rubber machines
CS for Robotics
CS for Machine Vision

EUROMAP 77 (Injection moulding machine – MES)
EUROMAP 79 (IMM – Robots)

www.euromap.org/i40
Thank you
Benefits of Robot Automation
UK manufacturing is alive…

UK is the world’s 9th largest manufacturing nation

Accounts for 11% of UK GDP, employing around 2.7 million people

Responsible for 45% of UK exports

UK car factories produced 1.72m vehicles in 2016 – 17 year high
Still room for improvement

The challenges

Growing competition from overseas

Employment is up but productivity is down

Rising costs (energy & materials)

Skills shortage – 257,000 vacancies in engineering practices by 2022

We cannot keep doing the same

Use resources effectively (apply lean engineering)

Use labour effectively

- Not tied to machines

- Use skills and attributes of staff
Benefits of robotic automation

Improved productivity
- Increased yield
- Improved utilisation of other equipment
- Better utilisation of space and energy
- Better utilisation of staff

Consistent high quality
- Minimised damage & breakages
- Less waste and rework
Benefits of robotic automation

Improved competitiveness and:

- Flexibility - quick changeovers, product redesign
- Extendable production hours
- Improved health and safety
- More rewarding jobs

Leading to:

- Growth
- More jobs

But…….
UK invests far less in robots

Robot density in non-automotive sectors
(Number of robots per 10,000 employees)

Source: IFR World Robotics report – 2016
The productivity puzzle

UK economic growth continues to be hampered by low productivity
Productivity has grown by just 0.6% a year from 2010 – 2015
Growth has been achieved by employing more people rather than investing in capital assets

Two possible solutions:
- Either we all work longer hours; OR
- We work smarter, not harder, to produce more with the same level of input

GDP per hour worked, G7 countries, 2014 and 2015

Source: Organisation for Economic Co-operation and Development, Eurostat and Office for National Statistics calculations
Working smarter – how automation could help

Productivity has grown in UK transport manufacturing sector

Companies now produce 56% more per hour than in 2009

Car manufacturers now producing 11.5 vehicles per employee per year compared to 9.3 in 2009

Investment in new technology has been a major factor

Introduction of new technology has also created thousands of jobs
Not just for big companies
Providing the proof

Growing number of UK automation success stories
- Strong management with long term strategy
- Not just automotive industry

Well-executed projects
Providing excellent performance
Users gaining competitive advantage
Good financial returns
Leading to growth (and more jobs)
Application – handling and cutting
Materials handling and sprue cutting of plastic injection moulded parts including badges, pendants, pencil toppers and fridge magnets

Key benefits
✓ Lights out operation
✓ Significant reduction in waste
✓ Lower production costs improved competitiveness
✓ 33,000 pieces produced per day
✓ Estimated ROI of 18 months

“It’s a bit like the elves and the shoemaker – we arrive in the morning and the work has been done.”
Andy Knight, Director, CHX Products
Industry 4.0 – The vision
Need for robots and automation

Seamless connectivity
Leveraging information through intelligence
Smart factories
• Robots & automation

Source: The Manufacturing Technology Centre
How productive could we really be?
Copenhagen Business School

Productivity change if automation implemented as in the most automated country

<table>
<thead>
<tr>
<th>Industry</th>
<th>Best</th>
<th>Worst</th>
<th>UK position</th>
<th>UK</th>
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<td>Food, Tobacco</td>
<td>FIN</td>
<td>JPN, UK</td>
<td>=8th</td>
<td>13.7%</td>
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<tr>
<td>Textile, Leather</td>
<td>DNK</td>
<td>JPN, UK, SWE</td>
<td>=7th</td>
<td>9.7%</td>
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<td>DNK</td>
<td>JPN</td>
<td>=7th</td>
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<td>Paper, Publishing</td>
<td>FIN</td>
<td>UK</td>
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<td>Chemical products</td>
<td>ITA</td>
<td>UK</td>
<td>9th</td>
<td>29.4%</td>
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<td>GER</td>
<td>UK</td>
<td>9th</td>
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<td>UK</td>
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<td>Electronic equipment</td>
<td>JPN</td>
<td>UK</td>
<td>9th</td>
<td>24.2%</td>
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<tr>
<td>All other</td>
<td>JPN</td>
<td>UK</td>
<td>9th</td>
<td>41.3%</td>
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</table>

