2015年行政院
生產力4.0科技發展策略會議

專題演講【二】

The Transformation of Manufacturing Policy in the United States

美國製造政策的變革

石昭明教授

PRODUCTIVITY 4.0
行政院科技會報

美國製造政策的變革
The Transformation of Manufacturing Policy in the United States

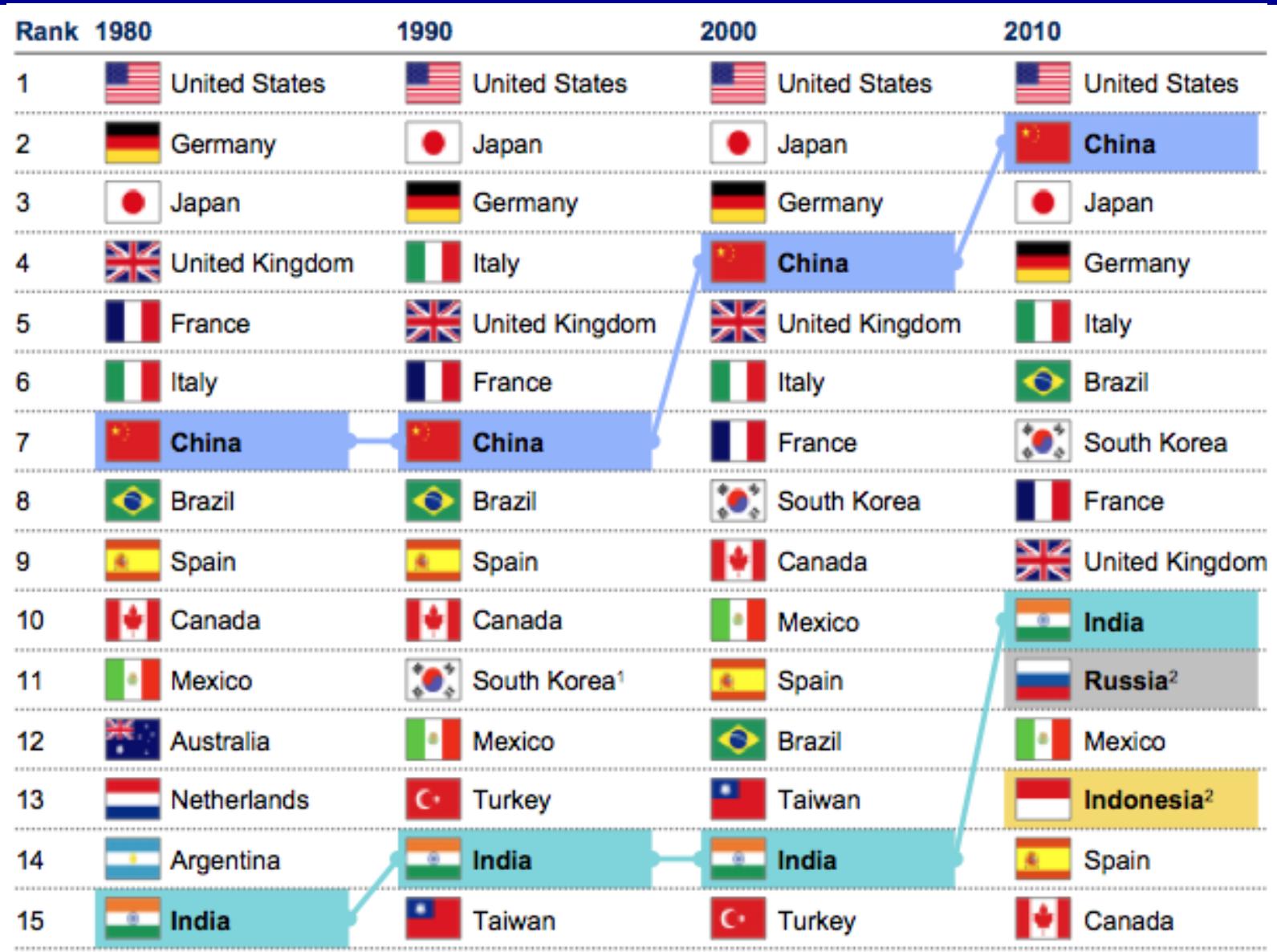
Albert Shih 石昭明
Mechanical Engineering, Biomedical Engineering,
Integrative Systems + Design
University of Michigan at Ann Arbor

MICHIGAN ENGINEERING
UNIVERSITY OF MICHIGAN

About Me

- 1984 BS, 1986 MS: 成功大學, 機械工程系
- 1991 PhD: 普渡大學, 航空工程系
- 1991-1998: 康明斯, 製造工程師
- 1998-2002: 北卡州立大學, 機械航空工程系
- 2003-date: 密西根大學, 機械工程系, 生醫工程系
- Research Area:
  - Machining
  - Biomedical Manufacturing
  - Cyber-Physical Additive Manufacturing of Personalized Assistive Devices (for Independent Living in Aging Society)

Top 15 Countries in Manufacturing

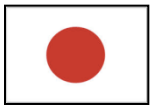


Rank	1980	1990	2000	2010
1	United States	United States	United States	United States
2	Germany	Japan	Japan	**China**
3	Japan	Germany	Germany	Japan
4	United Kingdom	Italy	**China**	Germany
5	France	United Kingdom	United Kingdom	Italy
6	Italy	France	Italy	Brazil
7	**China**	**China**	France	South Korea
8	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

http://samiri.org/top-15-manufacturing-countries/

Per Capita Manufacturing GDP

Rank

1 

2 

3 

4 

5 

6 

7 

Common among these countries:

1.Respect for hands-on skills in the society and dedication of skilled technicians and engineers in manufacturing.

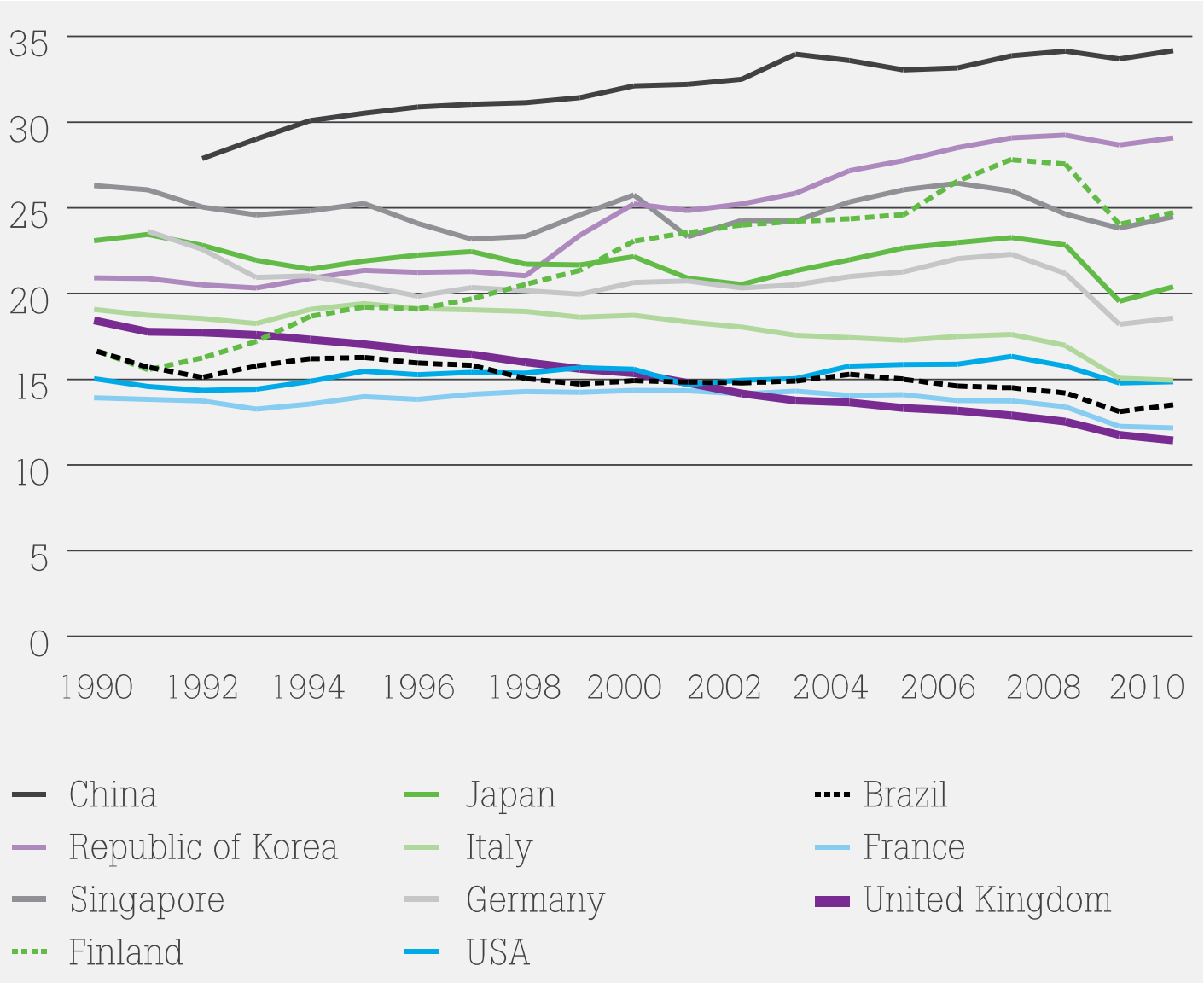
1.Solid education from high-tech technicians to PhDs

