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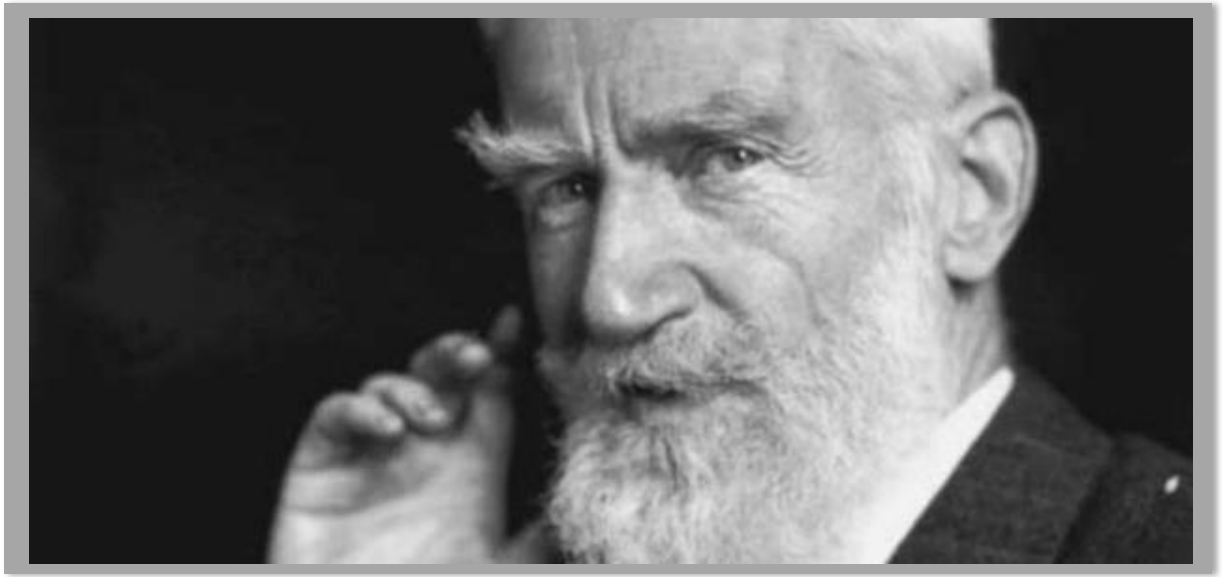
## Fabbrica Futuro

# La via italiana all'innovazione nell'industria

Prof Marco Taisch
Politecnico di Milano - Manufacturing Group



**"You see things; and you say, 'Why?'
But I dream things that never were; and I say, "Why not?"**

Charles Bernard Shaw

# Megatrends Socio - Ambientali

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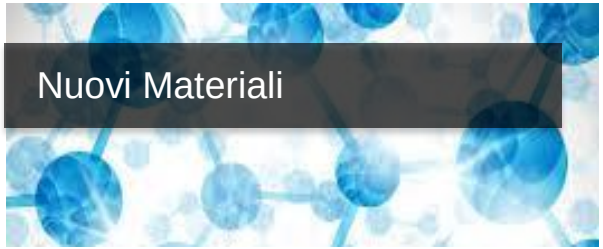
# I Megatrends di Prodotto


- Diagnostica
- Localizzazione
- Sensoristica


- Con il produttore
- Con l'utente
- Con gli altri oggetti


- Bassi consumi di energia
- Riciclabilità

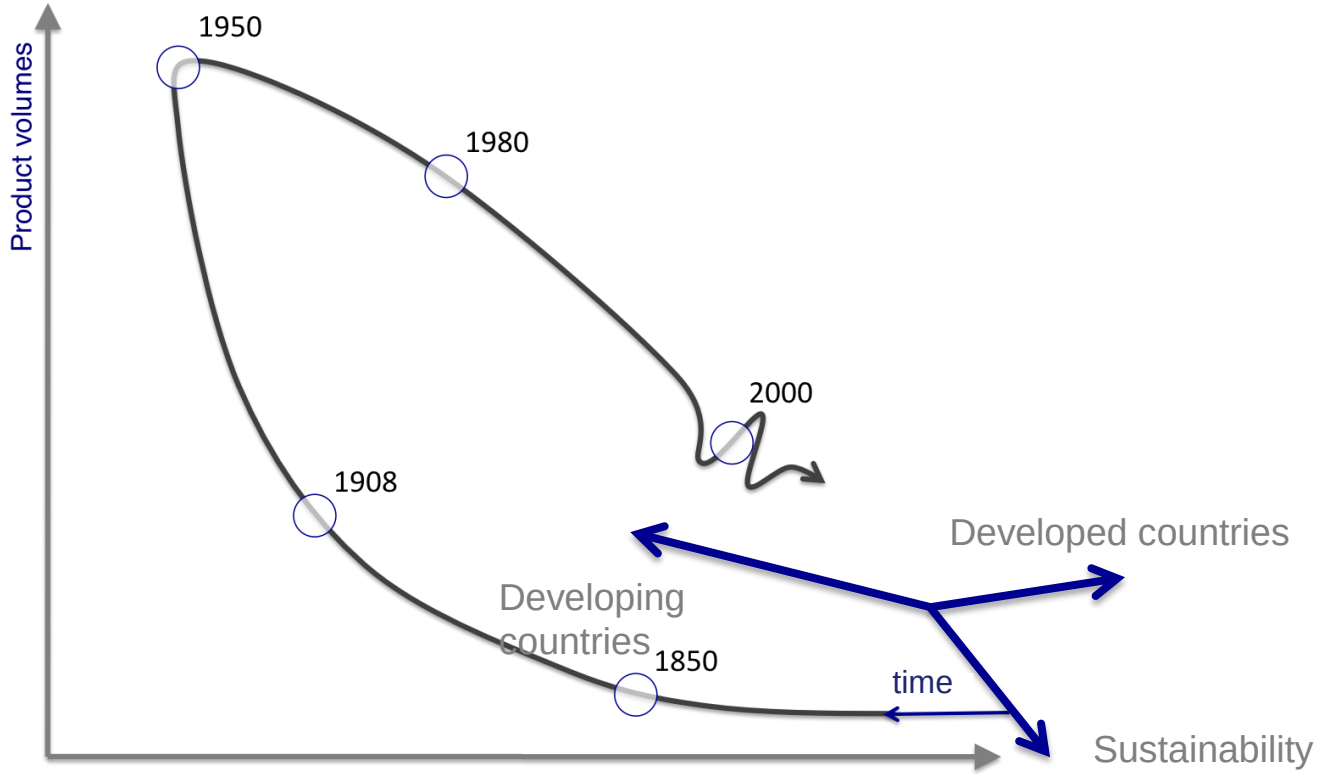

- Nella concezione/produzione
- Nella fruizione/pagamento




- Proprietà fisiche e meccaniche
- Producibilità

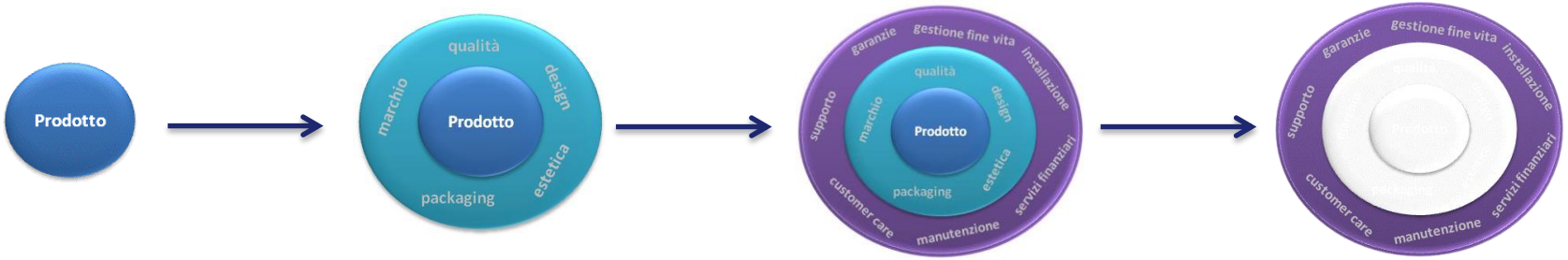
# Manufacturing Evolution





# Products become a service

Service for product → Service for customer




**Product**

Service to support product

Service to differentiate product

Service **IS** the product

*K.D. Thoben 2001*

Background

# THE IMPORTANCE OF MANUFACTURING

# Le Top 13 potenze manifatturiere nel Mondo

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## Valore aggiunto del settore manifatturiero sul GDP Mondiale

| | | | | |
|---|---|---|---|---|
| 1 | USA | USA | Cina | Cina |
| 2 | Giappone | Giappone | USA | USA* |
| 3 | Germania | Cina | Giappone | Germania |
| 4 | Italia | Germania | Germania | Giappone* |
| 5 | Francia | Regno Unito | Korea, Rep. | Korea, Rep. |
| 6 | Regno Unito | Italia | Italia | India |
| 7 | Cina | Francia | Brasile | Italia |
| 8 | Brasile | Korea, Rep | Francia | Regno Unito |
| 9 | Spagna | Messico | India | Francia |
| 10 | Canada | Spagna | Regno Unito | Russia |
| 11 | Korea, Rep | Brasile | Russia | Brasile |
| 12 | Olanda | Canada | Spagna | Messico |
| 13 | Messico | India | Messico | Canada |

