POLITECNICO DI MILANO

Trend e Vision del Manufacturing del Futuro

The New Industrial Revolution

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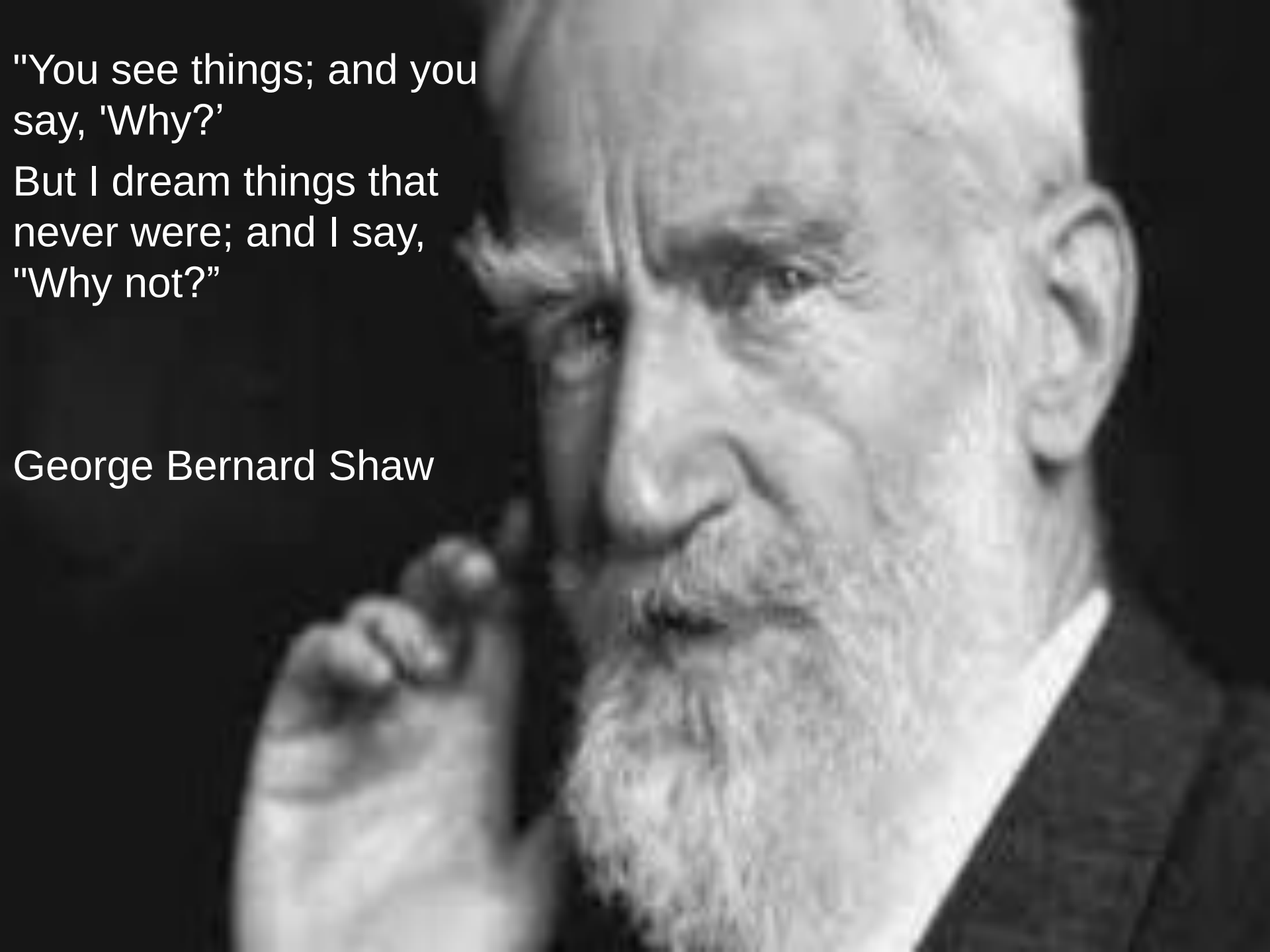

"You see things; and you say, 'Why?'
But I dream things that never were; and I say, "Why not?"
George Bernard Shaw

