

# Innovative Technological Industry Development, STI Policy and Civic Participation

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Industrial Economics and Knowledge Center

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# Industrial Technology Research Institute

Update: 2018.04.30

**ITRI**

**Total Staff: 6,121**

**Ph.D:** 1,416

**Master:** 3,564

**Bachelor:** 1,141

**Alumni:** 24,768

**Total Patents**

**27,020**

**Startups & Spinoffs** (~2017)

**273**

**Industry Services** (~2017)

**Provided Services : 17,939**

**Transferred Technologies : 614**

Industrial Technology Investment Corporation

ITRI College

Technology Transfer Center

Commercialization and Industry Service Center

ITRI International Center

Office of Strategy and R&D Planning

Office of Marketing Communications

Administrative Service Center

Accounting Resource Center

IT Service and Development Center

Human Resources Office

ITRI Southern Region Campus

ITRI Central Region Campus

**Biomedical Technology and Device Research Laboratories**

**Green Energy and Environment Research Laboratories**

**Material and Chemical Research Laboratories**

**Mechanical and Mechatronics Systems Research Laboratories**

**Information and Communications Research Laboratories**

**Electronics and Optoelectronics Research Laboratories**

Center for Measurement Standards

Service Systems Technology Center

**Industrial Economics and Knowledge Center**

Computational Intelligence Technology Center

Intelligent Machinery Technology Center

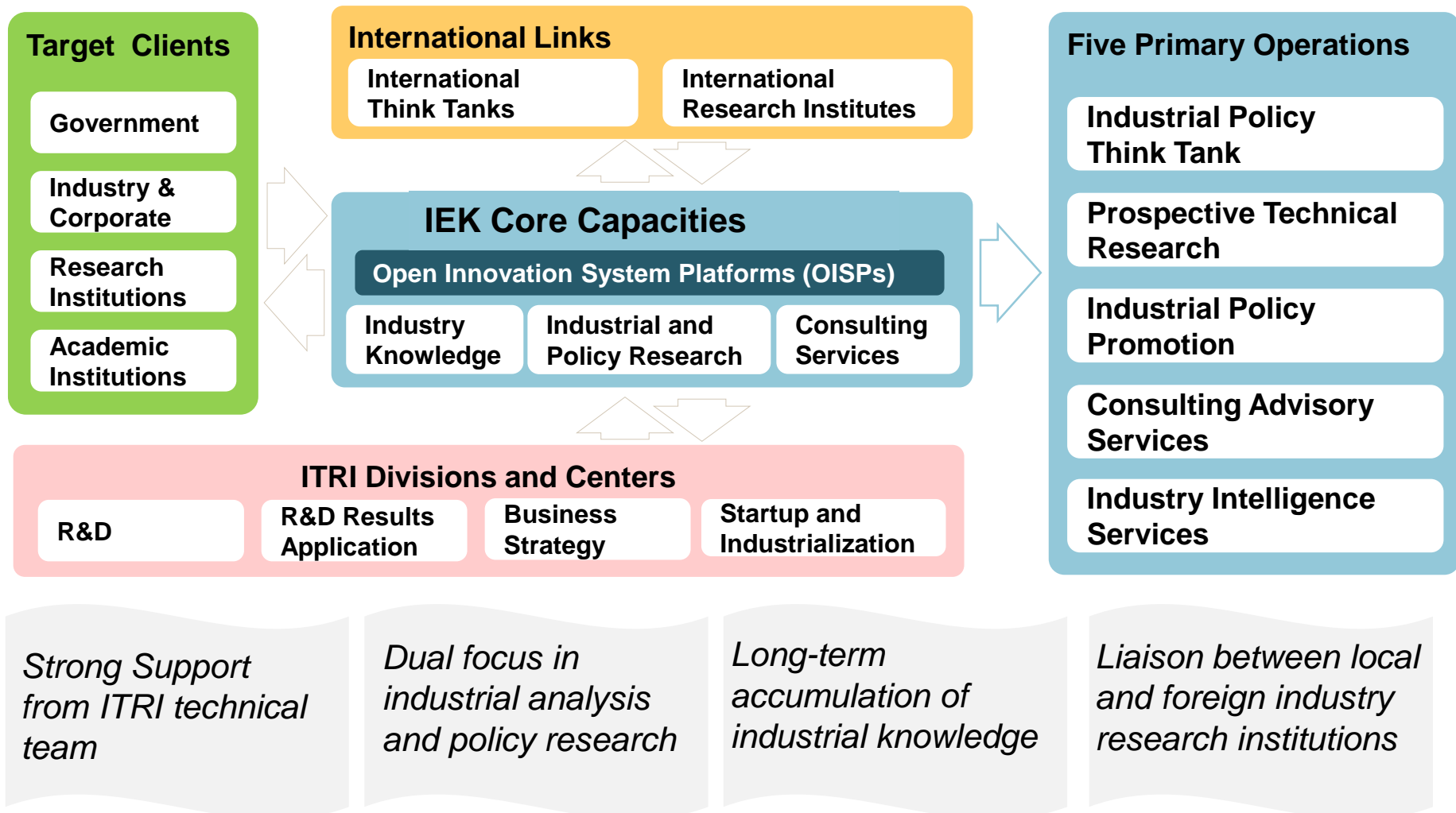
Smart Microsystems Technology Center

Laser and Additive Manufacturing Technology Center



# Industrial Economics and Knowledge Center (IEK)

With five primary operations, we intend to meet the extensive needs of local and foreign clients for the knowledge-based economy and make effort to promote Taiwan's industrial and technological development.



