The New Industrial Revolution

I trend innovativi per il Manufacturing del futuro

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

George Bernard Shaw
Evoluzione della produzione
Mass Customization

Product variety

Product volumes

Time

1850
1908
1950
1980
2000

globalization
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Product variety vs. Product volumes

- 1850
- 1908
- 1950
- 1980
- 2000

Time

Product variety
### VALORE AGGIUNTO DEL MANUFACTURING PER PAESE

Large developing economies are moving up in global manufacturing

Top 15 manufacturers by share of global nominal manufacturing gross value added

<table>
<thead>
<tr>
<th>Rank</th>
<th>1980</th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>United States</td>
<td>United States</td>
<td>United States</td>
<td>United States</td>
</tr>
<tr>
<td>2</td>
<td>Germany</td>
<td>Japan</td>
<td>Japan</td>
<td>China</td>
</tr>
<tr>
<td>3</td>
<td>Japan</td>
<td>Germany</td>
<td>Germany</td>
<td>Japan</td>
</tr>
<tr>
<td>4</td>
<td>United Kingdom</td>
<td>Italy</td>
<td>China</td>
<td>China</td>
</tr>
<tr>
<td>5</td>
<td>France</td>
<td>United Kingdom</td>
<td>United Kingdom</td>
<td>Italy</td>
</tr>
<tr>
<td>6</td>
<td>Italy</td>
<td>France</td>
<td>Italy</td>
<td>Brazil</td>
</tr>
<tr>
<td>7</td>
<td>China</td>
<td>China</td>
<td>France</td>
<td>South Korea</td>
</tr>
<tr>
<td>8</td>
<td>Brazil</td>
<td>Brazil</td>
<td>South Korea</td>
<td>France</td>
</tr>
<tr>
<td>9</td>
<td>Spain</td>
<td>Spain</td>
<td>Canada</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>10</td>
<td>Canada</td>
<td>Canada</td>
<td>Mexico</td>
<td>India</td>
</tr>
<tr>
<td>11</td>
<td>Mexico</td>
<td>South Korea</td>
<td>Spain</td>
<td>Russia²</td>
</tr>
<tr>
<td>12</td>
<td>Australia</td>
<td>Mexico</td>
<td>Brazil</td>
<td>Mexico</td>
</tr>
<tr>
<td>13</td>
<td>Netherlands</td>
<td>Turkey</td>
<td>Taiwan</td>
<td>Indonesia²</td>
</tr>
<tr>
<td>14</td>
<td>Argentina</td>
<td>India</td>
<td>India</td>
<td>Spain</td>
</tr>
<tr>
<td>15</td>
<td>India</td>
<td>Taiwan</td>
<td>Turkey</td>
<td>Canada</td>
</tr>
</tbody>
</table>


NOTE: Based on IHS Global Insight database sample of 75 economies, of which 28 are developed and 47 are developing.

Manufacturing here is calculated top down from the IHS Global Insight aggregate; there might be discrepancy with bottom-up calculations elsewhere.

SOURCE: IHS Global Insight; McKinsey Global Institute analysis
Average wages could approach 17 percent of those in the U.S. by 2015, up from 3 percent in 2000.

<table>
<thead>
<tr>
<th>Year</th>
<th>Ratio of average Chinese to average U.S. wage rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CAGR (%) 2005-2010 (%) 2010-2015 (%)</td>
</tr>
<tr>
<td>2000</td>
<td>3%</td>
</tr>
<tr>
<td>2001</td>
<td>4%</td>
</tr>
<tr>
<td>2002</td>
<td>9%</td>
</tr>
<tr>
<td>2003</td>
<td>17%</td>
</tr>
<tr>
<td>2004</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>10</td>
</tr>
<tr>
<td>2011E</td>
<td></td>
</tr>
<tr>
<td>2013E</td>
<td></td>
</tr>
<tr>
<td>2015E</td>
<td>17</td>
</tr>
</tbody>
</table>

Sources: Economist Intelligence Unit; U.S. Bureau of Labor Statistics; selected company data; BCG analysis.
Terre rare


Please note variations in the vertical scale.
Terre rare

Rare earth elements are a collection of 17 chemical elements, including Neodymium.

Cosa vogliono dire questi simboli?

Pericolo  Opportunità

CRISI IN LINGUA CINESE
Quale futuro?
Il consumatore Verde: mito o realtà?

I driver verso il green non sono cambiati

1. Prezzi dell’energia alti e volatili
2. Pressione dei governi verso le tematiche green
3. Interesse verso la sicurezza alimentare e di prodotto
4. Pulsione a ridurre i costi a causa dell’elevata concorrenza
5. L’ambiente non si pulisce da solo e l’impatto antropico è sempre più evidente

L’interesse verso il Green sta crescendo, nonostante la crisi.