Evoluzione della produzione

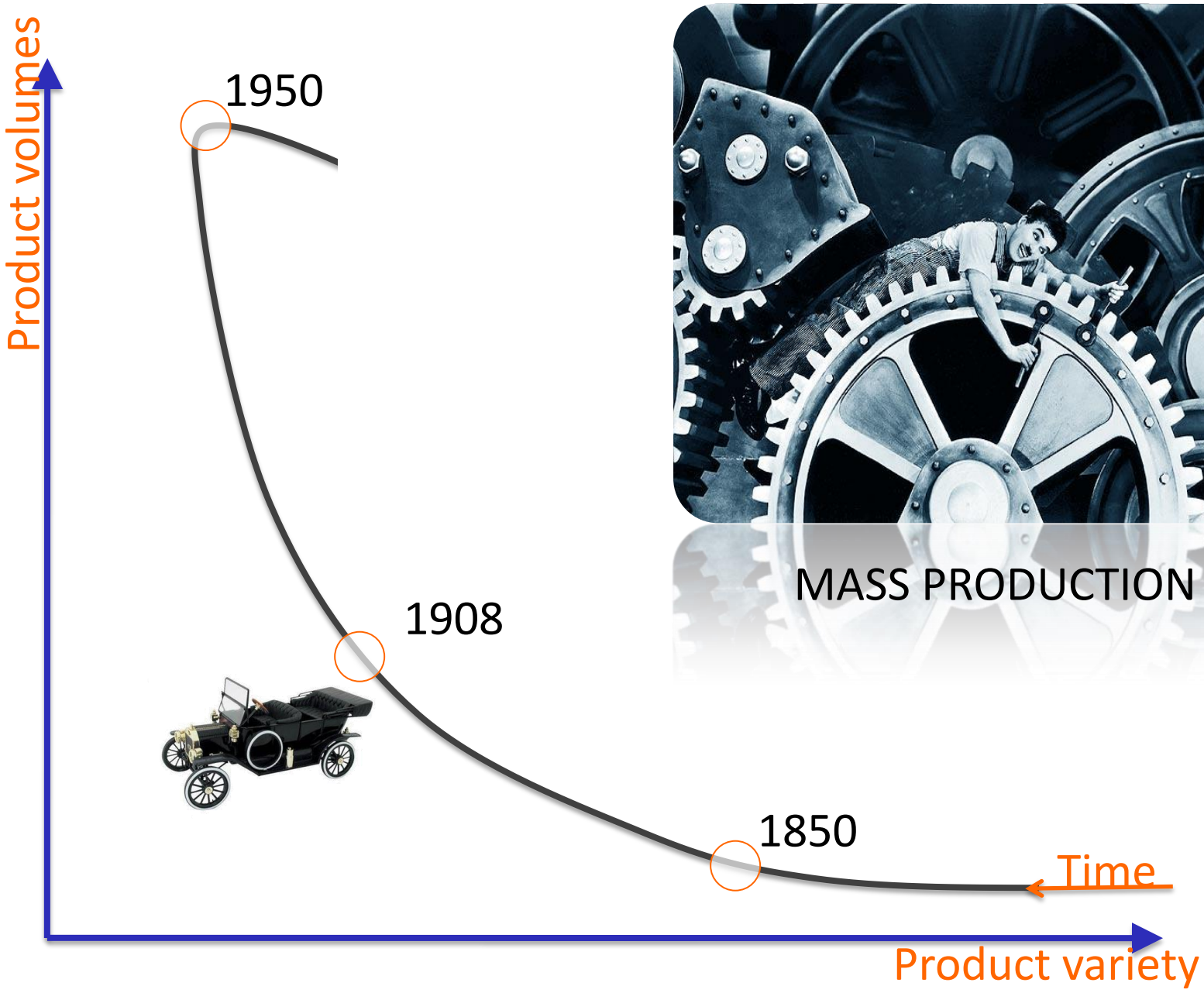
ARTIGIANATO

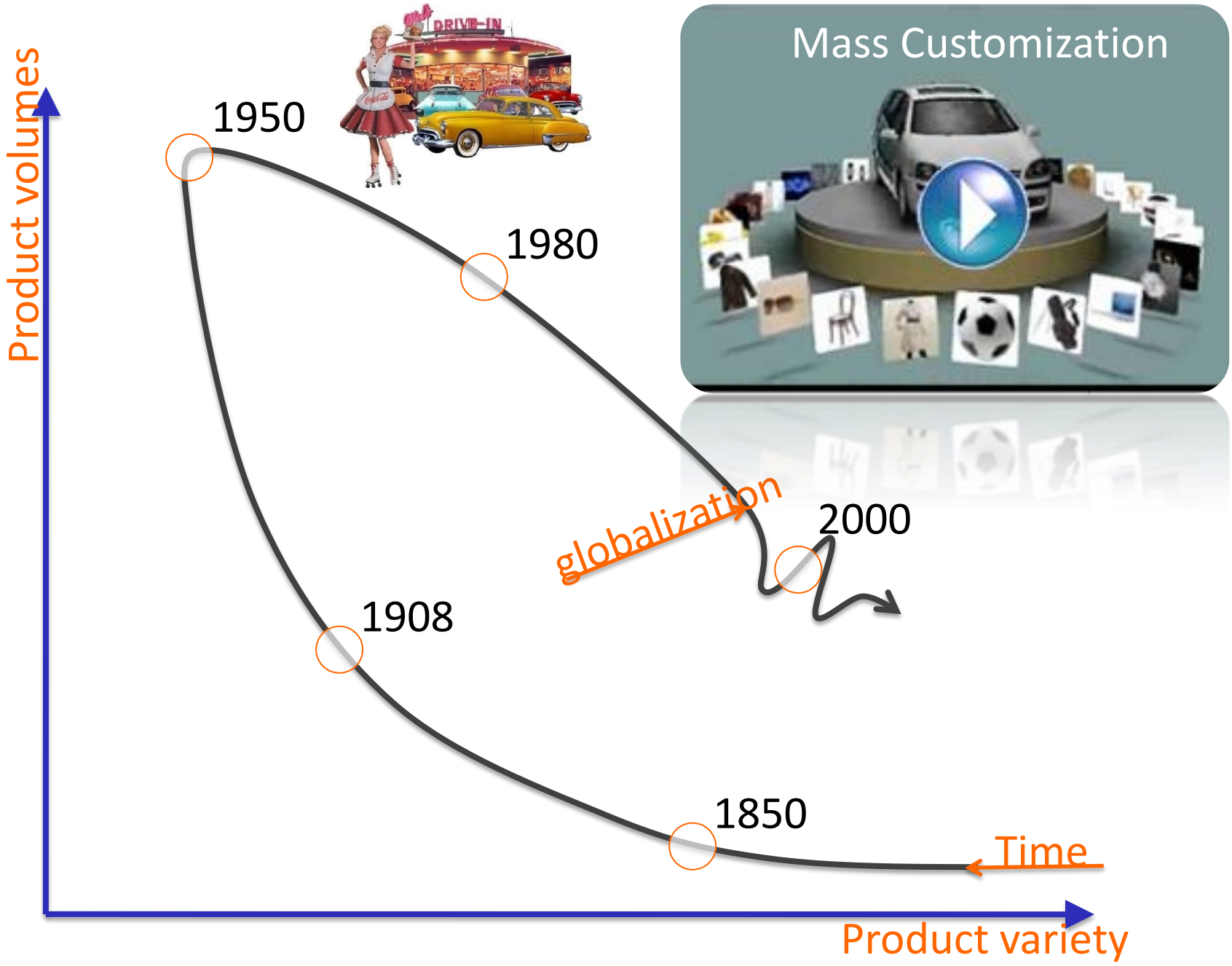
Product volumes

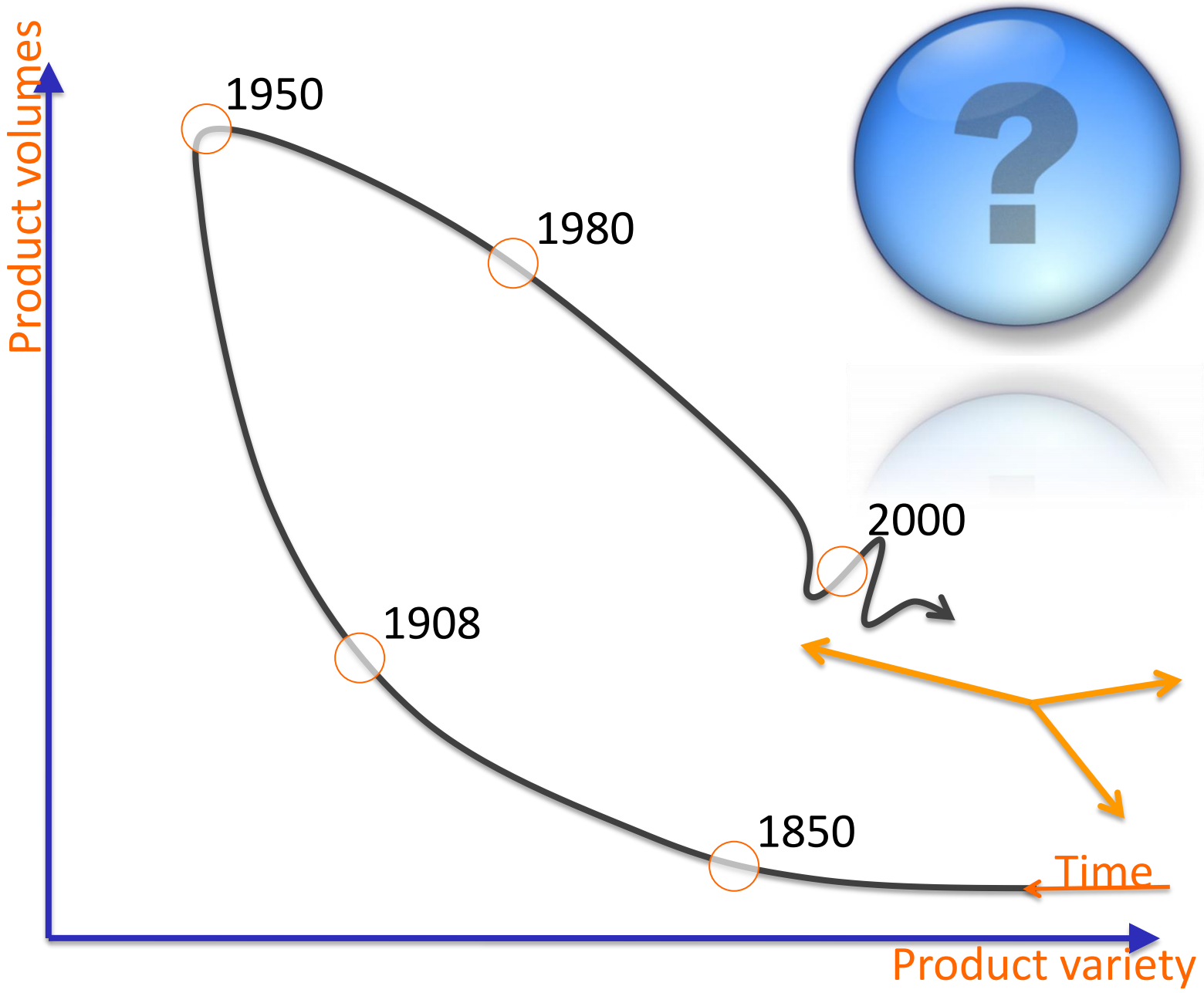
1850

Time

Product variety


Product volumes
1950
1908
1850
Time
Product variety
MASS PRODUCTION


Product volumes
1950
1980
2000
globalization
1908
1850
Time
Product variety
DRIVE-IN
Mass Customization