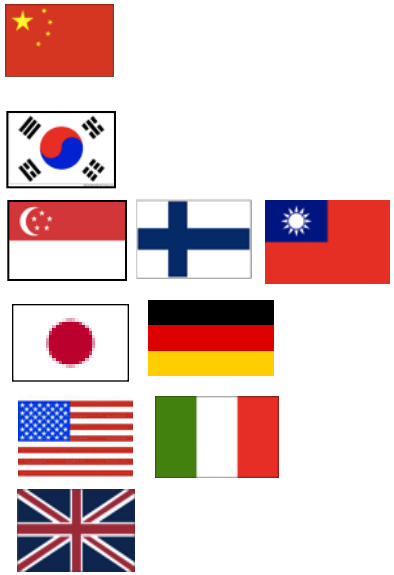
1.Innovative and high-value

2.Outstanding government and industry leaders

Note: anecdotal selection and comparison conducted by Albert Shih on countries without extensive natural resources

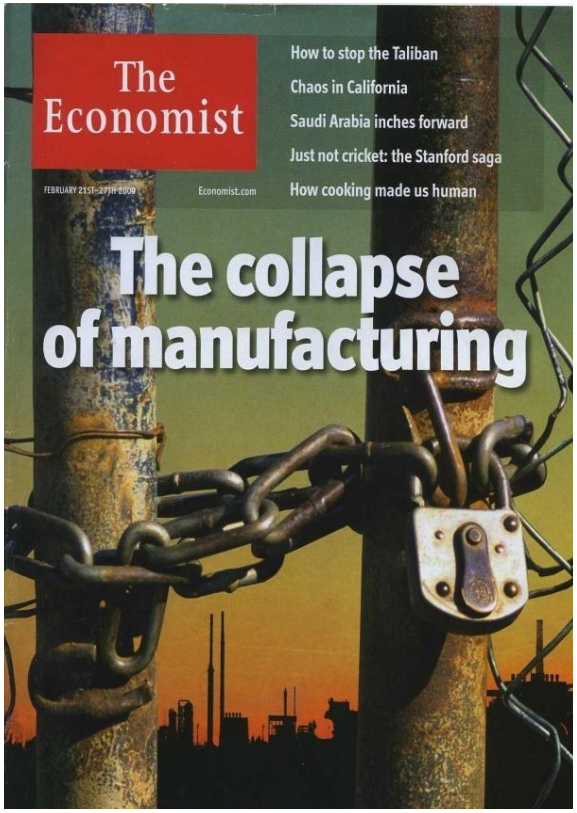
Manufacturing Share of GDP





Foresight (2013).The Future of Manufacturing: A new era of opportunity and challenge for the UK Summary Report, The Government Office for Science, London

Manufacturing – Collapsed in 2009 and Rebirth in 2012



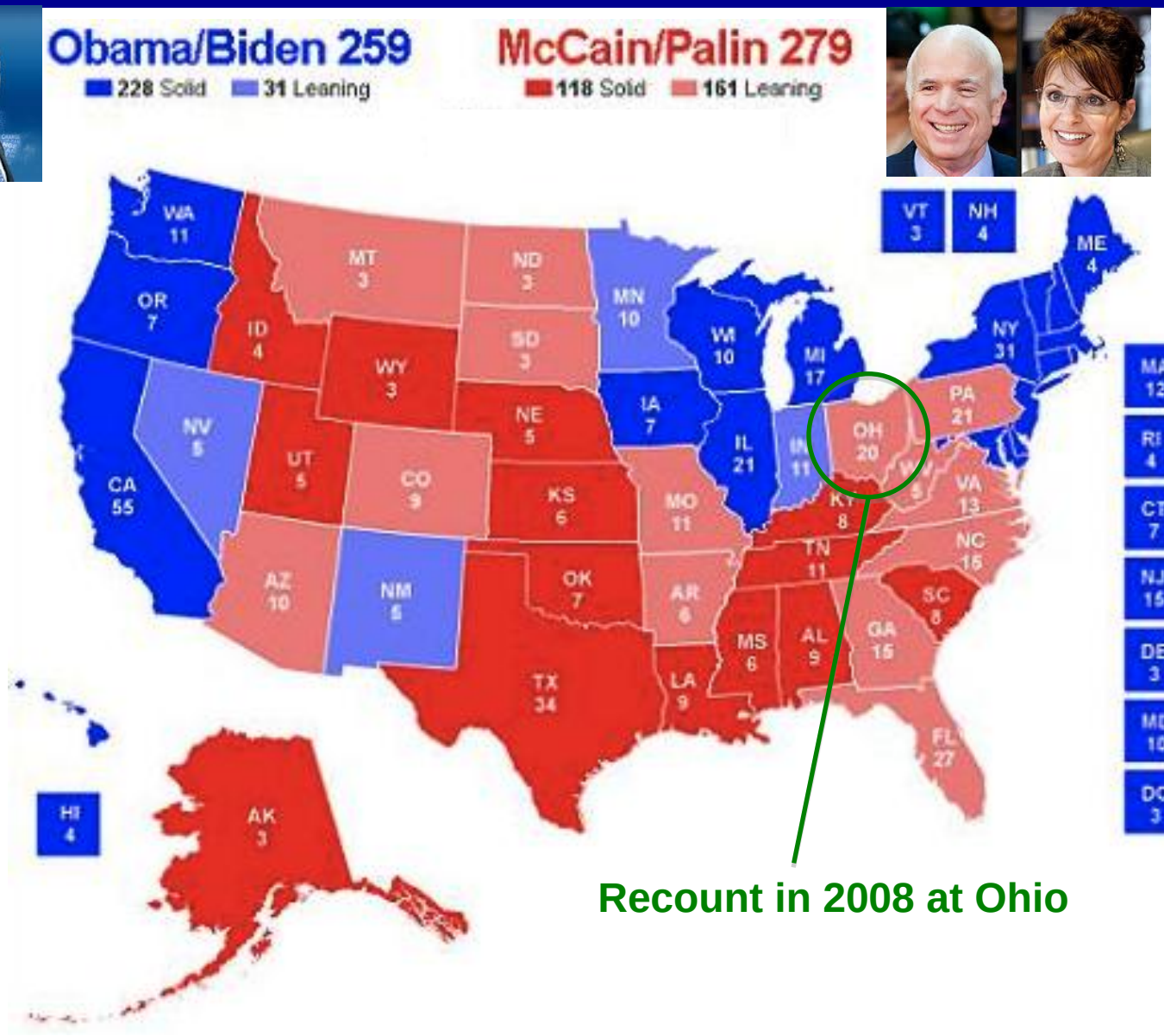
Feb 2009

April 2012

Manufacturing is the talk of politicians.