- UK productivity would increase by 22.3% if it was as automated as the world’s most automated country
- Projected change in employment:
  - Short term decrease
  - Longer term increase = 7.4%
Robotics: The next great leap in manufacturing
Sirkin, Zinser & Rose – Sept 2015

Three major trends behind growth of advanced industrial robots:

- Greater cost-effectiveness when compared with human labour
- Technological advances are wiping out barriers to adoption
- Arrival of systems that smaller manufacturers can afford and easily use

By 2025, the share of tasks performed by robots will rise from a global average of around 10 percent to about 25 percent across all manufacturing industries

Wider robotics adoption will boost manufacturing productivity by up to 30 percent
Cost of automation
Look beyond the short term

“If you need a machine and don't buy it, then you will ultimately find that you have paid for it, but don't have it.”

Henry Ford

Significant upfront costs but…

- Operates reliably every hour and every day
- Provides opportunity for unmanned operations
- Maximises utilisation of other machines
- Allows staff to be utilised where their skills and attributes are more effective
  - Manual operations often do not add value to product
- Produces high quality for many years (often >10 years)
Conclusion

Manufacturing must be competitive

3 Pillars for success

- Product & process innovation
- Effective organisation (lean engineering)
- Capital investment (flexible automation-robotics)

Success requires investment in equipment – “sweat the assets not the people”

Robotic automation has the potential to transform the UK’s manufacturing competitiveness and productivity
Plastics & the New Industrial Revolution
New business models with remote maintenance

Andrew Cowey – Head of Digitalisation
Digitalization changes everything.
Our customers have essential requirements – throughout the manufacturing industry

- Speed
- Flexibility
- Quality
- Efficiency

Security
Digital Enterprise is our portfolio of solutions for the digital transformation – in both discrete industry and process industry.

Digital Enterprise

Process Industries

Product design  Process and plant design  Engineering  Operation  Services

Discrete Industries

Product design  Production planning  Production engineering  Production execution  Services

Industrial Software and Automation for process industries

Industrial Communication  Industrial Security  Industrial Services

Digitalization of the field level

Industrial Software and Automation for discrete industries

Digital Enterprise Suite

Driving the Digital Enterprise for discrete industries
Integrating and digitalizing the entire value chain is key to staying competitive in the future.
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Integrating technical domains into ONE data model

- **Digital Twin of the product**
- **Digital Twin of the production process**
- **Digital Twin of the equipment**

Driving the Digital Enterprise for discrete industries
Publishing the optimized Digital Twin to all stakeholders, including suppliers, with the collaboration platform Teamcenter
Our holistic approach
Specific for end customers and machine builders

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

1. Machine concept
2. Machine engineering
3. Machine commissioning
4. Machine operation
5. Machine services

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Driving the Digital Enterprise for discrete industries
Holistic approach
Specific for end customers
Realizing innovation with 3D simulation
Human simulation to simulate, analyze, and optimize assembly processes and ergonomics
Simulate, visualize, analyze, and optimize production systems and logistics processes
Mechatronics Engineering and Virtual Commissioning

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

Digital Twin of SIMATIC S7-1500

Driving the Digital Enterprise for discrete industries
Efficient engineering of all automation components using the TIA Portal
MES and TIA coordinate the manufacture of individualized products
Plant performance with MindSphere

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

Digital Performance Twin

IDEATION

MindSphere

UTILIZATION

Digital Product Twin

Digital Production Twin

REALIZATION

Lifecycle and Data Analytics

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Driving the Digital Enterprise for discrete industries
With Siemens’ integrated technologies, Maserati was able to reduce development time considerably while increasing production output.

30% shorter development time
Close integration of suppliers

Ghibli available in 70,000 combinations

3 times more cars produced than before
Integration of two new assembly lines into existing factory

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

- NX CAD
- NX CAE
- LMS
- CD-adapco Star-CCM+
- Teamcenter
- Tecnomatix
- Teamcenter
- SIMATIC
- SIMATIC IT
- SINUMERIK
- SCALANCE
- SITOP
- SIRIUS
- Uptime
- and sparepart services

Driving the Digital Enterprise for discrete industries
Holistic approach for machine builders

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

1. Machine concept
2. Machine engineering
3. Machine commissioning
4. Machine operation
5. Machine services
Machine concept with Mechatronics Concept Designer

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Driving the Digital Enterprise for discrete industries
More efficiency in machine building for the plastics industry
Plastics Toolbox: digital solutions for standard applications

MOT – technological motion control
The MOT block provides technological motion control functions. This block facilitates high-precision, granular positioning of electric and hydraulic axes, including with a synchronous operation function.