Product volumes
1950
1980
2000
1908
1850
Time
Product variety

VALORE AGGIUNTO DEL MANUFACTURING PER PAESE

Large developing economies are moving up in global manufacturing

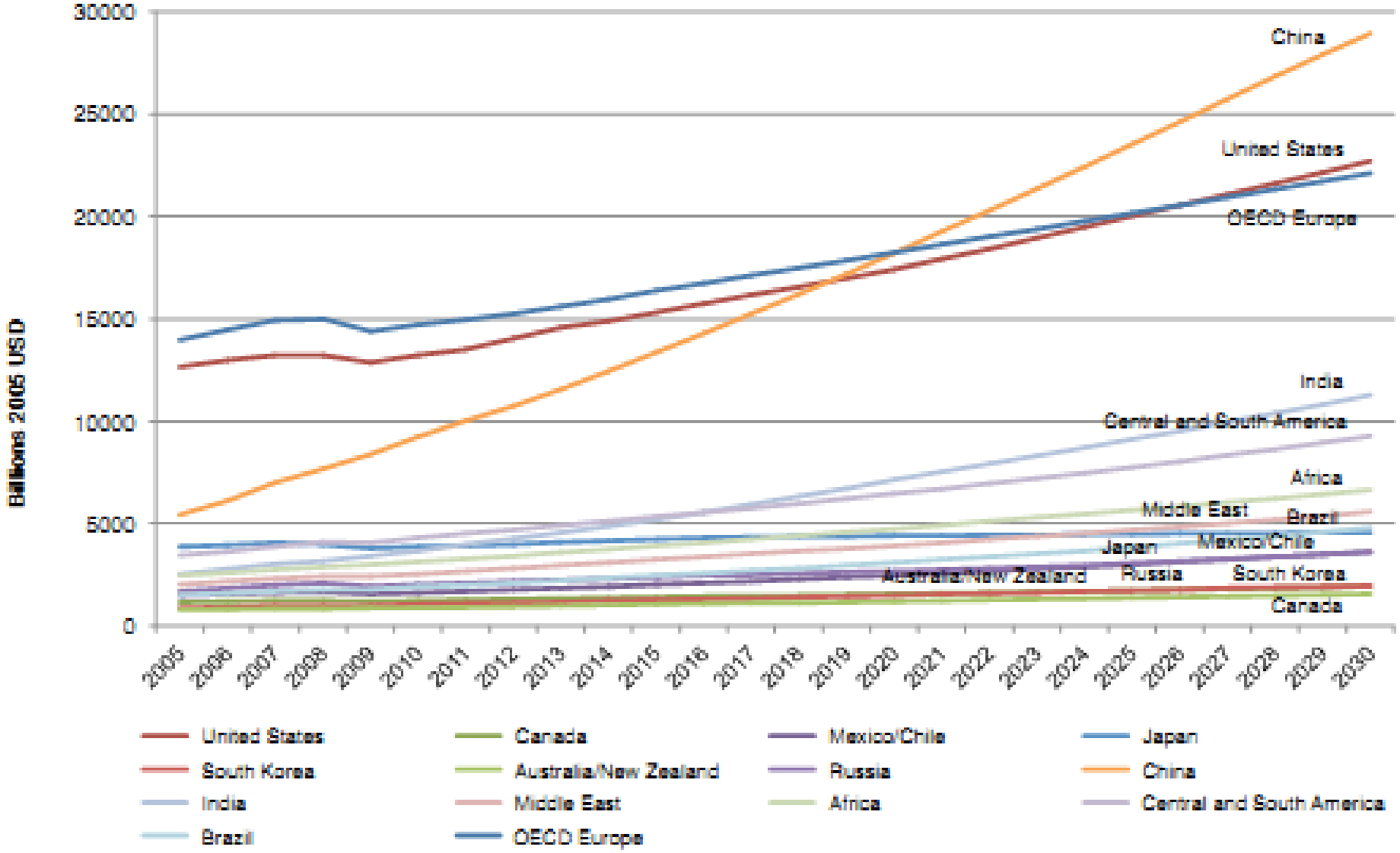
Top 15 manufacturers by share of global nominal manufacturing gross value added

Rank	1980	1990	2000	2010
1	United States	United States	United States	United States
2	Germany	Japan	Japan	China
3	Japan	Germany	Germany	Japan
4	United Kingdom	Italy	China	Germany
5	France	United Kingdom	United Kingdom	Italy
6	Italy	France	Italy	Brazil
7	China	China	France	South Korea
8	Brazil	Brazil	South Korea	France
9	Spain	Spain	Canada	United Kingdom
10	Canada	Canada	Mexico	India
11	Mexico	South Korea[1]	Spain	Russia[2]
12	Australia	Mexico	Brazil	Mexico
13	Netherlands	Turkey	Taiwan	Indonesia[2]
14	Argentina	India	India	Spain
15	India	Taiwan	Turkey	Canada

1 South Korea ranked 25 in 1980.
2 In 2000, Indonesia ranked 20 and Russia ranked 21.
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

PIL per nazione

Figure 9: GDP by Region, 1990-2030, Expressed in Purchasing Power Parity, Reference Case