Business, technical and medical leaders talk about 3D-printing.

2008 United State Election Prediction and Swing States

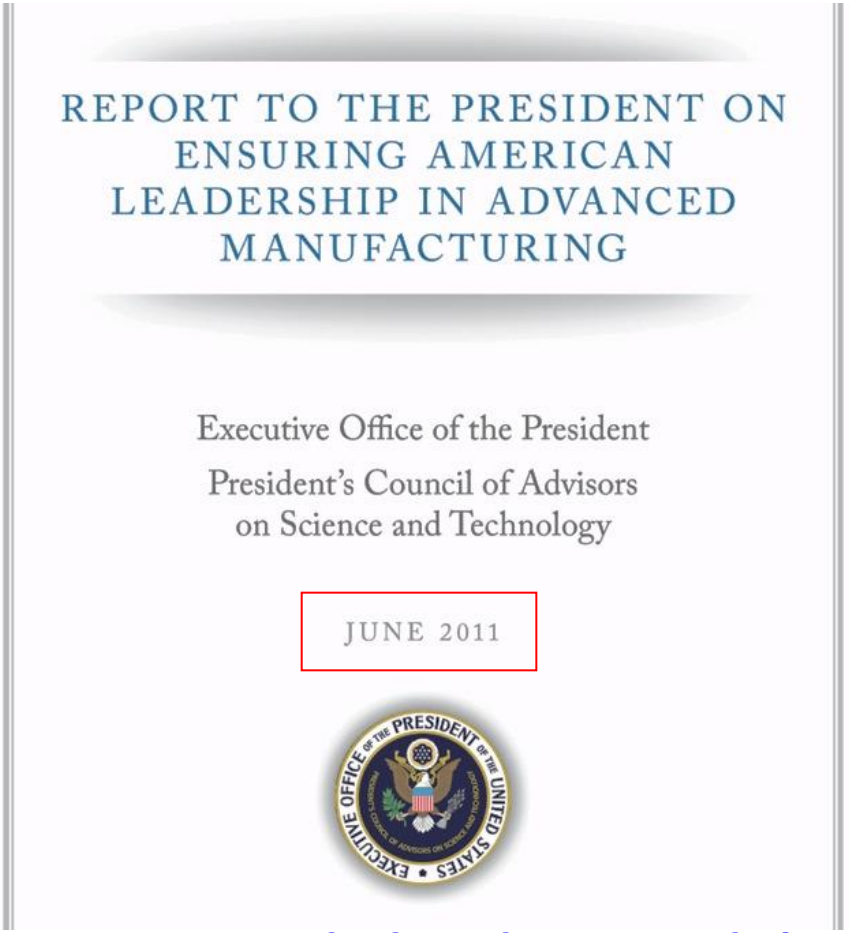


Manufacturing – A National Policy

Sridhar Kota
Professor of Mechanical Engineering
University of Michigan

Assistant Director of Advanced Manufacturing White House Office of Science and Technology Program (OSTP) (2009-2012)

Manufacturing → High Quality Jobs

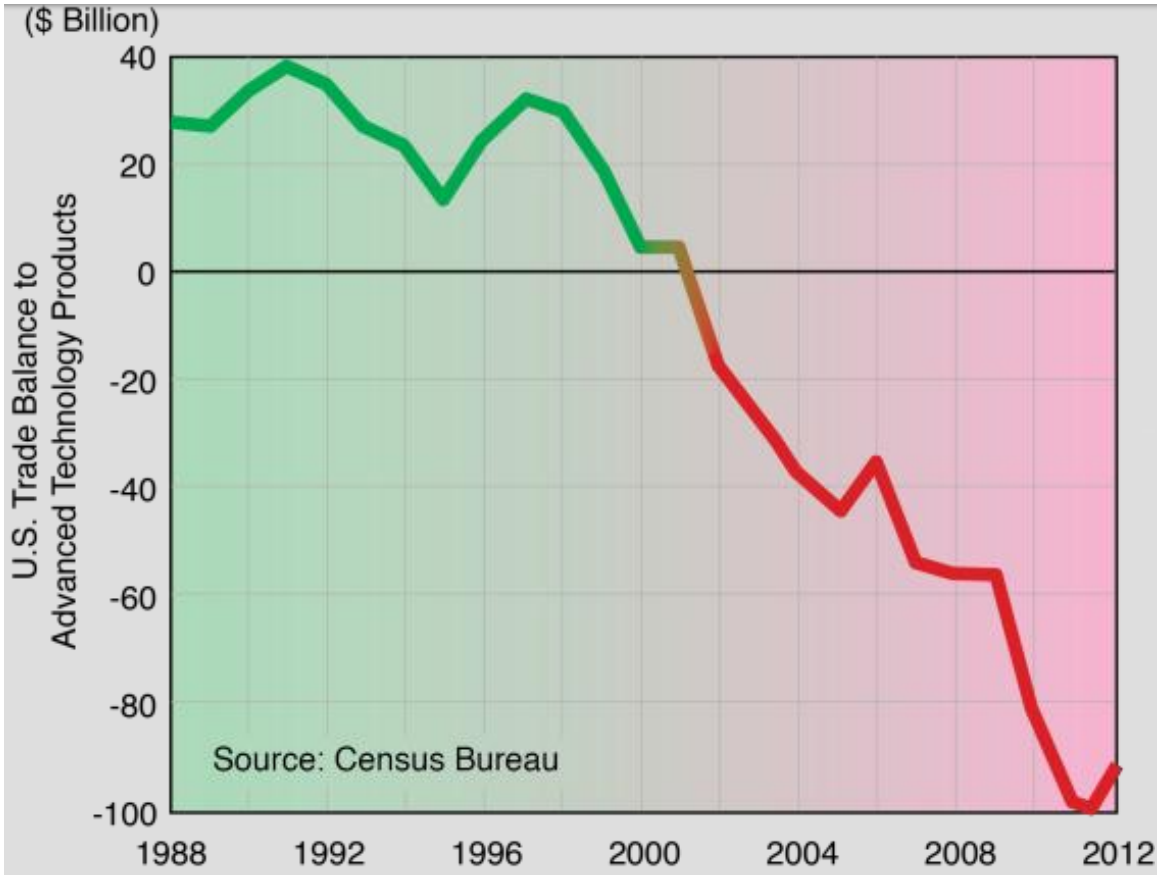


Recommended and Initiated the Advanced Manufacturing Partnership (AMP) (先進製造夥伴)

http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-advanced-manufacturing-june2011.pdf

State of Manufacturing in the US in 2010

Invented here, produced elsewhere.



