The Next Industrial Revolution: What’s driving it – and what are the opportunities?

OECD, Paris, March 5 2014

Address by Peter Marsh

www.petermarsh.eu
After the economic crisis...
What’s the future for manufacturing?
Some optimistic views

“There’s a new zeitgeist: I’m seeing a global manufacturing renaissance”:
Jeff Immelt, chief executive, General Electric, April 2012.
China a bigger part of the picture

110-inch flat screen made by BOE electronics company
A mix of skills and capabilities
Production jobs becoming scarcer
EU manufacturing employment dropped 11 per cent between 2008 & 2012 (net loss 4.3m jobs)
The Next Industrial Revolution

• What manufacturing means
• Global trends
• The 5th industrial revolution
• Growth opportunities
The Next Industrial Revolution

• The meaning of manufacturing
What lies behind manufacturing

- Manufacturing = Materials + Energy + Ideas
- The creative force behind 10bn unique products
- It accounts for 16 per cent of world economy (10pc of UK economy)
- It employs about 300m people (1/3 in China) or roughly 5 pc of world population
- The price effect: manufacturing characterised by deflation (compared to services)
Bringing order to chaos
(countering the 2nd law of thermodynamics)
Even though entropy cannot be beaten ...
...people are having a go
10,000 years of evolution in adding information to materials

Stone age axe: resources needed to make one unit
- Number of manufacturing workers: 1
- Number of sites: 1
- Number of materials: 1
- Skills honed by learning over decades
Where we are now

The iPhone 5: resources needed to make one unit
Number of manufacturing workers: 5,000
Number of sites: 50
Number of materials: 50
Skills honed by science and technology advances
The Next Industrial Revolution

• The meaning of manufacturing

• Global trends
The last 3,500 years

- **Pre-industry (1,500BC to 1500 AD)**: Iron Age, glass production, metals

- **Proto-industry (1500- 1780)**: Venice shipyard (c.1500)

- **First Industrial Revolution (1780-1850)**: steam power, textile machinery

- **Second Industrial Revolution (1840-1890)**: communications; railways, telegraph

- **Third Industrial Revolution (1860-1930)**: science based methodology; electricity, chemistry

- **Fourth Industrial Revolution (1950-2000)**: computers, electronics
1800 – At the dawn of modern manufacturing

Early Chinese astronomical clock

Share of world production

1. China       33.3%
2. India*      19.7%
3. Russia      5.6%
4. UK          4.3%
5. France      4.2%
6. Germany**   3.5%
6. Japan       3.5%

Source: Paul Bairoch data; *includes Pakistan; ** German states
1900 – Britain’s century; but the US taking over

Share of world production

1. US 23.6%
2. UK 18.5%
3. Germany 13.2%
4. Russia 8.8%
5. France 6.8%
6. China 6.2%
7. Japan 3.5%

Source: Paul Bairoch data

Isambard Kingdom Brunel, pioneer of the First Industrial Revolution
2012– China regains the lead

Giant Sany crane

<table>
<thead>
<tr>
<th>Share of world production</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. China</td>
<td>22.4%</td>
</tr>
<tr>
<td>2. US</td>
<td>17.5%</td>
</tr>
<tr>
<td>3. Japan</td>
<td>9.4%</td>
</tr>
<tr>
<td>4. Germany</td>
<td>6.0%</td>
</tr>
<tr>
<td>5. South Korea</td>
<td>2.8%</td>
</tr>
<tr>
<td>6. Italy</td>
<td>2.4%</td>
</tr>
<tr>
<td>7. Russia</td>
<td>2.3%</td>
</tr>
</tbody>
</table>

Source: UN data
Growth in manufacturing output 2000-12

China    +241%
Britain  - 9%
Europe   + 14%
World    + 52%
France   + 1%
Germany  + 23%
Japan    + 13%
US       +20%  (Constant 2005 dollars, Source: UN)
<table>
<thead>
<tr>
<th>Country</th>
<th>2012*</th>
<th>2013**</th>
<th>2014**</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>+1.8</td>
<td>+0.5</td>
<td>+1.3</td>
</tr>
<tr>
<td>US</td>
<td>+ 0.3</td>
<td>+0.3</td>
<td>-0.3</td>
</tr>
<tr>
<td>Mexico/Australia/Russia</td>
<td>+ 0.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>UK</td>
<td>-0.1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>India</td>
<td>-0.2</td>
<td>-0.1</td>
<td>-0.1</td>
</tr>
<tr>
<td>Japan</td>
<td>-0.3</td>
<td>-1.9</td>
<td>-0.3</td>
</tr>
<tr>
<td>Italy</td>
<td>-0.4</td>
<td>0</td>
<td>-0.1</td>
</tr>
<tr>
<td>Germany</td>
<td>- 0.5</td>
<td>+0.3</td>
<td>-0.3</td>
</tr>
</tbody>
</table>

(Source:*UN-2011/12 data; Oxford Economics-**estimates and forecasts for 2013/14)
<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Output (bn)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>China</td>
<td>2,556</td>
<td>22.4%</td>
</tr>
<tr>
<td>2</td>
<td>US</td>
<td>1,994</td>
<td>17.5%</td>
</tr>
<tr>
<td>3</td>
<td>Japan</td>
<td>1,076</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Germany</td>
<td>686.6</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>S Korea</td>
<td>315.8</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Italy</td>
<td>279.9</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Russia</td>
<td>262.4</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Brazil</td>
<td>253.8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>India</td>
<td>239.5</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>France</td>
<td>233.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>World</td>
<td>11,426</td>
<td></td>
</tr>
</tbody>
</table>