Fonte Dati: The World Bank
*Proiezione anno 2013

# L'importanza del Manufacturing nelle economie mondiali

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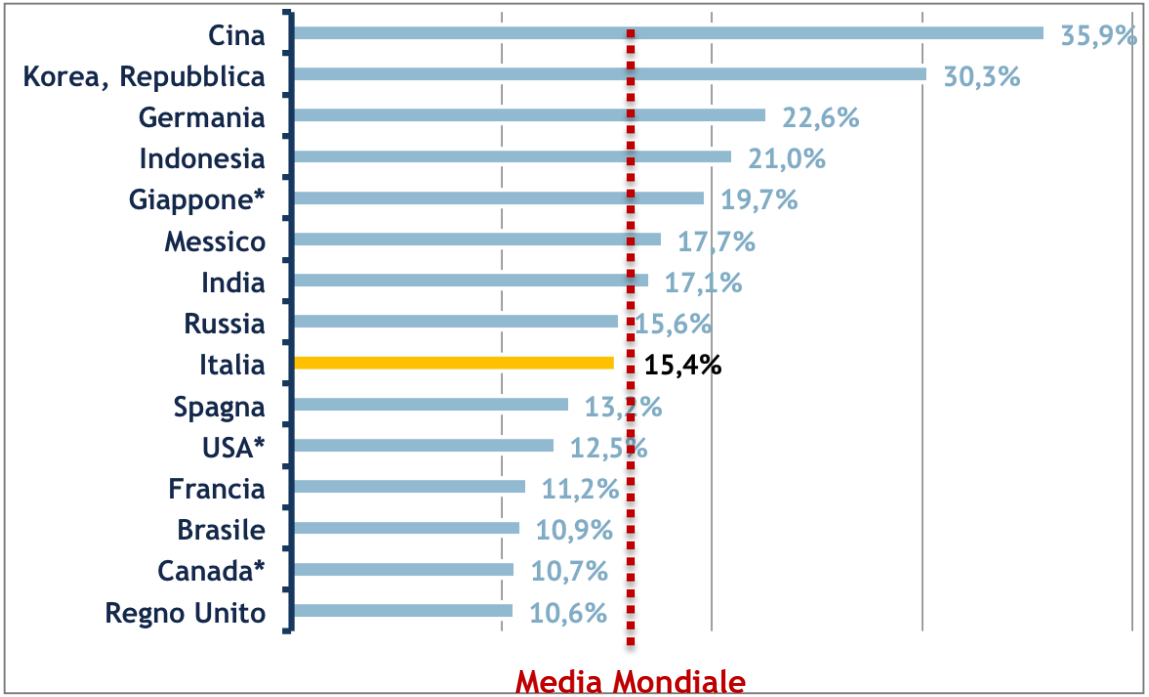
**Manufacturing, value added (% of GDP) – Anno 2014**

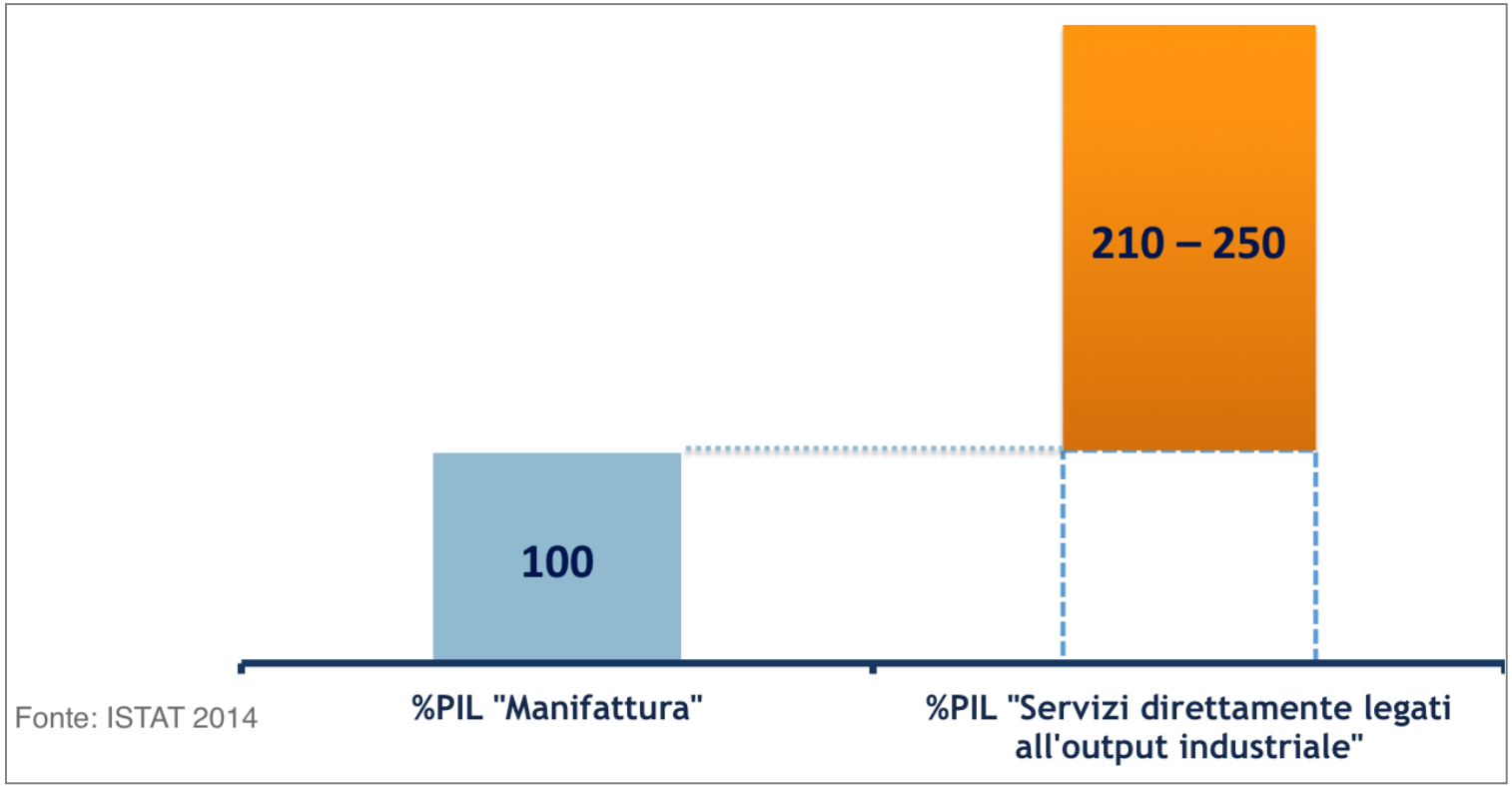
Fonte: The World Bank

*Ultimo anno con informazione disponibile (2013)



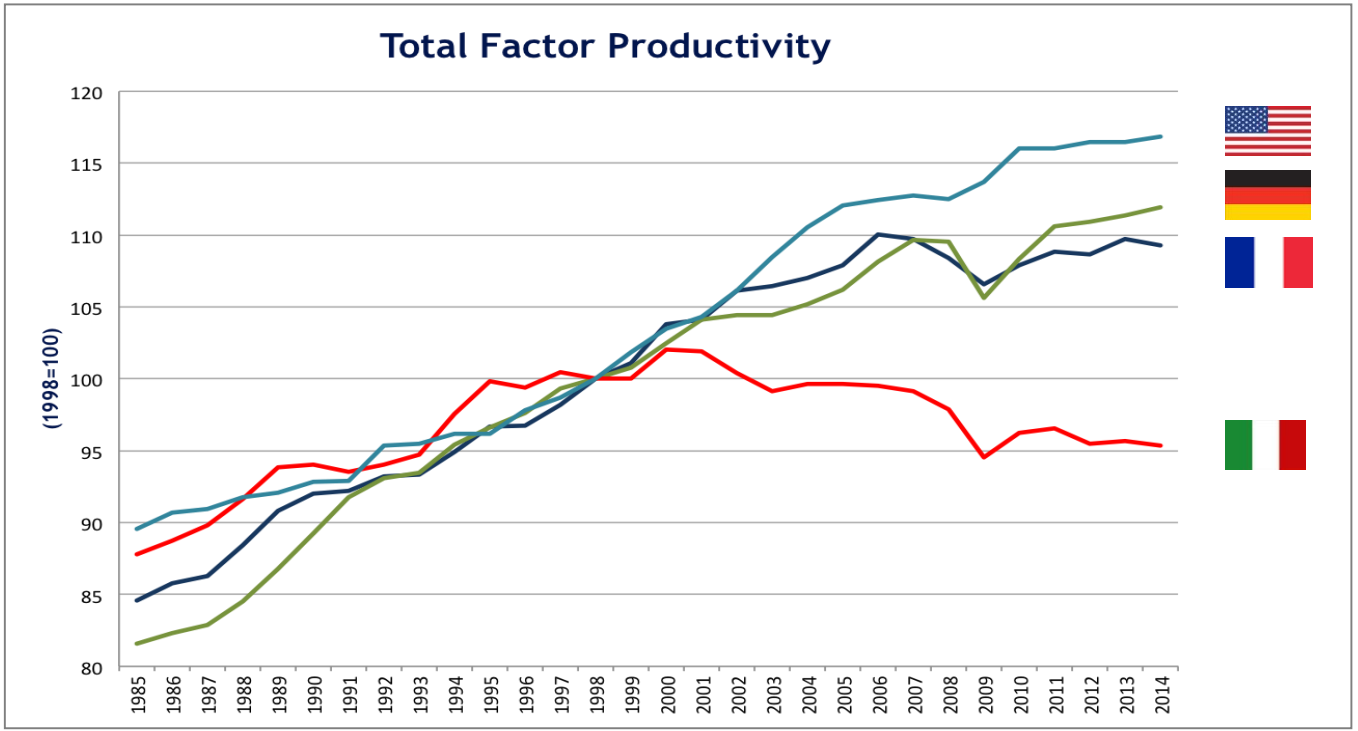
# Il settore manifatturiero come motore dell'economia dei servizi