Source: M Molnar, Advanced Manufacturing National Program Office

2013 State of the Union Announcement

"Our first priority is making America a magnet for new <u>jobs</u> and <u>manufacturing</u>. *Last year, we created our first manufacturing innovation institute in Youngstown, Ohio. ….*

President Obama
State of the Union Address
February 13, 2013

So tonight, I'm announcing the launch of 3 more of these manufacturing hubs, where businesses will partner with the Departments of Defense and Energy to turn regions left behind by globalization into global centers of high-tech jobs. And I ask this Congress to help create a network of 15 of these hubs and guarantee that the next revolution in manufacturing is Made in America."

Source: M Molnar, Advanced Manufacturing National Program Office

June 2011: Announcement of the Advanced Manufacturing Partnership (AMP) (先進製造夥伴)

- Announced by President Obama in June 2011 at CMU.
- 12 companies (**Dow**, ATI, Caterpillar, Corning, Ford, Honeywell, Intel, J&J, Northrop Grumman, P&G, Stryker, United Tech)
- 6 universities (**MIT**, Michigan, CMU, Berkeley, Stanford, Ga Tech)
- Government agencies (DoC, DoD, DoE, NSF)
- Public-private partnership (PPP)

2015-05-31 經濟日報社論

美國的先進製造夥伴計畫(AMP)，是總統歐巴馬於2011年6月向全國宣布，強烈表達振興美國製造業的決心，之後即邀請全美六位大學校長及12家領先的製造業公司如福特、英特爾、康寧、Honeywell等，在白宮設立指導委員會並擬定行動方案，之後分成五個工作小組，一年內每周都召開全美視訊會議，討論出16項具體可行的執行建議。在凝聚共識後，2013年9月起，歐巴馬又挑選20個諮詢委員，研議落實之道，並陸續公布具體的執行計畫，再由國會通過預算執行，讓AMP成為美國製造業全面復興的主要推力。

AMP Workstreams

- Technology
- Policy
- **Education and Workforce Development**
- Communications and Outreach
- **Shared Infrastructure and Facilities**

President's Council of Advisors on Science and Technology

Advanced Manufacturing Partnership

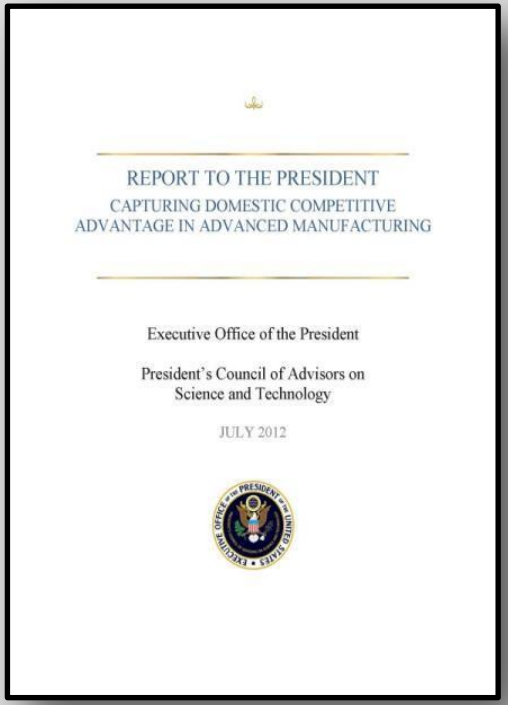
AMP Co-chairs

Andrew Liveris
CEO, Dow Chemical

Susan Hockfield
President, MIT

PCAST / AMP report released July 2012 on whitehouse.gov

- 16 Recommendations in three areas: innovation, talent, and policy



REPORT TO THE PRESIDENT
CAPTURING DOMESTIC COMPETITIVE ADVANTAGE IN ADVANCED MANUFACTURING

Executive Office of the President

President's Council of Advisors on Science and Technology

JULY 2012

Three key recommendations:

1)Create the Advanced Manufacturing National Program Office (AMNPO) to coordinate the "whole government" effort in manufacturing

2)Pursue the "gap" via the National Network for Manufacturing Innovation (NNMI)

3)Expand Community College apprenticeship skill training and certification programs

Community Colleges: A Key in AMP's Education and Workforce Development

- **Free** Community College for all ($60B for over 10 years) – an Obama's Initiative
- Lead by the **Department of Labor**
- Education and training for workers for skill "adjustment"
- Community Colleges need to:
  - Work with businesses
  - Teach skills for job
  - Meet students' needs

Pellissippi State Community College, Knoxville, Tennessee 2015

Ivy Tech, Indiana 2015

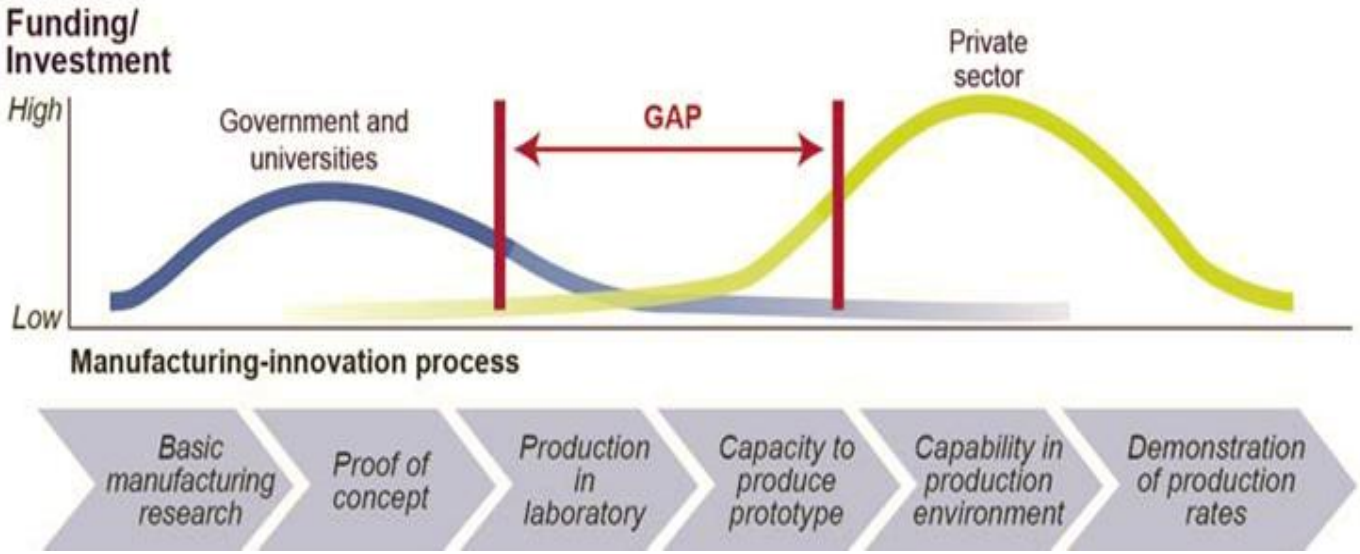
Interagency Advanced Manufacturing National Program Office (AMNPO) – Housed at Department of Commerce / Natl Institute of Standards and Tech

Michael Molnar
Director
Advanced Manufacturing National Program Office (AMNPO) (2011-present)

- Worked 25+ years at Cummins
- Started AMNPO (2011)
- Supported the Advanced Manufacturing Partnership (AMP)(2011-2012) and AMP2.0 (2013-2014)
- Establish the roadmap for National Network for Manufacturing Innovation (NNMI)
- Worked with congress on passing the Revitalize American Manufacturing & Innovation (RAMI) Act (2014)

Shared Infrastructure and Facilities: National Network of Manufacturing Innovation (NNMI)

Addressing the "Gap" to de-risk promising innovative technologies to production in the US.