...la domanda di prodotti verdi continua a crescere.

Source: BCG/Lightspeed Research Survey of more than 2,000 European adults.
### Complete Ford F-150 program

<table>
<thead>
<tr>
<th>Option</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trim Line</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Cab</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>Drive</td>
<td>2</td>
<td>36</td>
</tr>
<tr>
<td>Box</td>
<td>4</td>
<td>144</td>
</tr>
<tr>
<td>Engines</td>
<td>3</td>
<td>432</td>
</tr>
<tr>
<td>Transmission</td>
<td>3</td>
<td>1,296</td>
</tr>
<tr>
<td>Rear Axle Ratio</td>
<td>7</td>
<td>9,072</td>
</tr>
<tr>
<td>Wheel</td>
<td>9</td>
<td>81,648</td>
</tr>
<tr>
<td>Tires</td>
<td>8</td>
<td>653,184</td>
</tr>
<tr>
<td>Seats</td>
<td>18</td>
<td>11,757,312</td>
</tr>
<tr>
<td>Power Seats</td>
<td>2</td>
<td>23,514,624</td>
</tr>
<tr>
<td>Radios</td>
<td>5</td>
<td>117,573,120</td>
</tr>
<tr>
<td>Running Boards</td>
<td>4</td>
<td>470,292,480</td>
</tr>
<tr>
<td>Rear Window</td>
<td>3</td>
<td>1,410,877,440</td>
</tr>
<tr>
<td>Colors</td>
<td>12</td>
<td>16,930,529,280</td>
</tr>
<tr>
<td>Trim Colors</td>
<td>3</td>
<td>50,791,587,840</td>
</tr>
<tr>
<td><strong>16 Individual Options</strong></td>
<td><strong>12,870</strong></td>
<td><strong>653,687,735,500,800</strong></td>
</tr>
</tbody>
</table>

- **Thousands** of marketable combinations
- **Millions** of buildable combinations
- **Trillions** of theoretically possible combinations
Quale è più Sostenibile?

- **Toyota Prius**
  - 104 gCO₂/Km
  - 4,7L/100Km

- **Seat Leon**
  - 100 gCO₂/Km
  - 6,2L/100Km

- **VW Polo**
  - 108 gCO₂/Km
  - 4,0 L/100Km

Qual’è la più sostenibile?

E il processo produttivo?

E oltre all’impatto ambientale?

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Dal prodotto al servizio

Servizio per il prodotto

Prodotto ➔ Servizio per supportare il prodotto ➔ Servizio per differenziare il prodotto ➔ Il servizio È il prodotto

K.D. Thoben 2001

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La competizione verte sempre più attorno al tempo necessario per presentare al mercato un nuovo prodotto (dunque includendo progettazione, produzione e distribuzione). Infatti riducendo il time-to-market si:

- Aumenta l’affidabilità delle previsioni di vendita iniziali (riducendo il time-frame)
- Riduce il rischio della messa in produzione di un nuovo prodotto

As a result, Fiat was able to cut the time from “design freeze” to production on the Bravo and the 500 to just 18 months, from 26 months on the Stilo. Mr Marchionne says that cutting time to market is a critical source of competitive advantage for “the guys running the brand who are mostly not engineers, but are people with a very strong consumer product bias”.

“Rebirth of a carmaker” - The Economist - April 24th 2008
Internet of Things

Recycling

Design supplier

Co-designer

Main Supplier

Spare parts supplier

Service supplier

Component supplier
Come affrontare il futuro?
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