Fonte: ISTAT 2014

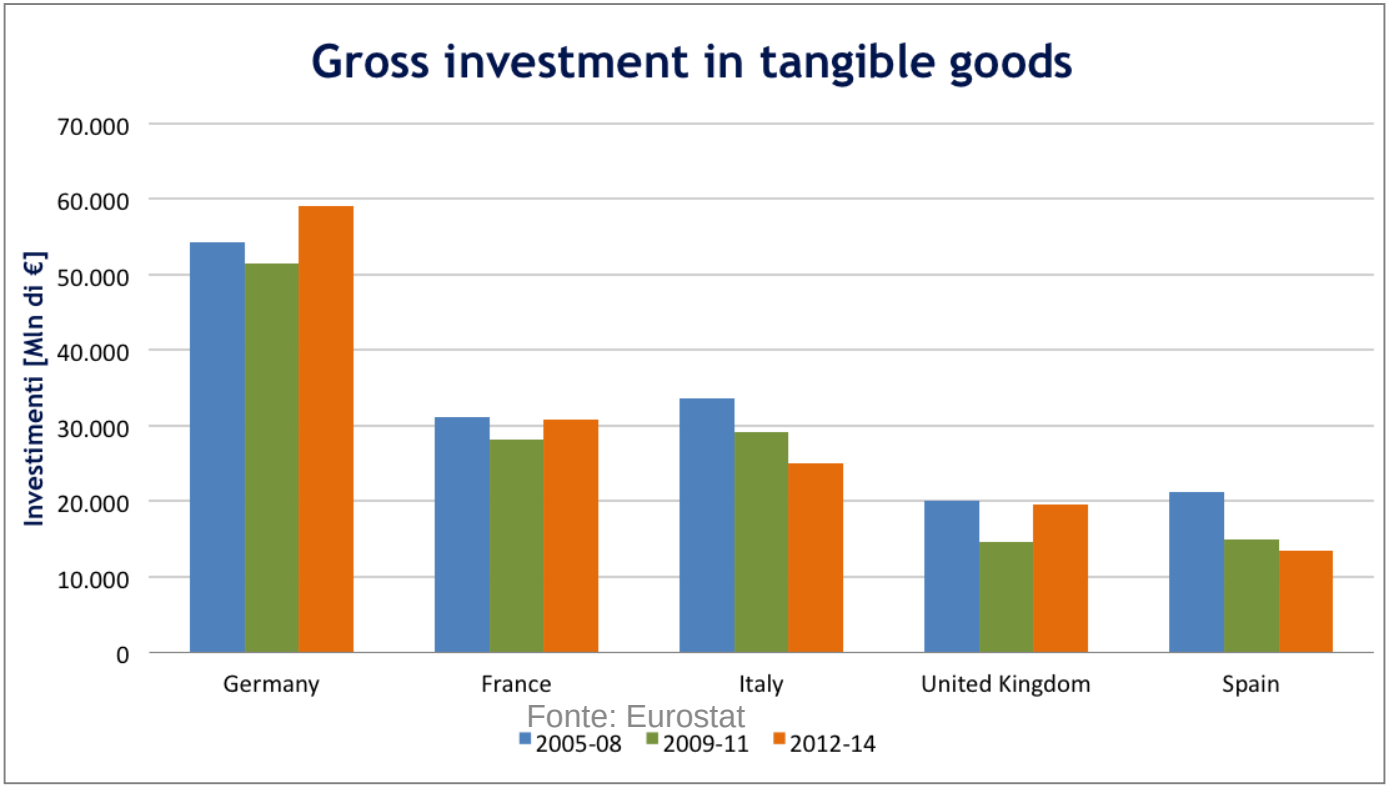
# Produttività del lavoro




Fonte: OEDC

# Investimenti in immobilizzazioni delle imprese manifatturiere






Fonte: Eurostat

## Table 3b: Global CEO Survey: Global drivers of manufacturing competitiveness index ranking

*Executives rank key drivers that impact a country's ability to compete in manufacturing*

| Overall rank (1–10) | Overall index score | Main driver | Most important sub-components | Sub-component rank (1-40) |
|---|---|---|---|---|
| 1 | 10.00 | **Talent-driven innovation** | Quality and availability of researchers, scientists, and engineers<br>Quality and availability of skilled labor | 1<br>2 |
| 2 | 8.42 | **Economic, trade, financial and tax system** | Tax rate burden and system complexity<br>Clarity and stability of regulatory, tax and economic policies | 3<br>5 |
| 3 | 8.07 | **Cost and availability of labor and materials** | Cost competitiveness of materials<br>Availability of raw materials | 11<br>21 |
| 4 | 7.76 | **Supplier network** | Cost competitiveness of local suppliers<br>Ability of supply base to innovate in products and processes | 8<br>9 |
| 5 | 7.60 | **Legal and regulatory system** | Stability and clarity in legal and regulatory policies<br>Labor laws and regulations | 7<br>13 |
| 6 | 6.47 | **Physical infrastructure** | Quality and efficiency of electricity grid, IT and telecommunications network<br>Quality and efficiency of roads, airports, ports, and railroad networks | 4<br>16 |
| 7 | 6.25 | **Energy cost & policies** | Cost competitiveness of energy<br>Ongoing investments to improve and modernize energy infrastructure | 14<br>20 |
| 8 | 3.99 | **Local market attractiveness** | Size and access of the local market<br>Intensity of local competition | 27<br>36 |
| 9 | 2.48 | **Healthcare system** | Cost of quality healthcare for employee and society<br>Regulatory policies (e.g., pollution, food safety, etc.) that are enforced to protect public health | 26<br>33 |
| 10 | 1.00 | **Government investments in manufacturing and innovation** | Government investments in R&D: science, technology, engineering and manufacturing<br>Private and public sector collaboration for long-term investments in R&D: science, technology, engineering and manufacturing | 29<br>30 |

Source: Deloitte Touche Tohmatsu Limited and U.S. Council on Competitiveness, 2013 Global Manufacturing Competitiveness Index
Note: See Appendix B1 for full list of 40 sub-components and associated ranking

# Global Manufacturing Competitiveness Index

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| 2016 (Current) | | |
|---|---|---|
| Rank | Country | Index score (100=High) (10 = Low) |
| 1 | China | 100.0 |
| 2 | United States | 99.5 |
| 3 | Germany | 93.9 |
| 4 | Japan | 80.4 |
| 5 | South Korea | 76.7 |
| 6 | United Kingdom | 75.8 |
| 7 | Taiwan | 72.9 |
| 8 | Mexico | 69.5 |
| 9 | Canada | 68.7 |
| 10 | Singapore | 68.4 |
| 11 | India | 67.2 |
| 12 | Switzerland | 63.6 |
| 13 | Sweden | 62.1 |
| 14 | Thailand | 60.4 |
| 15 | Poland | 59.1 |
| 16 | Turkey | 59.0 |
| 17 | Malaysia | 59.0 |
| 18 | Vietnam | 56.5 |
| 19 | Indonesia | 55.8 |
| 20 | Netherlands | 55.7 |
| 21 | Australia | 55.5 |
| 22 | France | 55.5 |
| 23 | Czech Republic | 55.3 |
| 24 | Finland | 52.5 |
| 25 | Spain | 50.6 |
| 26 | Belgium | 48.3 |
| 27 | South Africa | 48.1 |
| 28 | Italy | 46.5 |
| 29 | Brazil | 46.2 |
| 30 | United Arab Emirates | 45.4 |

| 2020 (Projected) | | | |
|---|---|---|---|
| Rank | 2016 vs. 2020 | Country | Index score (100=High) (10=Low) |
| 1 | (▲ +1) | United States | 100.0 |
| 2 | (▼ -1) | China | 93.5 |
| 3 | (⟷) | Germany | 90.8 |
| 4 | (⟷) | Japan | 78.0 |
| 5 | (▲ +6) | India | 77.5 |
| 6 | (▼ -1) | South Korea | 77.0 |
| 7 | (▲ +1) | Mexico | 75.9 |
| 8 | (▼ -2) | United Kingdom | 73.8 |
| 9 | (▼ -2) | Taiwan | 72.1 |
| 10 | (▼ -1) | Canada | 68.1 |
| 11 | (▼ -1) | Singapore | 67.6 |
| 12 | (▲ +6) | Vietnam | 65.5 |
| 13 | (▲ +4) | Malaysia | 62.1 |
| 14 | (⟷) | Thailand | 62.0 |
| 15 | (▲ +4) | Indonesia | 61.9 |
| 16 | (▼ -1) | Poland | 61.9 |
| 17 | (▼ -1) | Turkey | 60.8 |
| 18 | (▼ -5) | Sweden | 59.7 |
| 19 | (▼ -7) | Switzerland | 59.1 |
| 20 | (▲ +3) | Czech Republic | 57.4 |
| 21 | (▼ -1) | Netherlands | 56.5 |
| 22 | (▼ -1) | Australia | 53.4 |
| 23 | (▲ +6) | Brazil | 52.9 |
| 24 | (⟷) | Finland | 49.7 |
| 25 | (▲ +2) | South Africa | 49.3 |
| 26 | (▼ -4) | France | 49.1 |
| 27 | (▼ -2) | Spain | 48.4 |
| 28 | (▲ +5) | Romania | 45.9 |
| 29 | (▼ -3) | Belgium | 45.8 |
| 30 | (▼ -2) | Italy | 45.0 |