Jack Hu

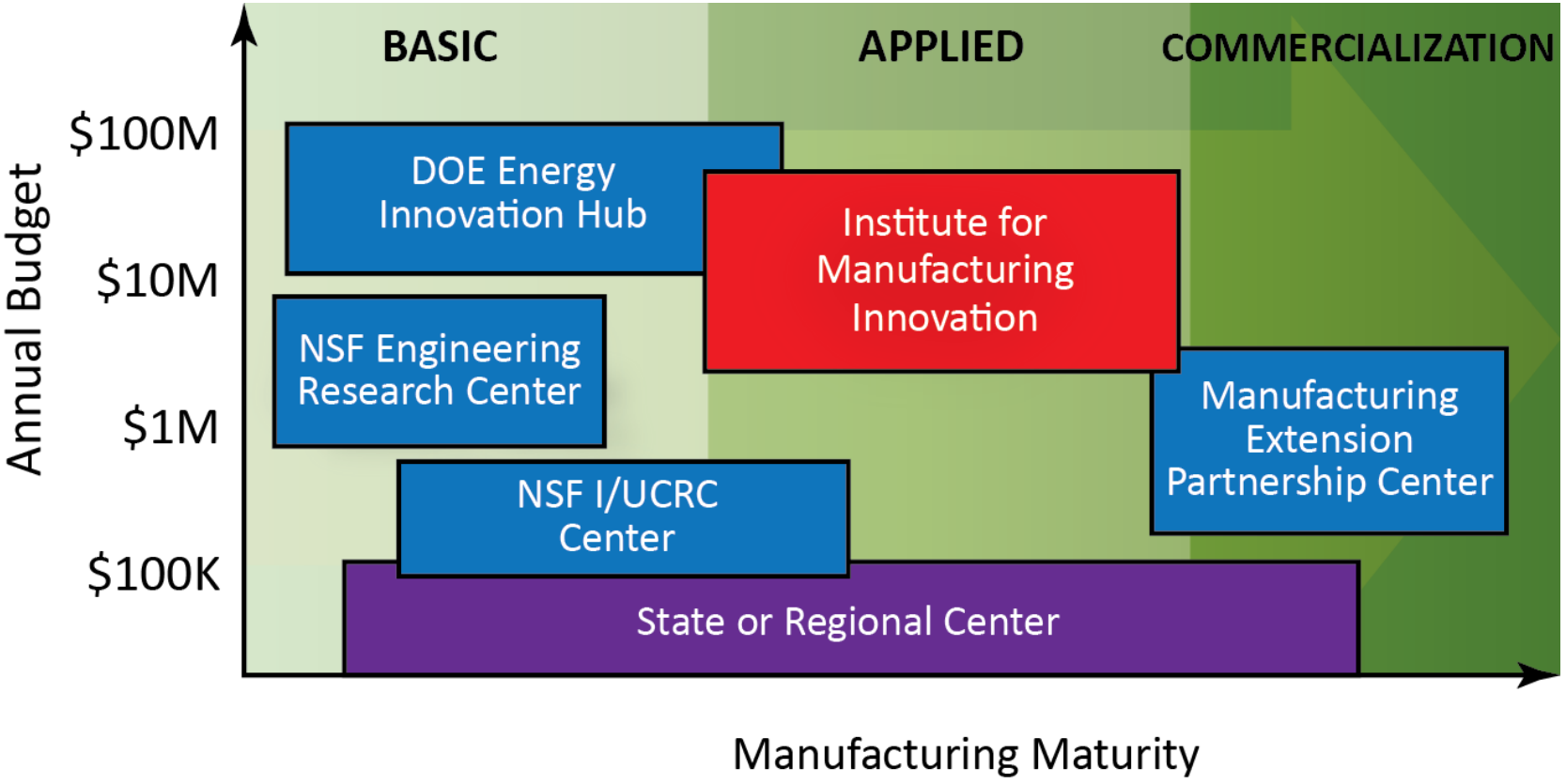
Co-lead of AMP Shared Infrastructure and Facilities

Interim VP of Research
Univ of Michigan

Manufacturing Innovation Institutes

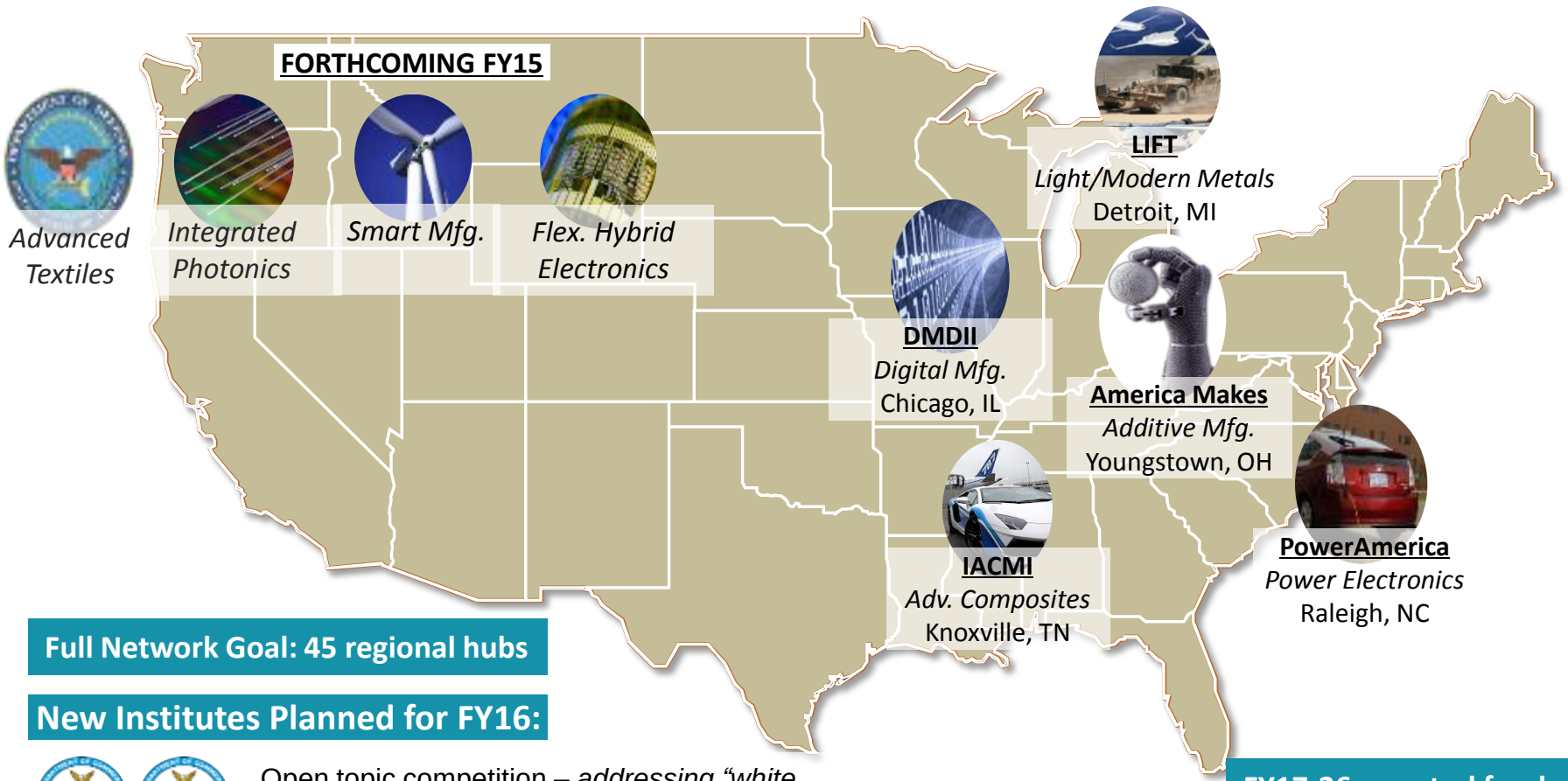
Basic science
Largely government funded

Commercialization
private sector owned/funded



Source: M Molnar, Advanced Manufacturing National Program Office

Status of NNMI: 5 funded, 4 in proposal stage



Full Network Goal: 45 regional hubs

New Institutes Planned for FY16:

Open topic competition – *addressing "white space" between mission agency topics*

Selected topic competitions supporting Agency mission – *using agency authorities and budgets*

FY17-26 – central fund proposed for remaining institutes, via open topic process

NNMI Authorized:
Revitalize American Manufacturing & Innovation (RAMI) Act

118 bipartisan RAMI Bill Sponsors

Rep. Tom Reed
R NY-23

Rep. Joe Kennedy
D MA-4

Sen. Sherrod Brown
D Ohio

Sen. Roy Blunt
R Missouri

September 15, 2014 –
Passed House
100 Cosponsors (51D, 49R)

December 11, 2014 –
Passed Senate with 2015 Appropriations
18 Cosponsors (10D, 7R, 1I)

December 16, 2014 –
Signed By President Obama

Bipartisan Momentum Supporting NNMI Passage

A NNMI Pilot Institute: America Makes (National Additive Manufacturing Innovation Institute)

Ralph Resnik
Founding Director
America Makes

Vice President, CTO
National Center for Defense Manufacturing and Machining (NCDMM)

Members:
Government: DoD, DoE, NSF, DoC, …
Private: 3D System, Stratasys, Boeing, Lockheed Martin, Boeing, Siemens, …

Proposal Calls: 50% matching, 18 month, industry-univ-community college

Proposal Evaluation Criteria
1.Problem statement and America Makes relevance (10 points)
2.Technical approach and methodology (25 points)
3.Technology transition and impact to industrial base (25 points)
4.Sustainability (10 points)
5.Education and workforce training (15 points)

In Summary: US Manufacturing Policy – An Outcome of the Private-Government Partnership

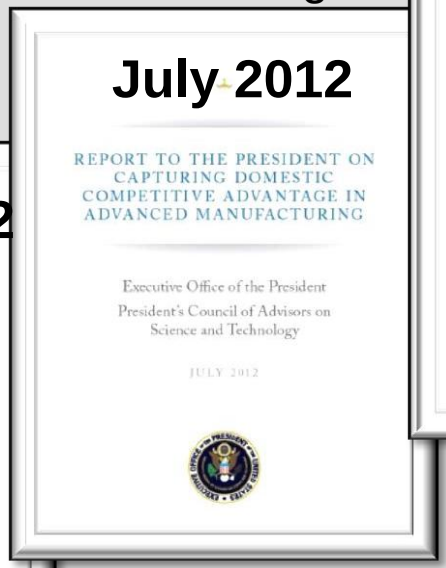
Report to the President on Ensuring America Leadership in Advanced Manufacturing

Initiating AMP

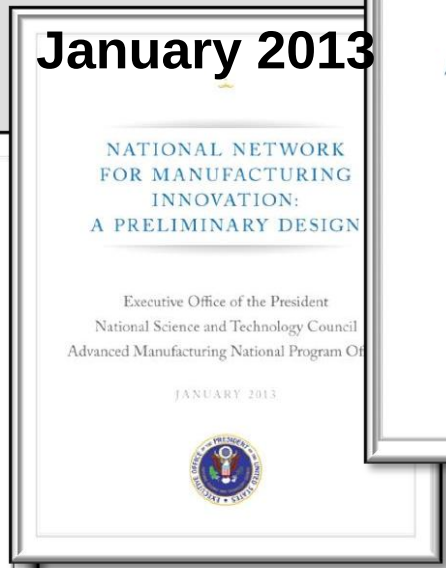
A National Strategic Plan for Advanced Manufacturing

Manufacturing Innovation Institute

Capturing Domestic Competitive Advantage in Advanced Manufacturing

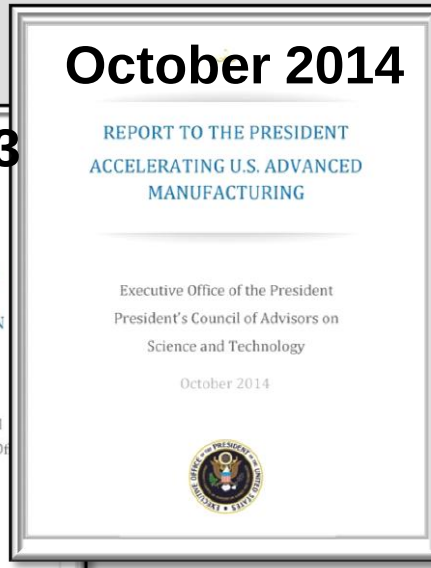


AMP Report



National Network for Manufacturing Innovation: A Preliminary Design

AMNPO Report



Accelerating U.S. Advanced Manufacturing

AMP 2.0 Report

What Next?

- US
  - Consortium for Advanced Manufacturing Foresights ($3M to $6M for 3-year, proposal due July 20) AMP3.0
  - Making Value for America: Embracing the Future of Manufacturing, Technology and Work
- Germany: Fraunhofer, Industrie 4.0
- United Kingdom: The Future of Manufacturing 2050
- China: 中國製造2025
- India, France, ….

What Next?

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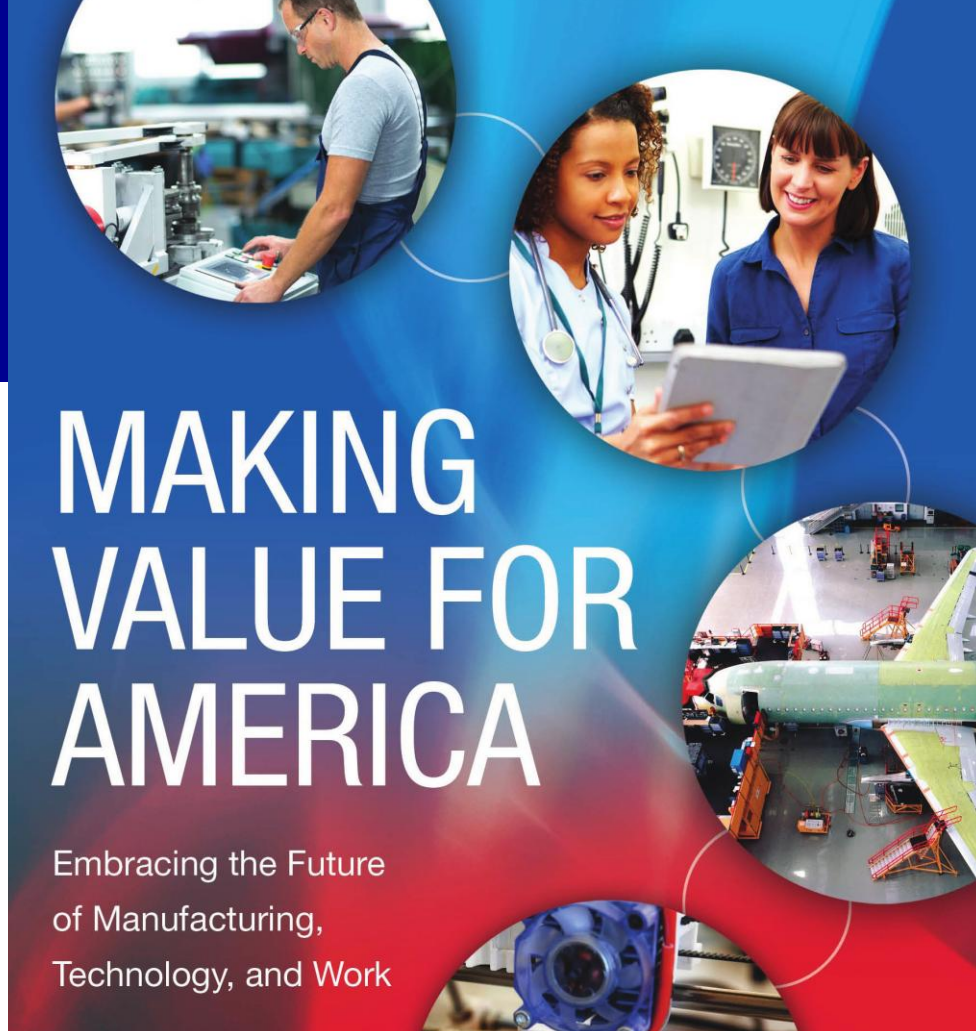
Making **Value** for America: Embracing the Future of Manufacturing, Technology and Work