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

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<table>
<thead>
<tr>
<th>Selected Country/Manufacturing</th>
<th>Germany</th>
<th>U.S.</th>
<th>Japan</th>
<th>China</th>
<th>Brazil</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talent-driven innovation</td>
<td>9.47</td>
<td>8.94</td>
<td>8.14</td>
<td>5.89</td>
<td>4.28</td>
<td>5.82</td>
</tr>
<tr>
<td>Economic trade, financial and tax system</td>
<td>7.12</td>
<td>6.83</td>
<td>6.19</td>
<td>5.87</td>
<td>4.84</td>
<td>4.01</td>
</tr>
<tr>
<td>Cost of labor and materials</td>
<td>3.29</td>
<td>3.97</td>
<td>2.59</td>
<td>10.00</td>
<td>6.70</td>
<td>9.41</td>
</tr>
<tr>
<td>Supplier network</td>
<td>8.96</td>
<td>8.64</td>
<td>8.03</td>
<td>8.25</td>
<td>4.95</td>
<td>4.82</td>
</tr>
<tr>
<td>Legal and regulatory system</td>
<td>9.06</td>
<td>8.46</td>
<td>7.93</td>
<td>3.09</td>
<td>3.80</td>
<td>2.75</td>
</tr>
<tr>
<td>Physical infrastructure</td>
<td>9.82</td>
<td>9.15</td>
<td>9.07</td>
<td>6.47</td>
<td>4.23</td>
<td>1.78</td>
</tr>
<tr>
<td>Energy cost and policies</td>
<td>4.81</td>
<td>6.03</td>
<td>4.21</td>
<td>7.16</td>
<td>5.88</td>
<td>5.31</td>
</tr>
<tr>
<td>Local market attractiveness</td>
<td>7.26</td>
<td>7.60</td>
<td>5.72</td>
<td>8.16</td>
<td>6.28</td>
<td>5.90</td>
</tr>
<tr>
<td>Healthcare system</td>
<td>9.28</td>
<td>7.07</td>
<td>8.56</td>
<td>2.18</td>
<td>3.33</td>
<td>1.00</td>
</tr>
<tr>
<td>Government investments in manufacturing and innovation</td>
<td>7.57</td>
<td>6.34</td>
<td>6.80</td>
<td>8.42</td>
<td>4.93</td>
<td>5.09</td>
</tr>
</tbody>
</table>

Scores on a 10 point scale, where 1 being "Least competitive" and 10 being "Most competitive" — adjusted for country, size, and industry

Source: Deloitte Touche Tohmatsu Limited and U.S. Council on Competitiveness, 2013 Global Manufacturing Competitiveness Index
Advanced manufacturing processes that will be focused on by the ‘Factories of the Future’ partnership are:

- Additive manufacturing (i.e. 3D Printing)
- Photonics-based materials processing tech
- Shaping technology
- High productivity & ‘self-assembly’ technologies
- Methods for the handling parts, metrology & inspection
- Flexible sheet-to-sheet & roll-to-roll
- Innovative physical, chemical & physiochemical processes
- Replication equipment for flexible, scalable production
- Integration of non-convention tech
ICT Megatrends - Technology Push Perspective

**Collaboration**
- OEM – subcontractor collaboration through cloud paradigm
- Trends of contract manufacturing and ‘product as a service’
- Customer involvement in product design

**Mobility**
- Proliferation of mobile devices
- ‘On-the-go’ and ‘Always-on’ users
- New businesses (manufacturing apps & manufacturing app store)

**Connectivity**
- Sensors, controllers, embedded devices a commonplace
- ‘Intranet of Things’ to ‘Internet of Things’
- Bidirectional interaction with real-world objects

**Intelligence**
- Data analytics and forecasting on-the-fly
- Leveraging cheaper storage and low cost processors
- Better visualization & intelligence on manufacturing data

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**Human-centric Manufacturing**
Factories of the future are expected to create a large amount of employment opportunities for citizens. Factory workers are key to competitiveness but challenges such as changing demographics & news skills must be addressed.

Companies should address the following items:

- New approaches to accommodate different demographics
- New technical, educational & organisational ways to increase attractiveness of factory work
- New approaches to development of skills & competences
- New ways to organise factories: Human-centred work environments
- Ways to integrate future factory work into social patterns
They are coming!
World Manufacturing Forum (WMF2014)

The Way Forward to Global Prosperity
Through Manufacturing Collaboration

Milano, 1-2 July 2014, 440 partecipanti

- Direction of Manufacturing Policy
- Policies, Challenges, and Opportunities in Next-Generation of Manufacturing
- Workforce, Education and Human centered Manufacturing
- Venture Capital/Ecosystem for Manufacturing Start-ups
- Robotics for SMEs
- Global standards for products and manufacturing
- Cyber security Issues for Manufacturing
- Game Changing Technologies for Manufacturing
”Stay hungry, stay foolish.”
Who I am

- Professor of Advanced and Sustainable Manufacturing @ Politecnico di Milano
- Leader of a 40-people group on Manufacturing Engineering and Management
- Member of the European Factory of the Future Research Association
- Technology Foresight expert
  - Coordination of 3 Technological Foresight Roadmaps on Manufacturing over the last 10 years
- 22 EU Funded projects for a total amount of 10,9M€ funding since Jan 2009
- Scientific Chairman of the World Manufacturing Forum

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I trend innovativi per il Manufacturing del futuro

The New Industrial Revolution

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