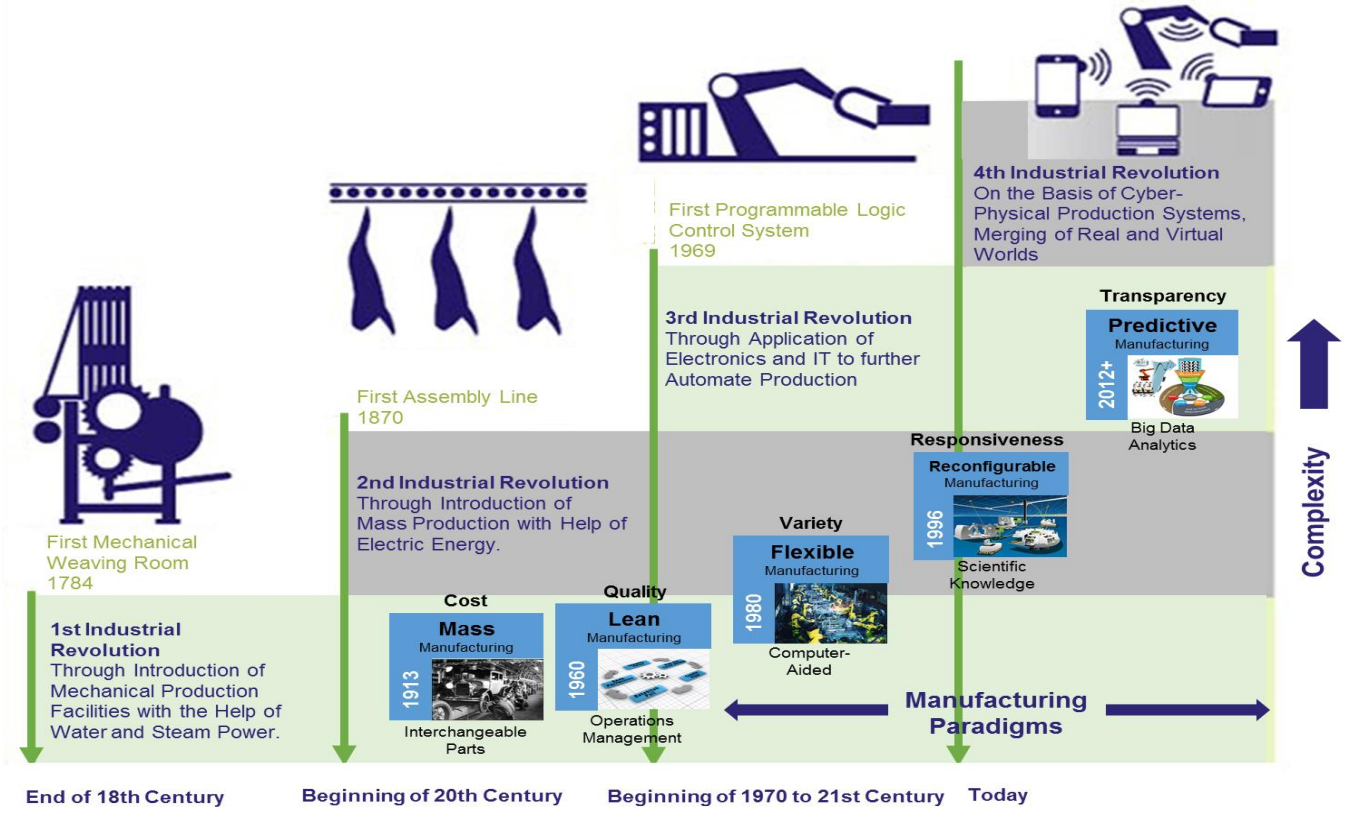
Deloitte.

Come reagire?

# LA VIA ITALIANA ALL'INDUSTRIA 4.0

# Industry 4.0 (R)Evolution





# Le Tecnologie abilitanti

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BIG DATA

INTERNET OF THINGS

AUTOMAZIONE ROBOTICA

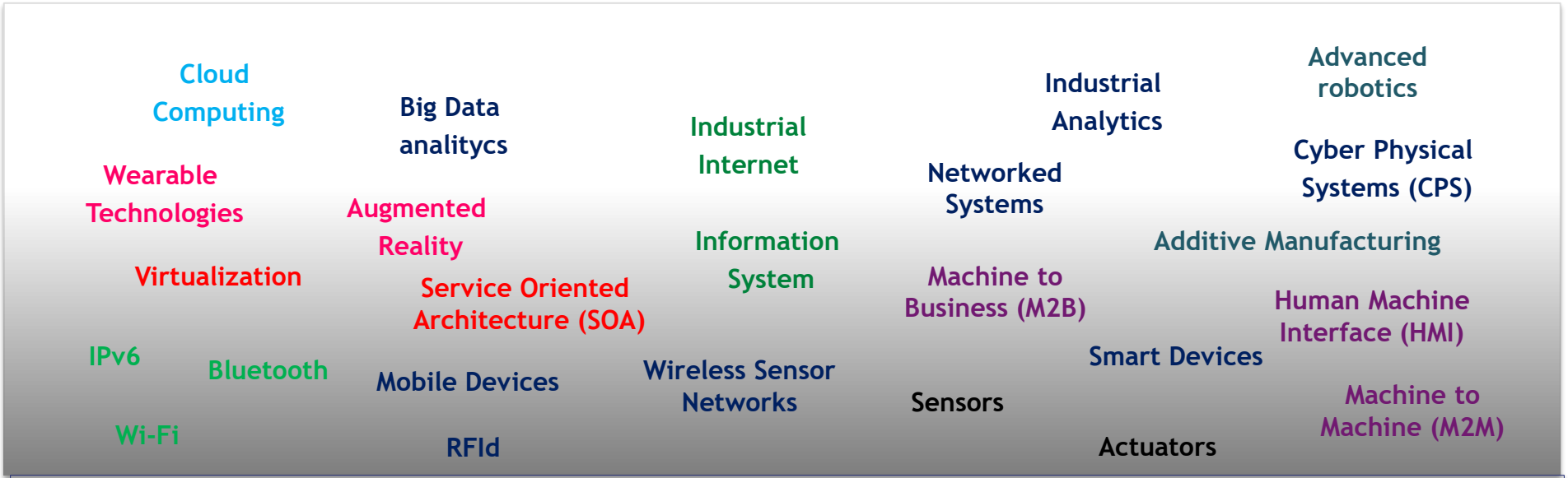
CLOUD COMPUTING & CYBER SECURITY

INTERFACCIA UOMO MACCHINA

ADDITIVE MANUFACTURING

# Le Tecnologie



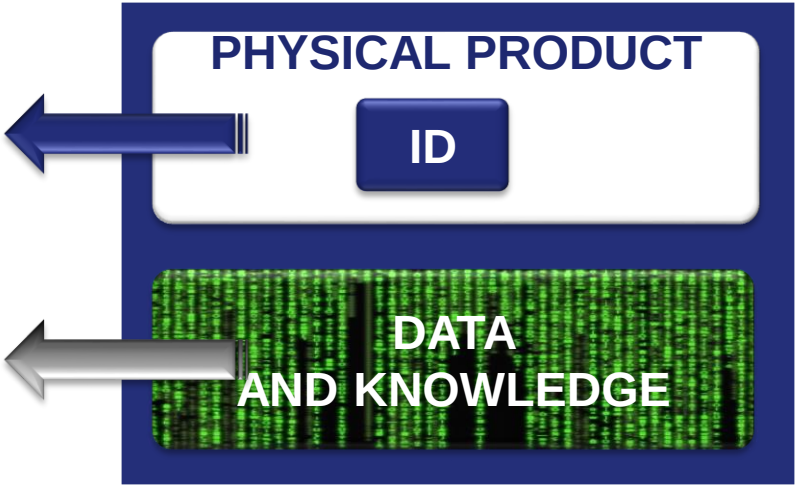



*'Ubiquitous computing names the third wave in computing, just now beginning. First were mainframes, each shared by lots of people. Now we are in the personal computing era, person and machine staring uneasily at each other across the desktop. Next comes* ***ubiquitous computing****, or the age of calm technology, when* ***technology*** *recedes* ***into the background*** *of our lives"*

Weiser, 1991 The computer for the 21st century. Scientific American, special issue on communications, computers, and networks