Source: UN
## World manufacturing output 2012 ($bn, current prices)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Output ($bn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.</td>
<td>UK</td>
<td>219.5</td>
</tr>
<tr>
<td>12.</td>
<td>Indonesia</td>
<td>210.2</td>
</tr>
<tr>
<td>13.</td>
<td>Mexico</td>
<td>205.0</td>
</tr>
<tr>
<td>14.</td>
<td>Canada</td>
<td>185.6</td>
</tr>
<tr>
<td>15.</td>
<td>Spain</td>
<td>161.8</td>
</tr>
<tr>
<td>16.</td>
<td>Taiwan</td>
<td>130*</td>
</tr>
<tr>
<td>17.</td>
<td>Turkey</td>
<td>123.2</td>
</tr>
<tr>
<td>18.</td>
<td>Australia</td>
<td>120.7</td>
</tr>
<tr>
<td>19.</td>
<td>Switzerland</td>
<td>113.4</td>
</tr>
<tr>
<td>20.</td>
<td>Thailand</td>
<td>111</td>
</tr>
</tbody>
</table>

Source: UN, IHS Global Insight

* estimate
World manufacturing output 2012 (percentages)

Asia 43%
Europe 26%
N America 22%
S America 3%
Africa 2%
Rest of world 4%

Source: UN
World manufacturing deflation

A typical factory-produced item today typically sells for half the price it sold for in 1970 (relative to overall global inflation)
The Next Industrial Revolution

- The meaning of manufacturing
- Global trends
- The 5th industrial revolution
The Next Industrial Revolution
(Fifth Industrial Revolution)-Key factors

1. Blended technology
2. Mass personalisation/customisation
3. Focus on specialisation/niches
4. Environmental stewardship
5. Service dimension
6. Global networking
7. Cluster dynamics
8. The new geography – China/India/S America
9. The maverick manufacturer
The Next Industrial Revolution

1. Blended technology
The A350: many key technologies
Glass for flat-screen TVs/monitors...
Blended technology: the biotech/electronics mix
The Next Industrial Revolution

1. Blended technology

2. Mass personalisation/customisation
Technology/business methods make customisation more affordable and practicable...
The Zara production model – short production runs, made near the customer
The Next Industrial Revolution

1. Blended technology
2. Mass personalisation/customisation

3D Printing adds new tools
The new technology of “additive manufacturing”
Building objects by layers
A few European entrants (Prodways of France)
China is making big strides

(Beijing Long Yuan machines)
A range of new products/parts ...
..but the US firmly ahead (Abe Reichenthal and his 3D-printed guitar)
The Next Industrial Revolution

1. Blended technology
2. Mass personalisation/customisation
3. Focus on specialisation/niches
Tunnelling machines – Herrenknecht (made in Germany)
Winzeler (Chicago): global leader in plastic gears
The Next Industrial Revolution

1. Blended technology
2. Mass personalisation/customisation
3. Focus on specialisation/niches
4. Environmental stewardship
Qbotix: robots (made in California) for solar tracking
Environmental stewardship: grow your own wool
The Next Industrial Revolution

1. Blended technology
2. Mass personalisation/customisation
3. Focus on specialisation/niches
4. Environmental stewardship
5. **Service dimension**
Goppion: manufacture/service in combination
Exploit skills links in areas such as ship repair
The Next Industrial Revolution

1. Blended technology
2. Mass personalisation/customisation
3. Focus on specialisation/niches
4. Environmental stewardship
5. Service dimension
6. Global networking
What’s the link between......
......Chinese electronics factories....
...the Westwind air bearing company in southern Britain .......
.....and a factory in the English countryside?
Global networking: R.A.Chilton coatings company
The Next Industrial Revolution

1. Blended technology
2. Mass personalisation/customisation
3. Focus on specialisation/niches
4. Environmental stewardship
5. Service dimension
6. Global networking
7. Cluster dynamics
IMA: packaging machines (Bologna district)
The Next Industrial Revolution

1. Blended technology

2. Mass personalisation/customisation

3. Focus on specialisation/niches

4. Environmental stewardship

5. Service dimension

6. Global networking

7. Cluster dynamics

8. The new geography – China/India/S America
Giant new competitors (Sany in construction machines)...

![Construction site with large cranes](image)
..but Chinese connections can pay off for Europe (Jaguar Land Rover)
The Next Industrial Revolution

1. Blended technology
2. Mass personalisation/customisation
3. Focus on specialisation/niches
4. Environmental stewardship
5. Service dimension
6. Global networking
7. Cluster dynamics
8. The new geography – China/India/S America
9. The maverick manufacturer
Maverick approach: Thomas Heatherwick – designer/engineer
Linking US and China business/technology: Mark Zou of Alltech
Madécassse: Tim McCollum
(Madagascar chocolate production)
The Next Industrial Revolution

• The meaning of manufacturing

• Global trends

• The 5th industrial revolution

• Growth opportunities
Support specialists (Nidec)
Spot entrepreneurs: Berthold Leibinger of Trumpf
Vital to support existing businesses – Vitsoe sitting comfortably -
...and help new ones – Bouncepad - niche products made in London by a German designer
Encourage cross-border businesses: Ning Li of Made.com
Add skills to old industries: a €600m gamble at Arvedi steelmaker (Italy)
Manufacturing clusters: take note of Germany
Add service skills: manufacturers as physicians
Possibilities abound