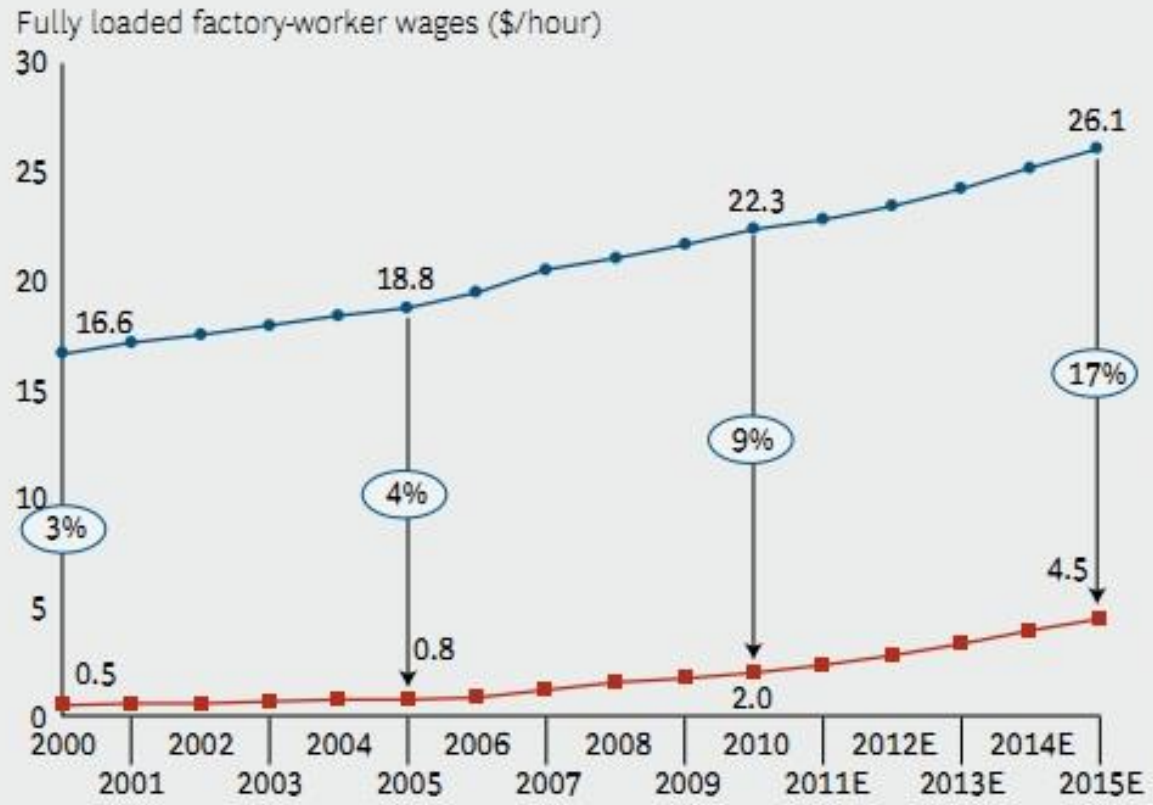


Source: United States Energy Information Administration. (2011) Annual Energy Outlook 2011. Available at: www.eia.gov/forecasts/archive/aeo11/

Crescita dei salari in Cina

EXHIBIT 1 | China's Wage Rates Are Growing Rapidly

Average wages could approach 17 percent of those in the U.S. by 2015, up from 3 percent in 2000

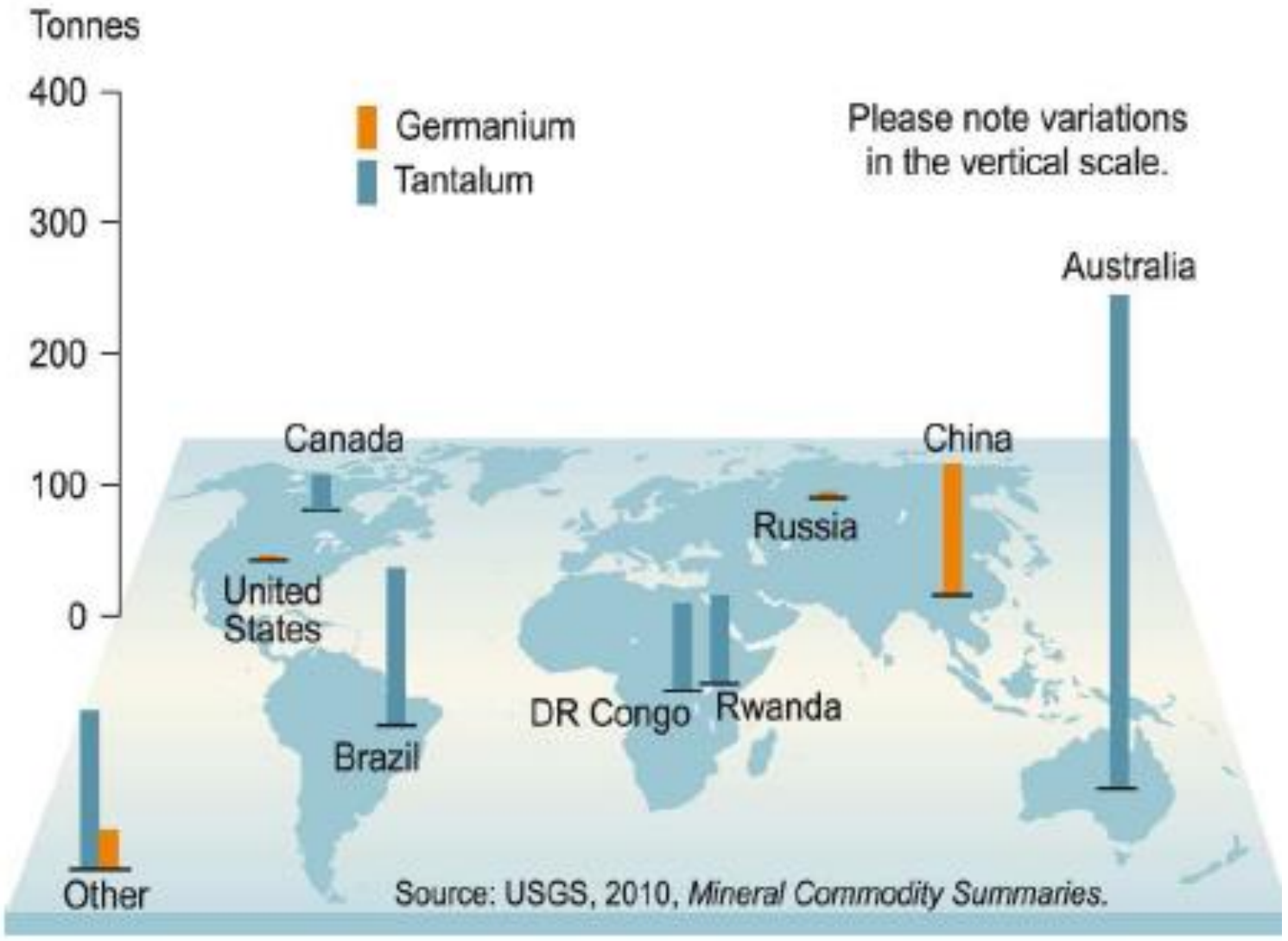


	CAGR 2000–2005 (%)	CAGR 2005–2010 (%)	CAGR 2010–2015 (%)
U.S.	2	4	3
China	10	19	17