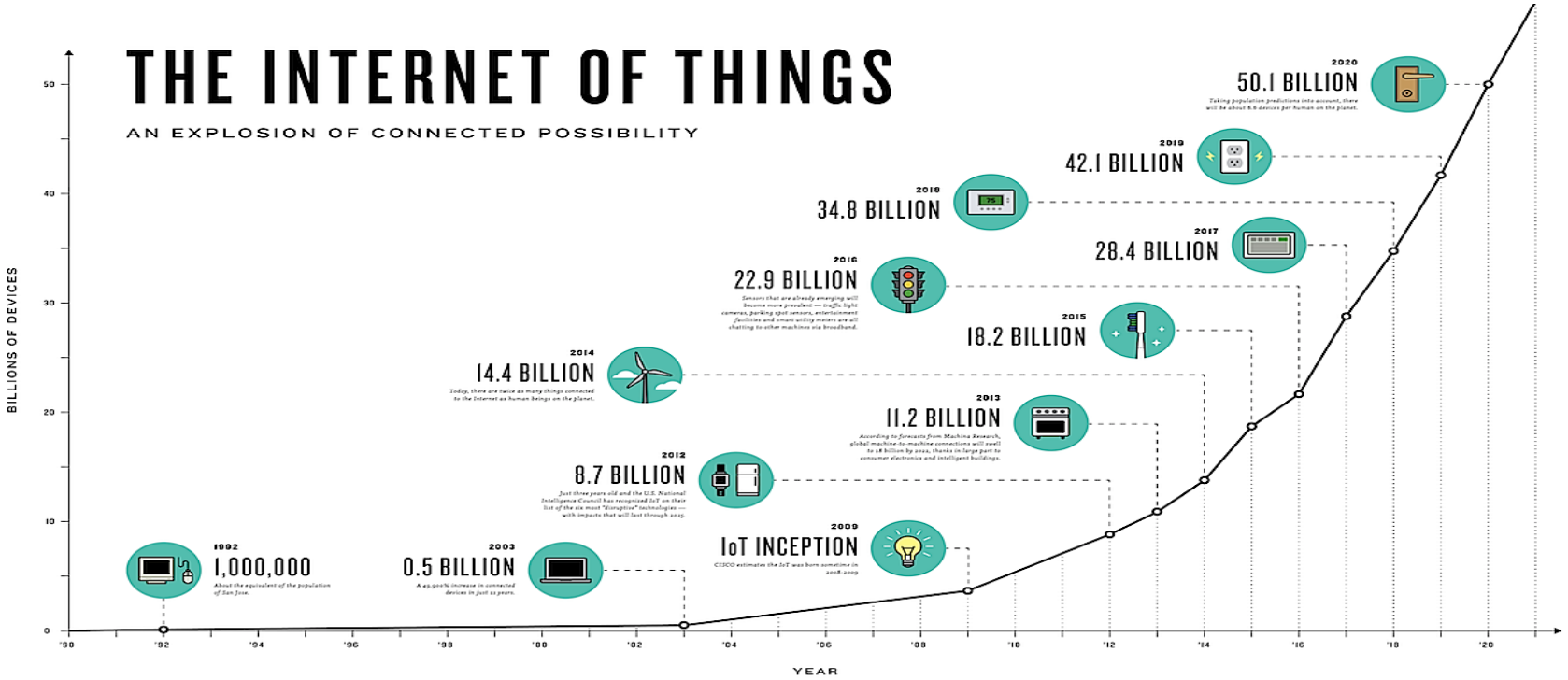
# Internet of Things



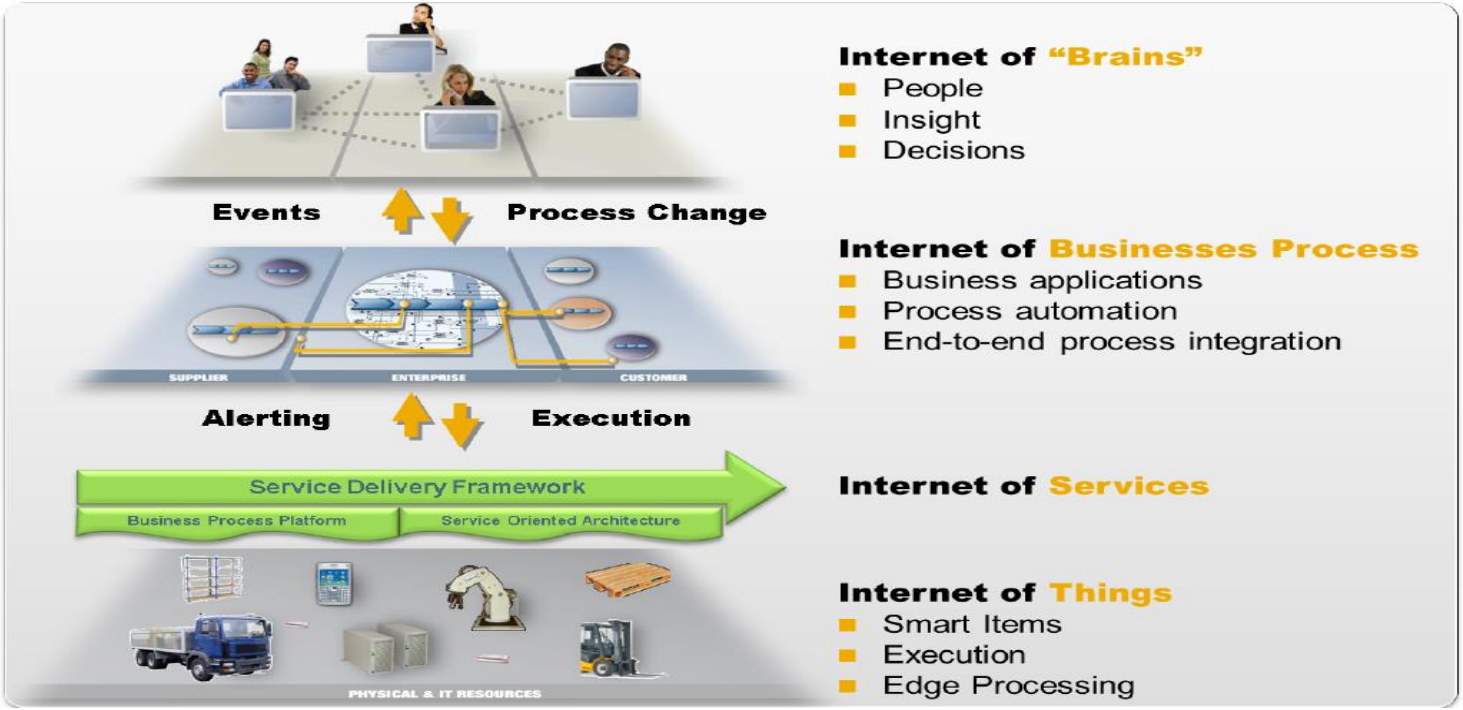




- According to some estimates there will be 50 billion mobile wireless devices connected to the Internet across the globe by 2020
- The total number of devices connected to the Internet in some way could reach 500 billion.
- OECD (2012), "Machine-to-Machine Communications: Connecting Billions of Devices", *OECD Digital Economy - Papers*, No. 192, OECD Publishing.

# IoT growth


THE INTERNET OF THINGS
AN EXPLOSION OF CONNECTED POSSIBILITY
BILLIONS OF DEVICES
YEAR
1992
1,000,000
2003
0.5 BILLION
2009
IoT INCEPTION
2012
8.7 BILLION
2013
11.2 BILLION
2014
14.4 BILLION
2015
18.2 BILLION
2016
22.9 BILLION
2017
28.4 BILLION
2018
34.8 BILLION
2019
42.1 BILLION
2020
50.1 BILLION