- New ways of working are happening now.
- Need a broader recognition of this fact and policies and education that reflect it.



Making Things vs. Making <u>Value</u>: the Apple Story

Raw Materials	Components	Assembled Product	Software	Connectivity	Online Services	Content
• Corning	• Broadcom • Qualcomm • Samsung • Pegatron	• Apple • Foxconn	• Apple • Firefox • Independent app developers	• AT&T • Verizon	• Apple • Amazon • Netflix • Skype • Google • Facebook	• TimeWarner • NYTimes • Universal Music Group • User-generated content

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The German Example: The Value of a Government

1. Policy for national needs

Prof. Dr. Henning Kagermann (孔翰寧)

2. Innovation eco-system: Fraunhofer Society

Securing the future of German manufacturing industry

Recommendations for implementing the strategic initiative INDUSTRIE 4.0

Final report of the Industrie 4.0 Working Group

TU Aachen and Prof. Fritz Klocke

Professor and Director of Laboratory for Machine Tools & Production Engineering (WZL) RWTH Aachen

Executive Director and Senior Head of Department “Process Technology” Fraunhofer Institute for Production Technology (IPT)

- **After high school, started the apprenticeship training in manufacturing**
  - **Split the working day between the company job and school classroom.**
  - **Well-respected in the society**
  - **Joined college after the apprenticeship**
- PhD 1982, Chief Engineer 1984, Manufacturing Engineering, TU Berlin
- 1984-1994, Ernst Winter & Sohn in Hamburg
- 1995-date, RWTH Aachen

What Next?

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  - Making Value for America: Embracing the Future of Manufacturing, Technology and Work
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- India, France, ….

United Kingdom: The Future of Manufacturing: A new era of opportunity and challenge for the UK Summary Report

Along term and strategic look at manufacturing out to 2050 to:

- Identify and analyze drivers of change affecting the UK manufacturing sector;
- Identify challenges and opportunities that lie ahead and which require action by Government and industry; and
- Advise how Government policy needs to be refocused and rebalanced so that it is better positioned over coming decades.

Foresight (2013).The Future of Manufacturing: A new era of opportunity and challenge for the UK Summary Report, The Government Office for Science, London

An Ideal Template for Government Report on Manufacturing Policy

- Manufacturing matters
- Four key characteristics of manufacturing
  - Faster, more responsive and closer to customers
  - Exposed to new market opportunities
  - More sustainable
  - Increasingly dependent on highly skilled workers
- Three systemic areas for future Government focus
  - Integrated view of value creation in the manufacturing
  - Targeting manufacturing value chain
  - Enhancing Government capability in evaluating and coordinating policy over the long term

What Next?

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中國製造2025: 目標, 五大工程, 十大重點領域

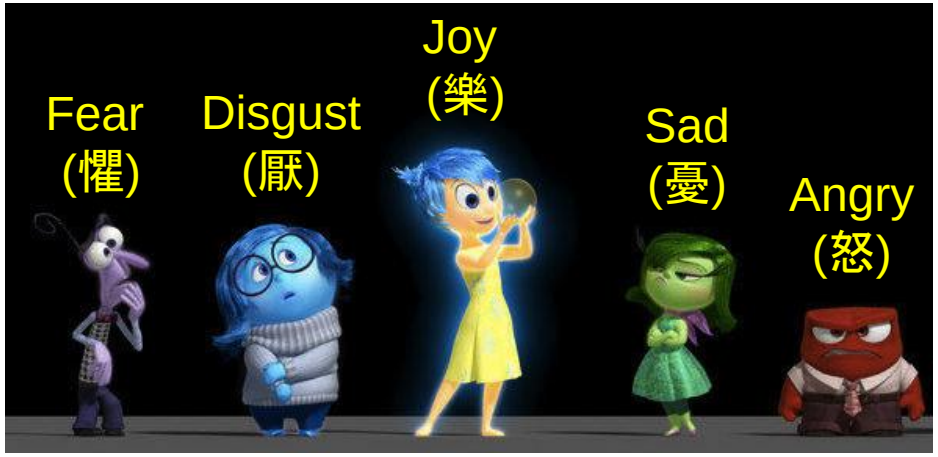
目標: <u>製造強國</u>

五項重點工程:

- 國家製造業創新中心建設
- 智能製造
- 工業強基
- 綠色製造
- 高端裝備創新

十大重點領域:

- 新一代信息通信技術
- 高檔數控機床和機器人
- 航空航天裝備
- 海洋工程裝備及高技術船舶
- 軌道交通裝備
- 節能與新能源汽車
- 電力裝備
- 新材料
- 生物醫藥及高性能醫療器械
- 農業機械裝備



Walt Disney Pixar Movie
Inside Out (腦筋急轉彎)

中國製造2025: 目標, 五大工程, 十大重點領域

目標: 為人民服務 →為人民福利

五項重點工程:

- 國家製造業創新中心建設
- 智能製造
- 工業強基
- 綠色製造
- 高端裝備創新

十大重點領域:

- 新一代信息通信技術
- 高檔數控機床和機器人
- 航空航天裝備
- 海洋工程裝備及高技術船舶
- 軌道交通裝備
- 節能與新能源汽車
- 電力裝備
- 新材料
- 生物醫藥及高性能醫療器械
- 農業機械裝備

Conclusions: People make the difference

Per Capita Manufacturing GDP

Rank	
1	
2	
3	
4	
5	
6	
7	

Common among these countries:

1.Respect for hands-on skills in the society and dedication of skilled technicians in manufacturing