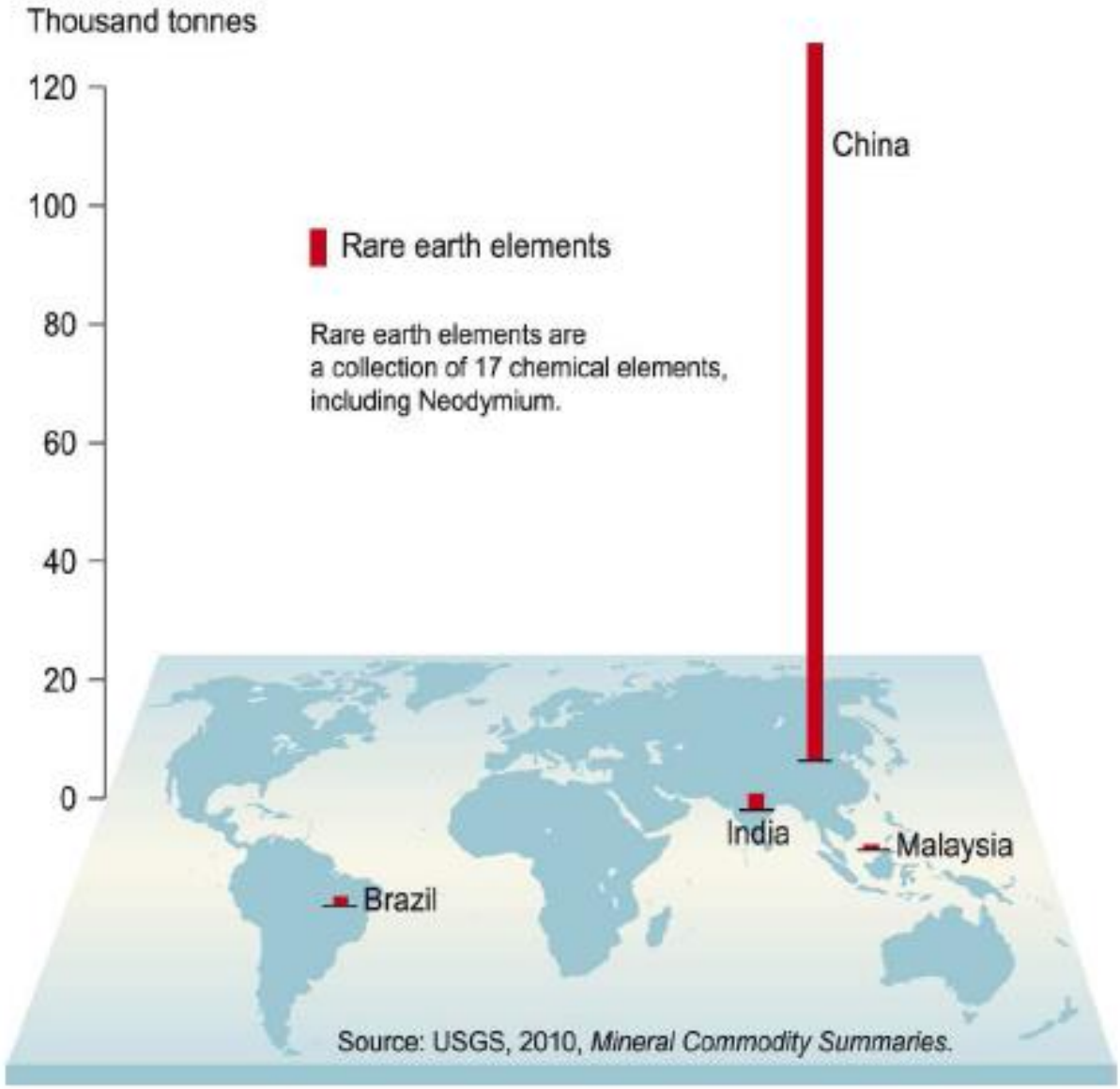
Ratio of average Chinese to average U.S. wage rates

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

Terre rare


Tonnes
400
300
200
100
0
Germanium
Tantalum
Please note variations in the vertical scale.
Australia
Canada
China
Russia
United States
DR Congo
Rwanda
Brazil
Other
Source: USGS, 2010, Mineral Commodity Summaries.

Terre rare


Thousand tonnes
120
100
80
60
40
20
0
China
Rare earth elements
Rare earth elements are
a collection of 17 chemical elements,
including Neodymium.
India
Malaysia
Brazil
Source: USGS, 2010, Mineral Commodity Summaries.

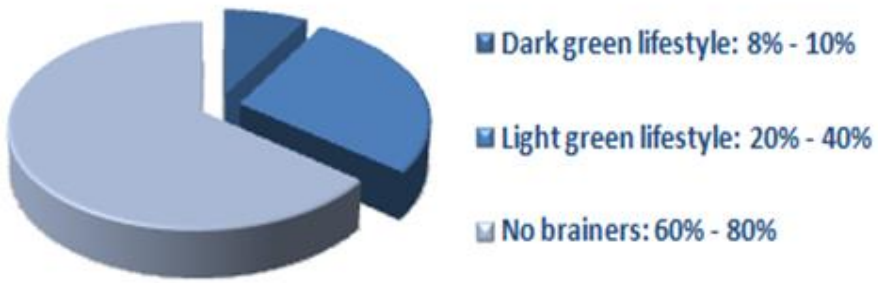
Cosa vogliono dire questi simboli?

Pericolo Opportunità

CRISI IN LINGUA CINESE


Quale futuro?

Il consumatore Verde: mito o realtà?

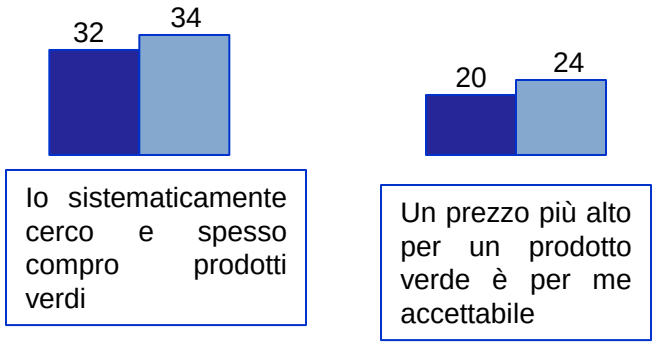


L'interesse verso il Green sta crescendo, nononstante la crisi.