# Interconnected Manufacturing

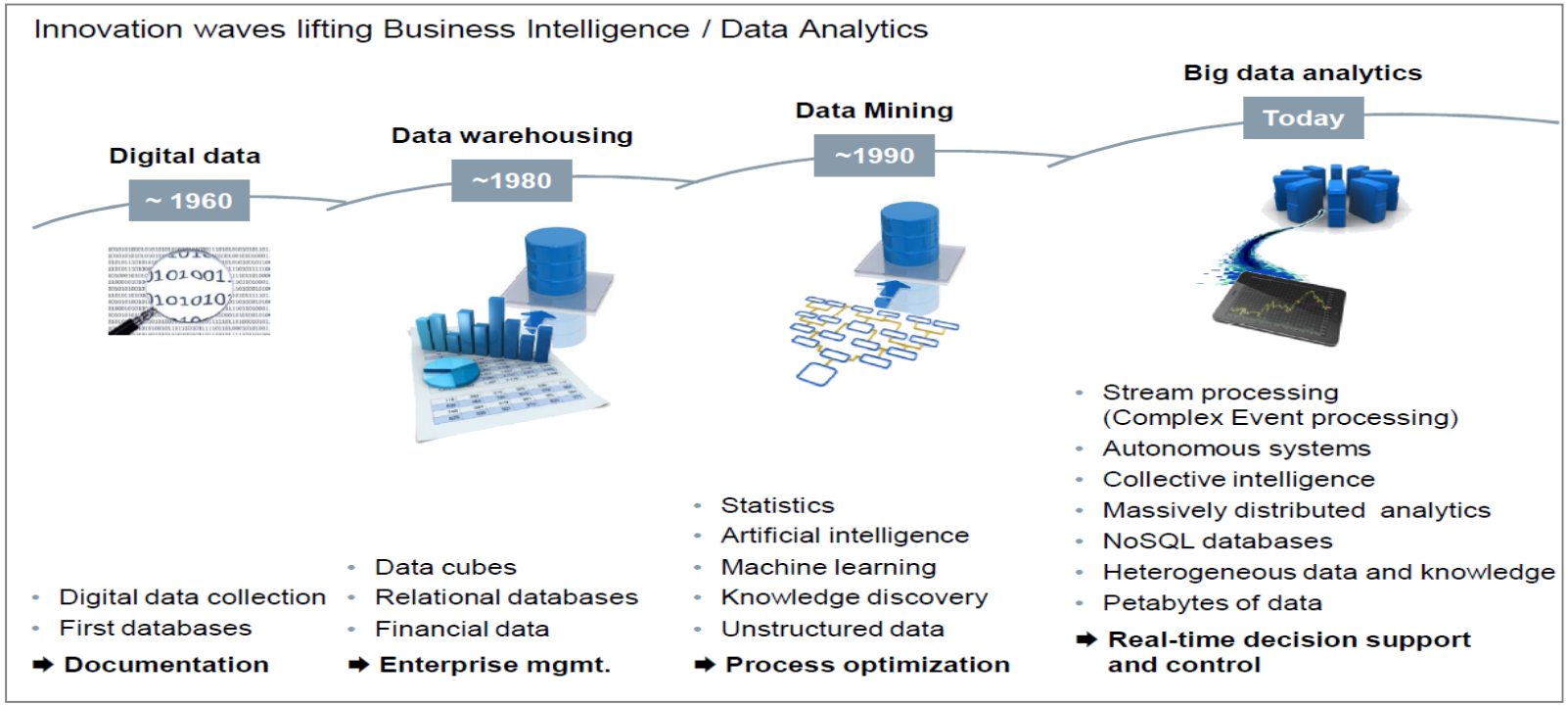



Stamatis Karnouskos
Cyber-Physical Systems in manufacturing and production workshop
Brussels 30th October 2013

# Big Data



*** Cyber Physical Systems for Manufacturing and Production Thomas Runkler, Siemens Corporate Technology Session: The role of Cyber-Physical Systems (CPS) for manufacturing Cyber-Physical Systems in manufacturing and production workshop Brussels 30th October 2014



# Cloud computing



# Cyber-physical systems (CPS) enable the future of Manufacturing

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**Communication everywhere and every time**

- Future infrastructure will support the access to information everywhere and every time without any specific installation / parameterization needs

**Production and products will be intelligent**

- Production resources will be autonomic and will connect to each other (M2M)
- Products know their own production systems

**Digital and real world will merge**

- Each real object will have a digital shadow, which reflects the characteristics of the real object

*** Cyber Physical Systems for Manufacturing and Production
Thomas Runkler, Siemens Corporate Technology | Session: The role of Cyber-Physical Systems (CPS) for manufacturing
Cyber-Physical Systems in manufacturing and production workshop Brussels 30th October

# From MES to MOS (Mfg Operating System)

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**M-Apps Store**

App1 App2 App3 App4 App5 App …

M-Apps are aggregated and customized based on user and business needs

**Manufacturing Workspace**

**MOS – Manufacturing Operating System**

User/Process X

App1 App3

User/Process Y

App1 App2 App5

User/Process Z

App2 App5

**Migration from MES world**

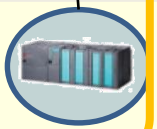
Existing Monolytic Applications (e.g. ERP, MES, …)

Interface Layer

Enterprise network (office)

Manufacturing Service Bus / Real time / Industrial Middleware

(Shop floor)

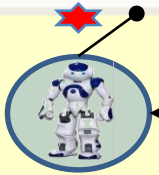


CPPR 3

**CPPR – Cyber Physical Production Resource**

**Real/virtual production plant**

**Migration from Standard Equipments World**



CPS enabled production resources

encapsulation

Additional control intelligence

Standard Production equipment

# La Fabbrica Intelligente

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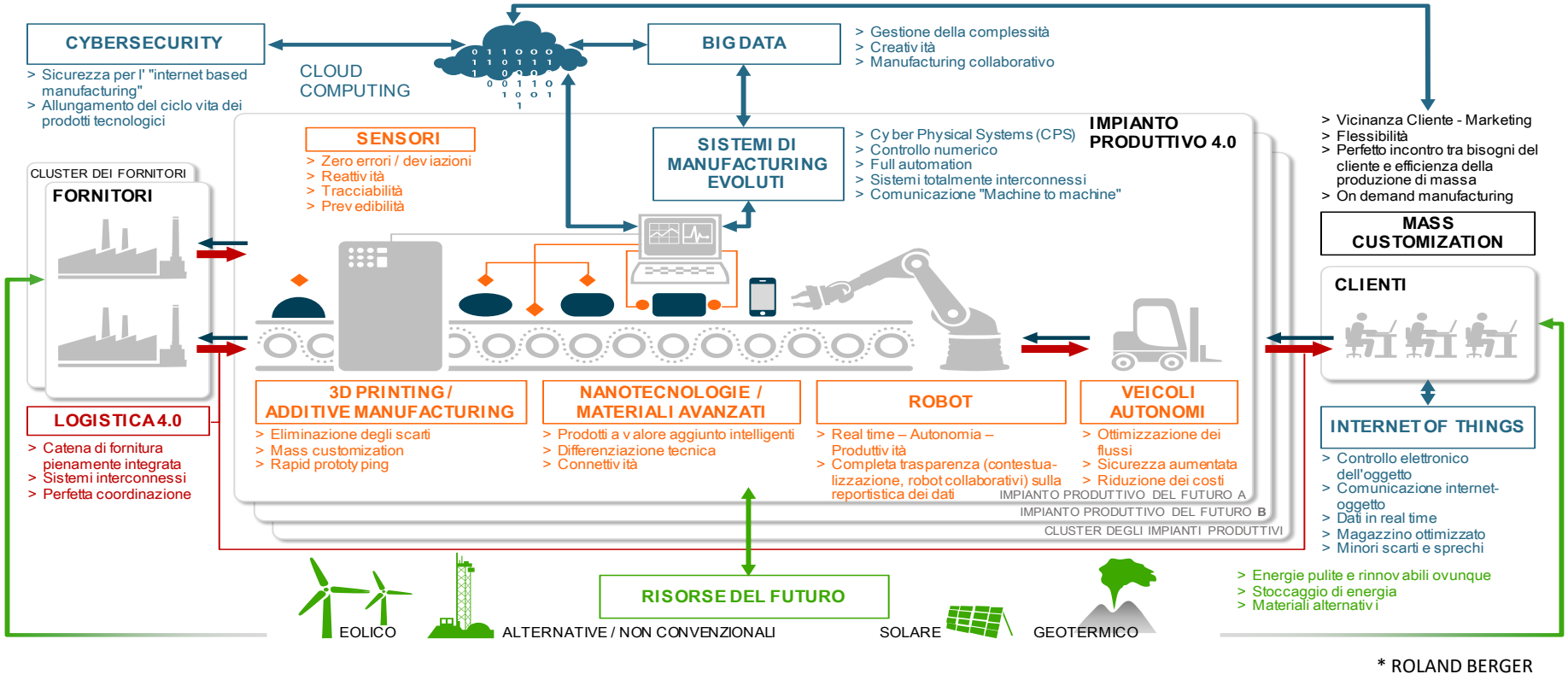
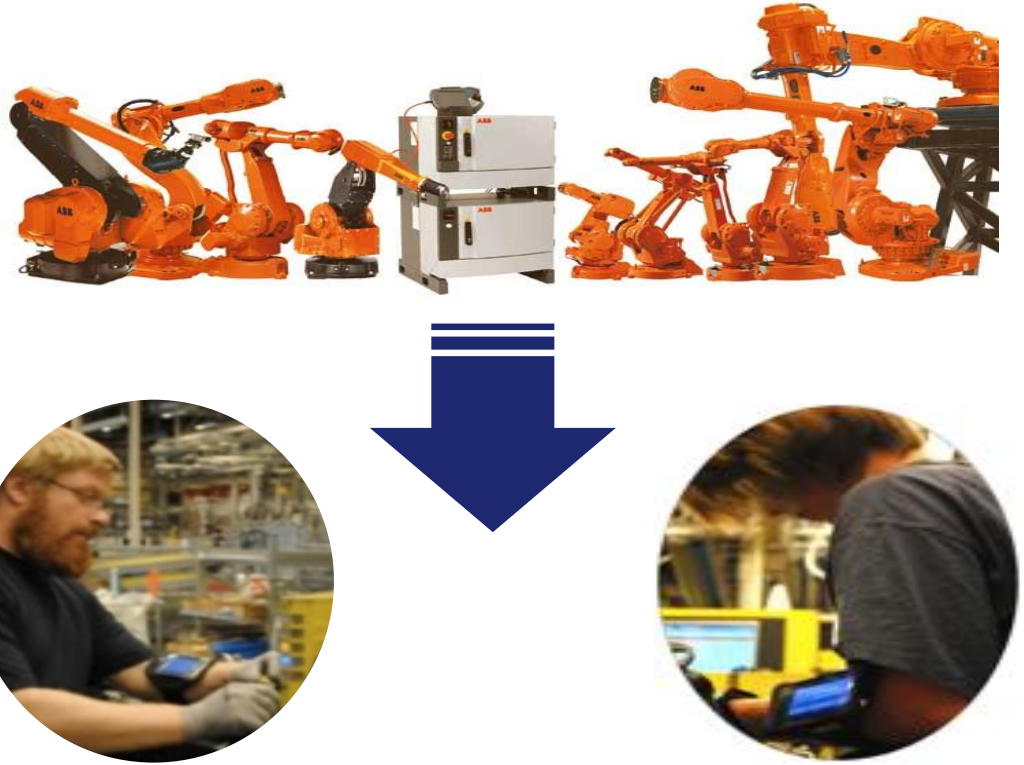