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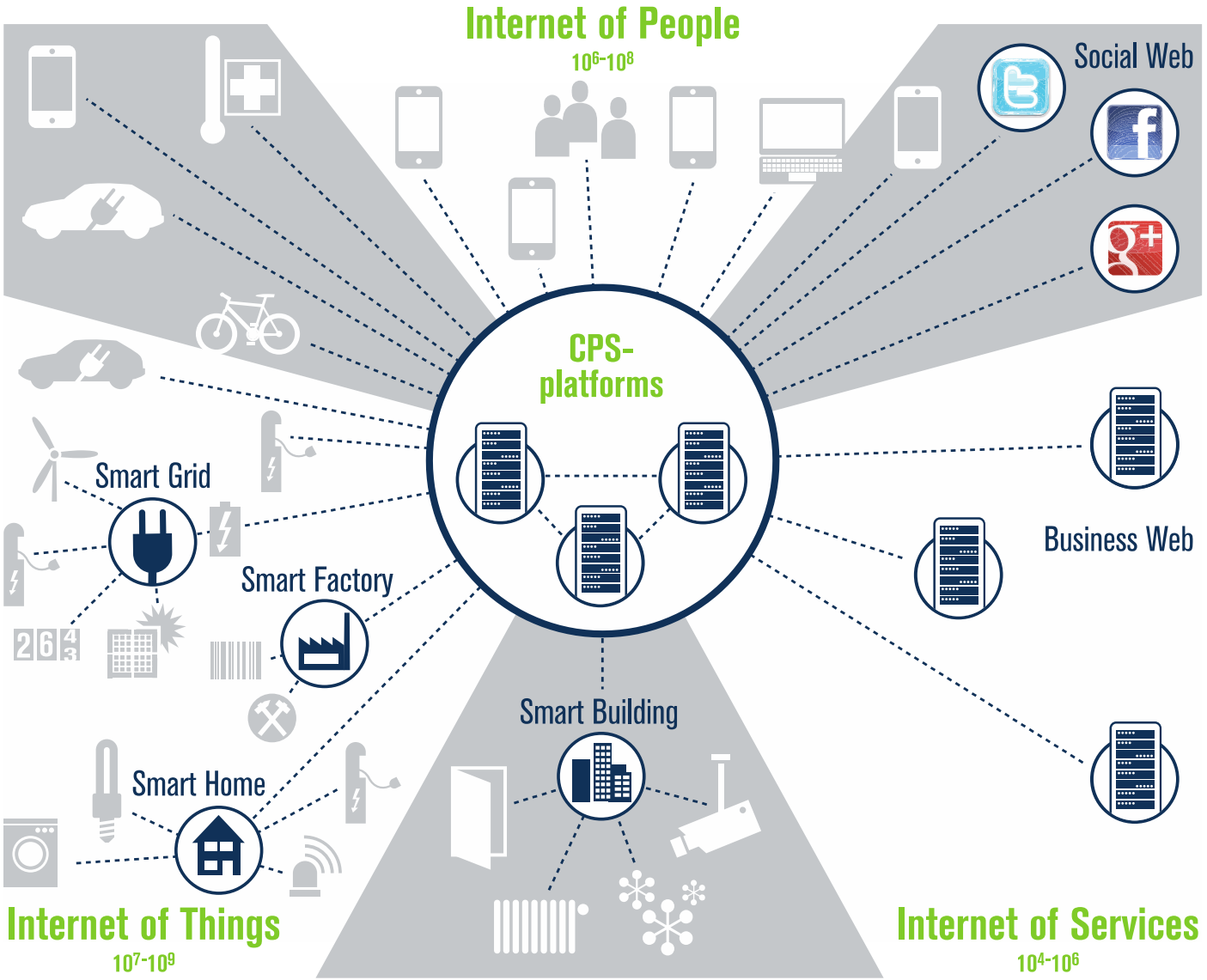
Note: anecdotal selection and comparison conducted by Albert Shih on countries without extensive natural resources

Conclusions: 美國製造政策的變革

- Will it work? Can NNMI continue after after 5 years?
- When all 45 MIIs are running and consume the majority of funding – what do we do? r & D??
- *A Tale of Two Cities* (雙城記) by Charles Dickens (狄更斯)
  - It is the best of times and the worst of times.
    這是最好的時代, 也是最壞的時代.
  - It is the age of wisdom and the age of foolishness.
    這是智慧的時代,也是愚蠢的時代.
  - It is the era of belief and the era of doubt.
    這是信仰的時代, 也是懷疑的時代.
  - It is the season of light and the season of darkness
    這是光明的季節, 也是黑暗的季節.

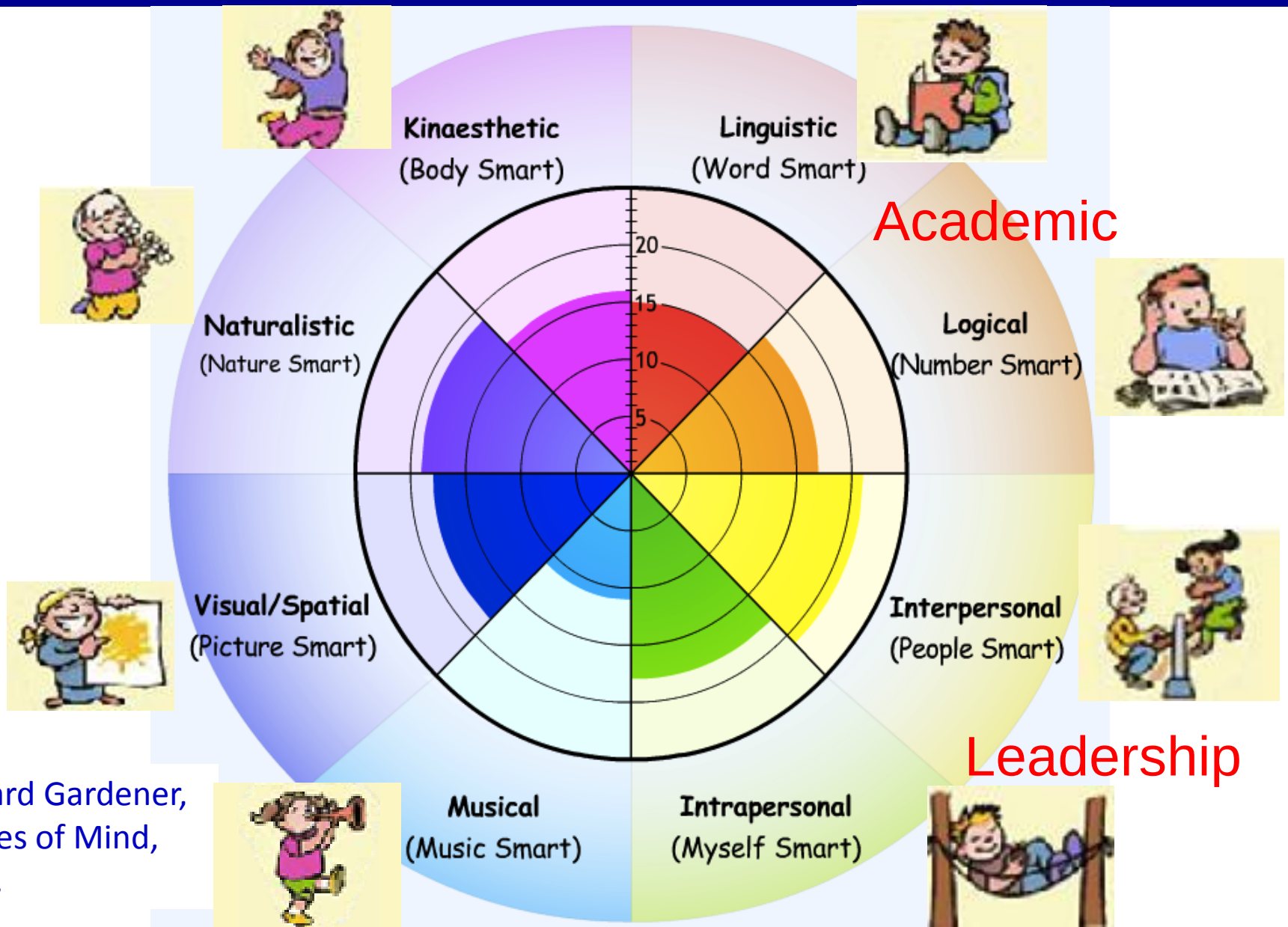
Thank You

The Internet of Things and Services – Networking People, Objects and Systems



Source: Bosch Software Innovations 2012

Gardener's Eight Intelligence



Howard Gardener, Frames of Mind, 1983.