PCO – wall thickness control
The PCO block implements the parison control technology required to regulate wall thickness. In blow-molding machines, it is used for precise control of the extruded tube profile. The module supports both machines with continuous material feed and accumulator feed machines. Additional functions, such as tube length and fill level control, are off the practical functionality of this block.

DRV – drive package for extruders
The DRV block makes it possible to control and regulate any number of extruders. It includes all the required monitoring and control functions and facilitates synchronous speed adjustment and/or synchronous throughput or pressure control of several linked extruders where required.

TCP – high-precision temperature control
The TCP temperature control package ensures high-precision temperature control and is optimized for the requirements of the plastics industry. It offers an outstanding level of control accuracy for heating and cooling processes and integrates all the key monitoring functions, such as automatic controller optimization, coolant monitoring, group switching, a weekly timer, and other important core functions.

ACL – configurable sequence control
Beyond the basic functionality of the blocks and standard applications that have already been treated, developers at Siemens’ application center in Cologne are currently working on a block for flexible sequence control of cyclical processes: a modular and configurable automatic cycle. The integrated, step-based sequence system is suitable and can even be configured via the operating system where required. This allows the definition of flexible machine sequences that are adapted to the product – with a greatly reduced development time for the overall system.

1 Machine concept
2 Machine engineering
3 Machine commissioning
4 Machine operation
5 Machine services

Driving the Digital Enterprise for discrete industries
Machine engineering
with Automation Designer and PLC code generation for TIA Portal
Machine commissioning with Mechatronics Concept Designer and PLCSim Advanced

Digital Twin of SIMATIC S7-1500

1. Machine concept
2. Machine engineering
3. Machine commissioning
4. Machine operation
5. Machine services

Driving the Digital Enterprise for discrete industries
Machine operation with the TIA portfolio

1 Machine concept  2 Machine engineering  3 Machine commissioning  4 Machine operation  5 Machine services

Driving the Digital Enterprise for discrete industries
Geiss was able to introduce the first thermoforming machine driven by **servomotors** – smaller footprint, optimized processes, shorter cycle times, and reduced energy consumption.

**Faster**
commissioning and installation

**Higher**
product quality

**Reduced**
energy consumption. Productivity Cycle times reduced up to **50%**
MindSphere enables customers to create new data-driven services in only two easy steps

**STEP 1**
Connect
Get MindSphere user-account, receive and integrate Connector Box into machine / equipment

**STEP 2**
Configure
Configure data acquisition, connectivity and Visual Analyzer via MindSphere

Run the Service
Monitor e.g. health status of all assets in MindSphere with Fleet Manager and drill into details using Visual Analyzer
MindSphere – The cloud-based, open Internet of Things ecosystem

MindApps
- Asset transparency and analytical insights, e.g. predictive maintenance
- Subscription based pricing model
- Fleet management

MindSphere
- Open interface for development of customer specific apps (MindApps)
- Various cloud infrastructures: Public, private or on-premise

MindConnect
- Open standards (e.g. OPC UA) for connectivity (also to 3rd party products)
- Plug and play connection of Siemens products
MindSphere Open Partner Ecosystem

Exemplary Set of Partners

Predefined Partner Roles

Consulting/Strategy Partners
Connectivity Developer
Application Developer
Technology Provider
System Integrator
IaaS Provider
## Profile
- Globally operating machine tool company in the area of honing technology (market leader)
- Technicians support located in China, Brazil, India, the USA, France and Germany

## Challenge
- Digital Service Vision: “We want to convince our customer of the value of our services worldwide.”

## Solution
- Connection of machines via S7
- 6 Data Points on Honing machine (End customer Weber Automotive)
- Data Point Sampling range 30 sec
- Creation of rules for failure alarming at Fleet Manager / Visual Analyzer at MindSphere

## Customer Benefit
- Out-of-the-box digital service offering for end-customers
- Insights about usage of machines
Digital Enterprise Suite – Siemens’ answer to digital transformation

- MindSphere
- Totally Integrated Automation
- Product Lifecycle Management
- Manufacturing Operations Management
- Teamcenter

Driving the Digital Enterprise for discrete industries
Plastics & the New Industrial Revolution

Thank you

siemens.com/plastics