* ROLAND BERGER

# Cognitive Automation





# Industrial Internet creates opportunities

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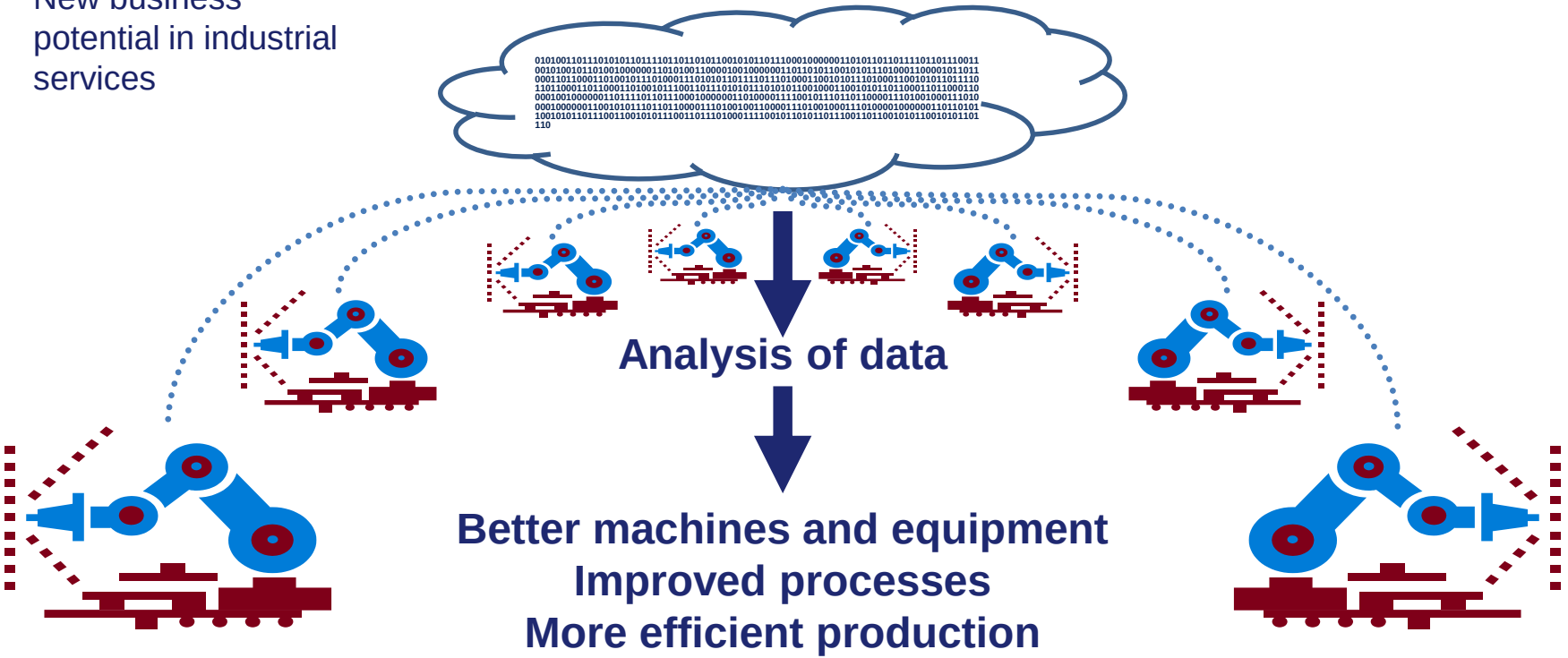
- New business potential in industrial services



# Reshoring



## The transfer of business operation back to its country of origin

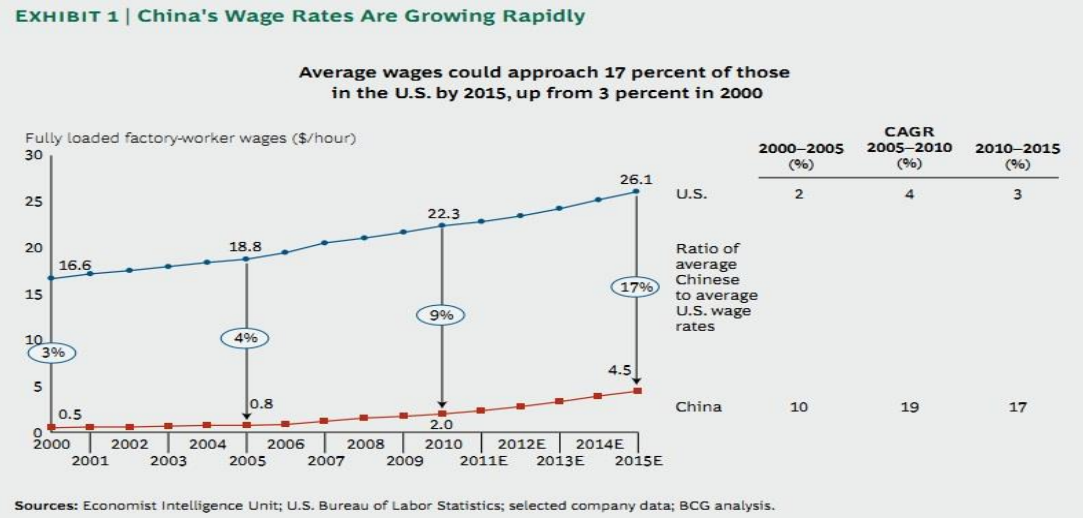
"We expect net labor costs for manufacturing in China and the U.S. to converge by around 2015"

"Take a hard look at the total costs"

**Source:** BCG group press release 5/5/11

"End the practice of awarding business on the basis of price tag. Instead, minimize total cost"

**Source:** "4th key principle for management," Out of the Crisis, W. Edwards Deming



# How Digitisation will change the ROCE

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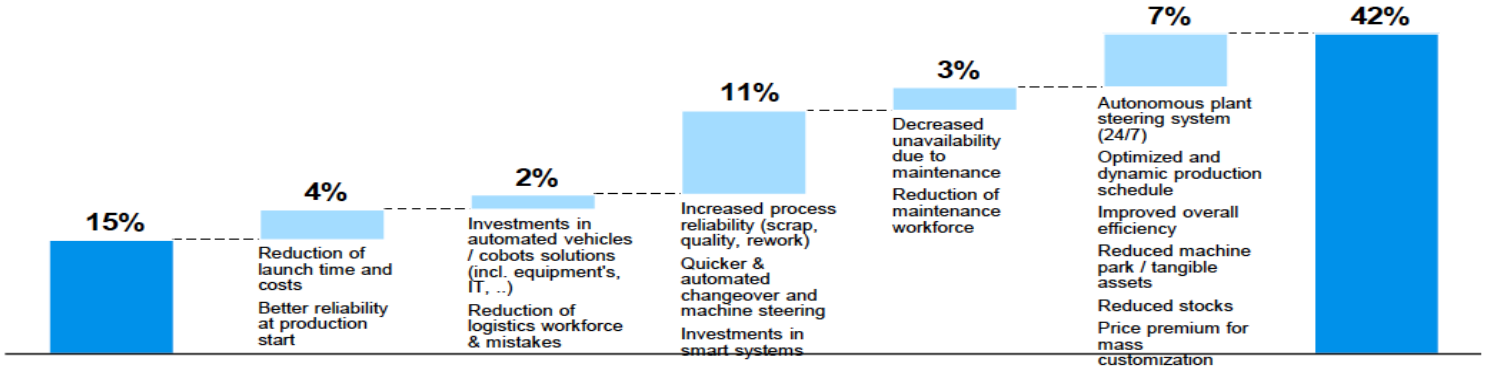
## ROCE evolution per lever for an average Tier-1 Auto supplier [%]




| | Before Industry 4.0 | Virtual industrialization | Automated flows | Smart machines | Predictive maintenance | Cyber-production system | After Industry 4.0 |
|---|---|---|---|---|---|---|---|
| % Profit (EBIT) | 6.0% | 1.2% | 0.9% | 4.6% | 0.8% | -0,4% | 13.1% |
| Asset rotation (*) | 2,5 | 0.1 | - 0.1 | - 0.2 | 0.1 | 0.5 | 3.1 |
| Overall Effectiveness | 65% | +6% | 0,1% | +9% | +3% | +7% | 90% |

Machine park: **-30% less**
Direct Labor: **-50% less**
Indirect Labor: **-30%**
Total : **-45%**