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

…la domanda di prodotti verdi continua a crescere.



Source : BCG/Lightspeed Research Survey of more than 2,000 European adults.

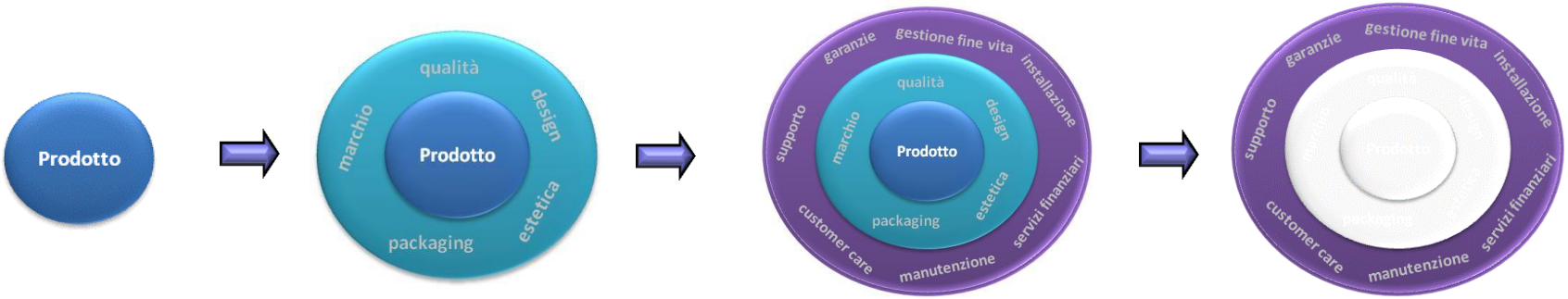
From Mass to Personalised Production

Complete Ford F-150 program		
Trim Line	6	6
Cab	3	18
Drive	2	36
Box	4	144
Engines	3	432
Transmission	3	1,296
Rear Axle Ratio	7	9,072
Wheel	9	81,648
Tires	8	653,184
Seats	18	11,757,312
Power Seats	2	23,514,624
Radios	5	117,573,120
Running Boards	4	470,292,480
Rear Window	3	1,410,877,440
Colors	12	16,930,529,280
Trim Colors	3	50,791,587,840
16 Individual Options	**12,870**	**653,687,735,500,800**

- **Thousands** of marketable combinations
- **Millions** of buildable combinations
- **Trillions** of theoretically possible combinations

Dal prodotto al servizio

Servizio per il prodotto → **Servizio per i clienti**



Prodotto

Servizio per **supportare** il prodotto

Servizio per **differenziare** il prodotto

Il servizio

È

Il prodotto

K.D. Thoben 2001

Riduzione del time-to-market

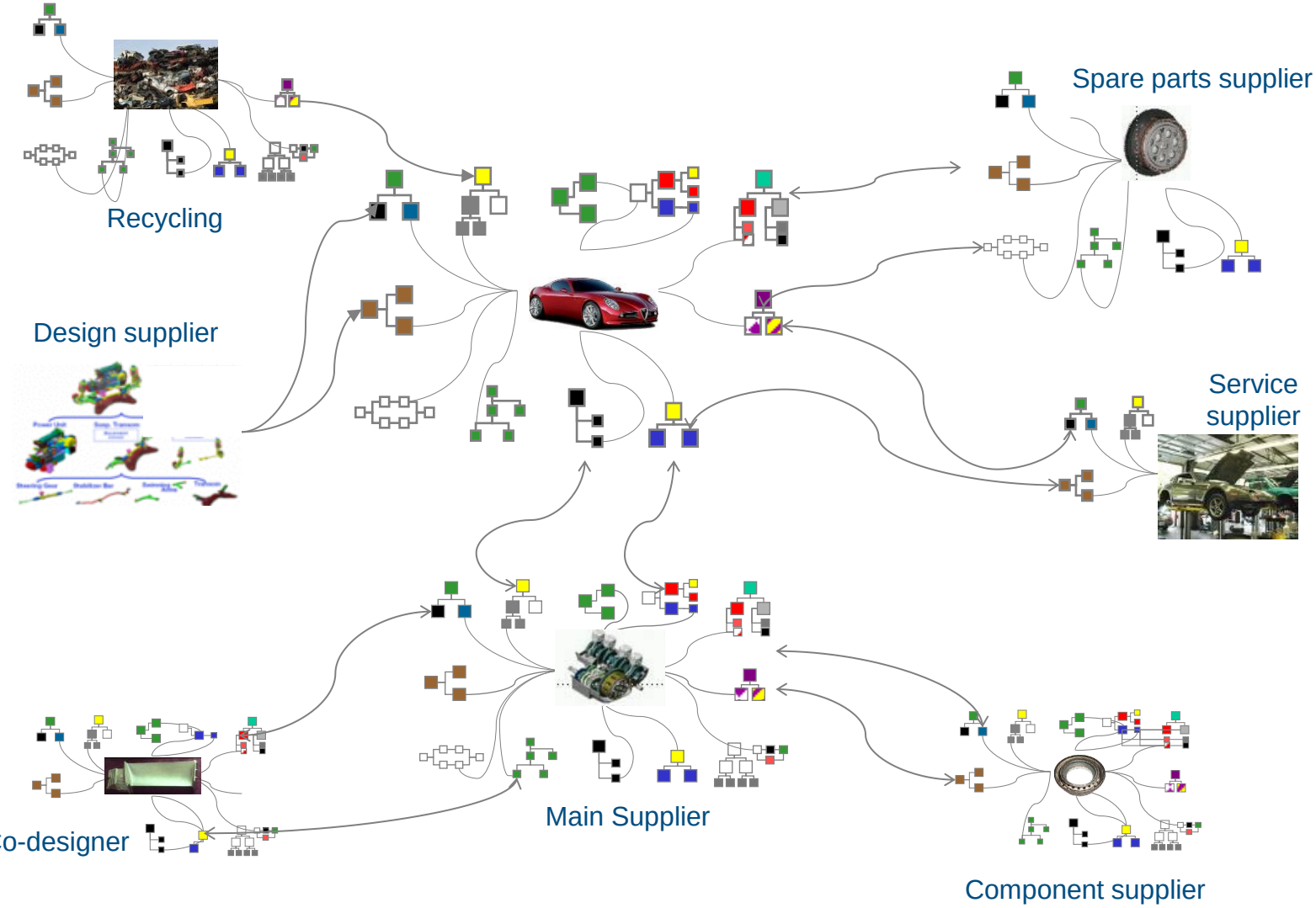
La competizione verte sempre più attorno al tempo necessario per presentare al mercato un nuovo prodotto (dunque includendo progettazione, produzione e distribuzione). Infatti riducendo il time-to-market si:

- 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



Da un'idea di PLM Systems


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

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 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

Table 4: China's transformation reveals itself through key competitiveness drivers

Country level ratings for key drivers of competitiveness

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

Most competitive — Least competitive

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

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.

FACTORIES OF THE FUTURE
Multi-annual roadmap for the contractual PPP under Horizon 2020

Prepared by EFFRA

Policy Research

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

Human–centric Manufacturing

Knowledge Workers

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!

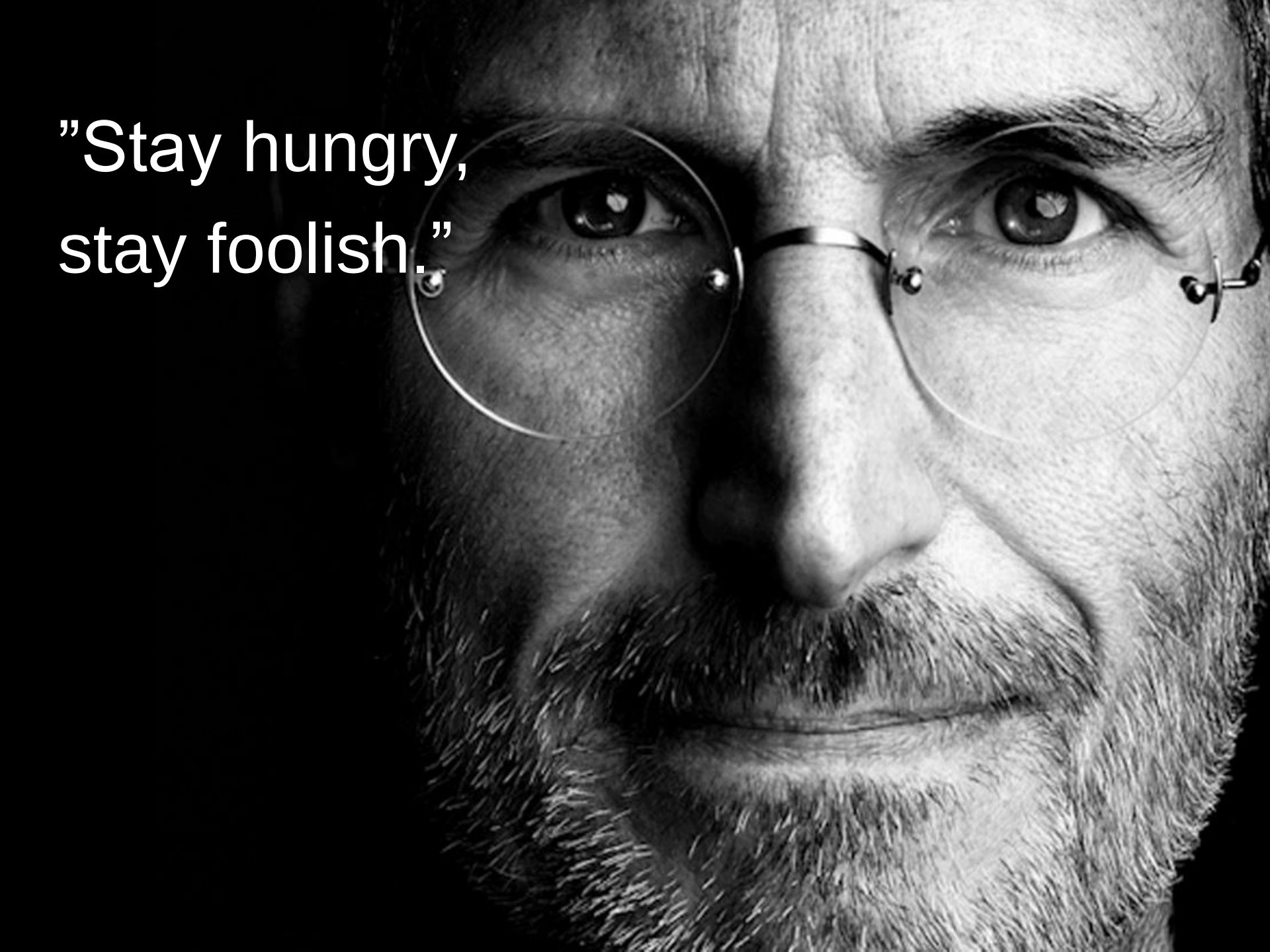
World Manufacturing Forum (WMF)

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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