Roland Berger

# Impact of Digitisation

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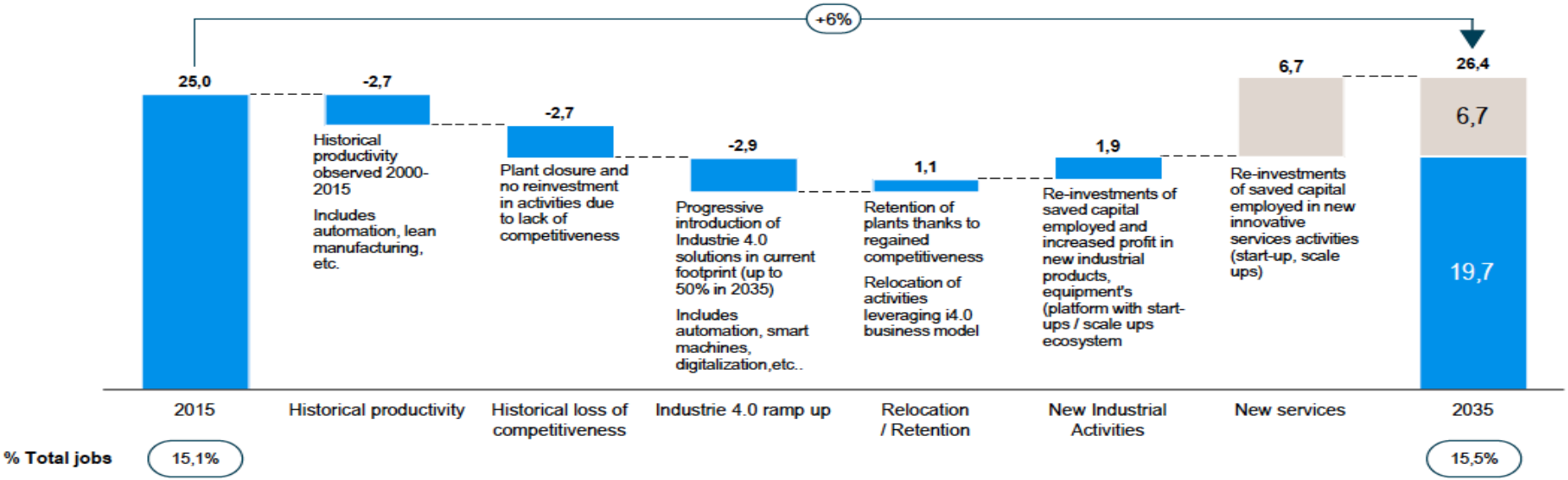
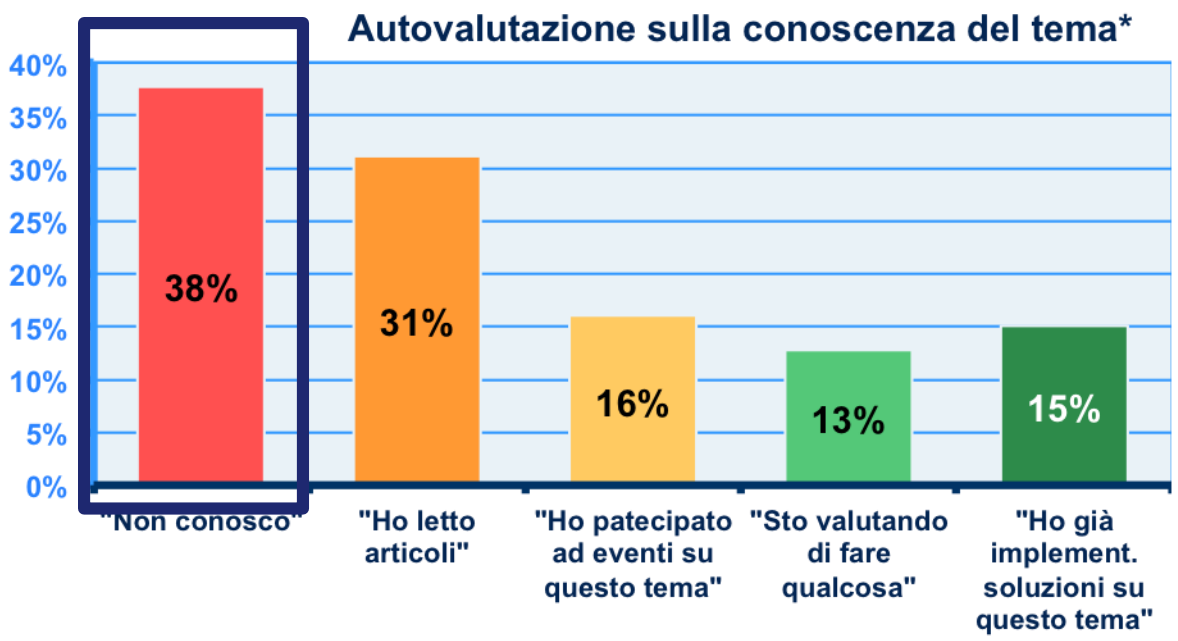
## Industrie job destruction and creation[millions, Western Europe]




Source: Roland Berger analysis

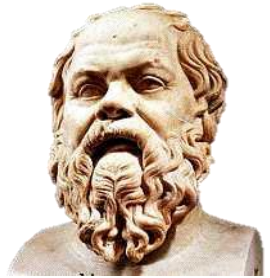
# TUTTO BELLO MA…

# Lo Smart Manufacturing in Italia
# Conoscenza dello Smart Manufacturing




Oltre un terzo dei rispondenti dichiara di non sapere di cosa stiamo parlando oggi!

"So di non sapere…"



*Campione: 305 aziende, domanda a risposta multipla

# Lo Smart Manufacturing in Italia – La radici del processo di digitalizzazione

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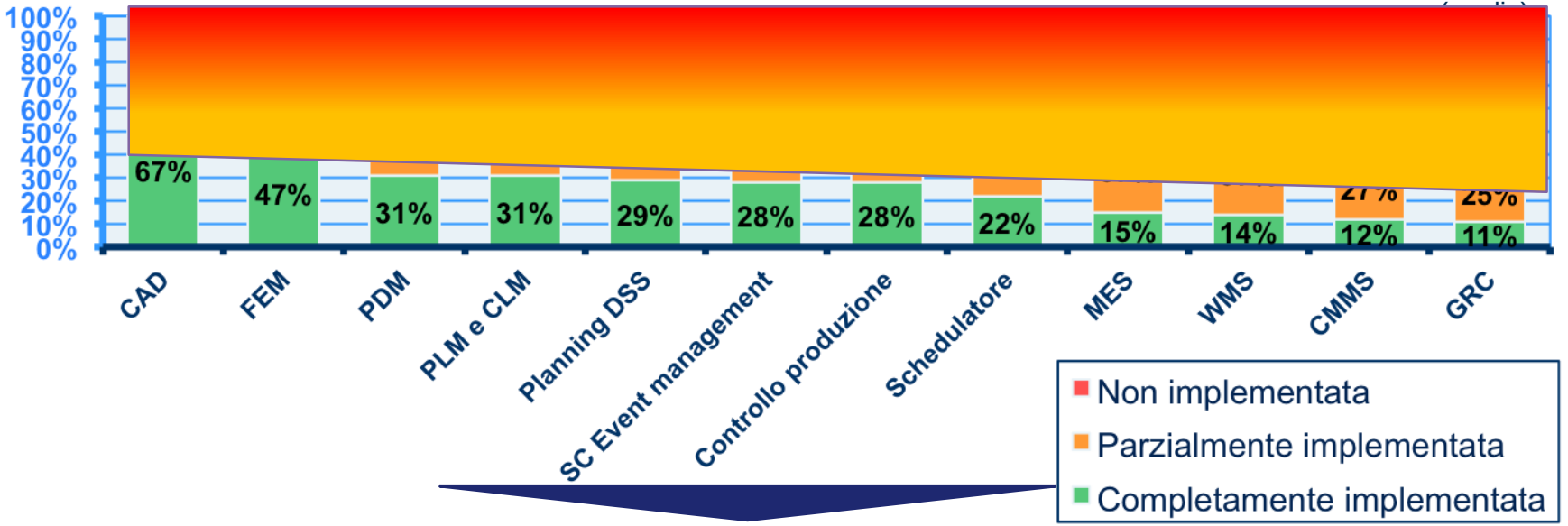
- Soluzioni tradizionali – Livello di Implementazione

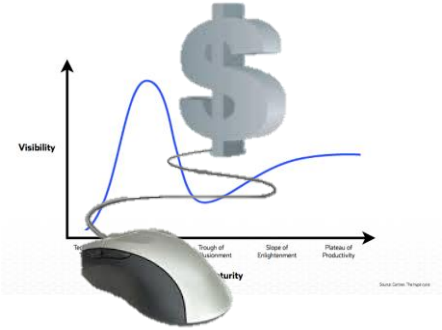
*Campione: 289 aziende

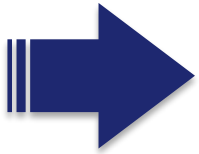



Le soluzioni tradizionali più complesse sono ancora scarsamente diffuse.
Si può fare la quarta rivoluzione industriale, se non si è fatta la terza?

# Digital divide delle PMI

**DIGITAL DIVIDE**:
La crescente velocità del cambiamento tecnologico incentiva una conseguente **rapidità di trasformazione**, a velocità altrettanto crescente, la quale, se non colta, porta ad un **divario digitale e tecnologico** compromettendone la capacità produttiva e innescando, quindi, un fenomeno di **esclusione** dal quadro macro-economico del mondo manifatturiero



# Impatti sul lavoro : Skills 4.0



**Industry 4.0 e l'impatto sul lavoro nei settori manifatturieri.**

Dall' automazione tradizionale ad una automazione cognitiva (l'operatore, 'aumentato' delle sue funzionalità diventa fattore di aumento della produttività della fabbrica)

**Automazione Collaborativa: Collaborazione Uomo-Macchina**

**Monitoring & Control: Attività di supervisione alle macchine**

**Attività di supporto alle Macchine**

# KEEP CALM AND THINK 4.0

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***Il percorso per la comprensione del futuro***

industria 4.IT

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