# Outline



# Taiwan: High Ranking in WW Competitiveness, Business Sophistication and Innovation



(WEF/2017-2018)

## Global Competitive Index

- 1 Switzerland
- 2 USA
- 3 Singapore
- 4 Netherlands
- 5 Germany
- 6 HK
- 7 Sweden
- 8 UK
- 9 Japan
- 10 Finland
- 14 Canada
- 15 Taiwan**
- 26 Korea
- 27 China

## Innovation

- 1 Switzerland
- 2 USA
- 3 Israel
- 4 Finland
- 5 Germany
- 6 Netherlands
- 7 Sweden
- 8 Japan
- 9 Singapore
- 10 Denmark
- 11 Taiwan**
- 18 Korea
- 28 China



(WCY/2018)

## World Competitiveness Scoreboard

- 1 USA
- 2 HK
- 3 Singapore
- 4 Netherlands
- 5 Switzerland
- 6 Denmark
- 7 Luxembourg
- 8 Norway
- 9 Sweden
- 10 Canada
- 13 China
- 17 Taiwan**
- 27 Korea

# Taiwan's High-Tech Industry Clusters

## 1.5 Hours From North to South

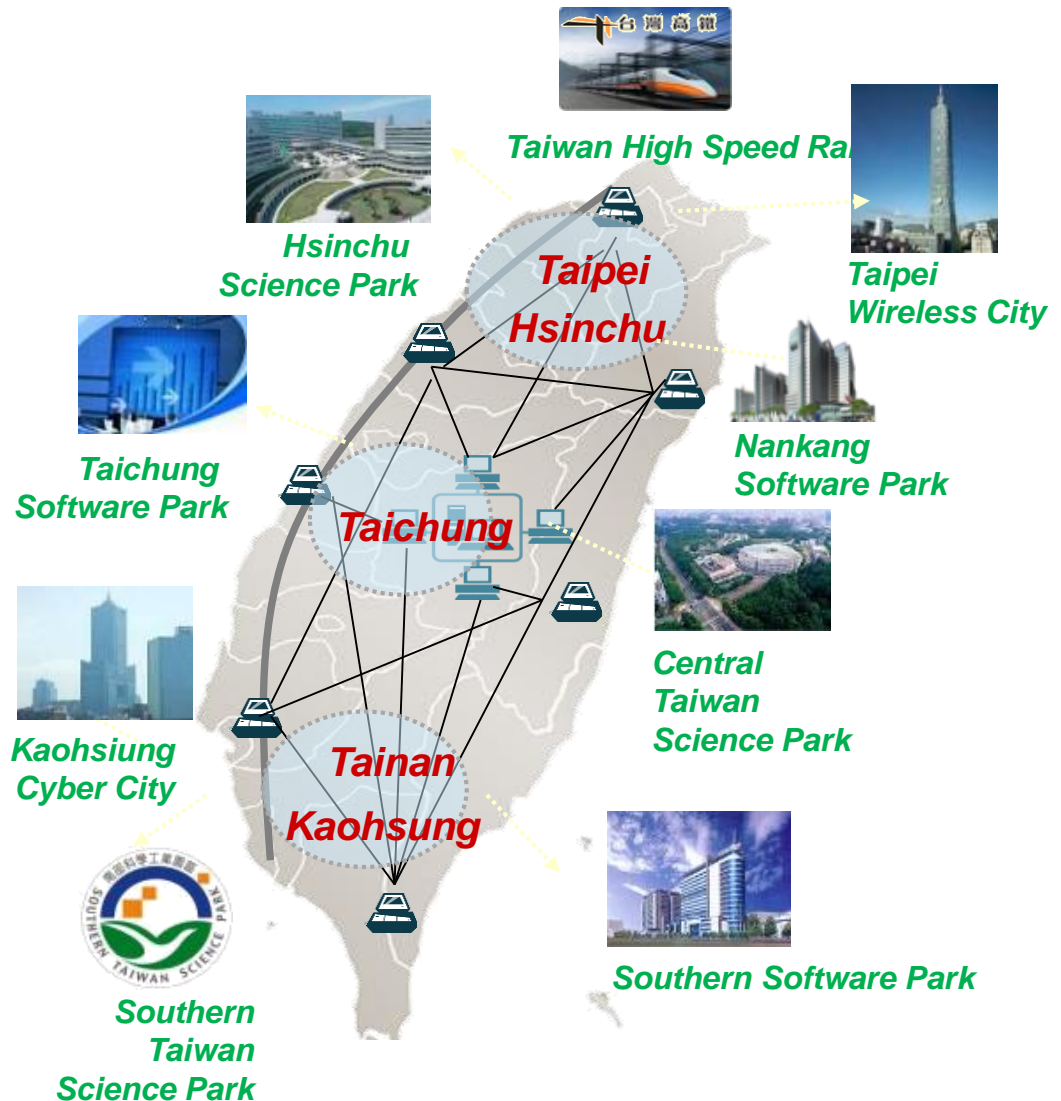
### Contribute to Economic Growth

The industry-academia-research institute technology networks are well established and located surrounding the research parks

- Hsinchu Science Park
- Central Science Park
- Southern Taiwan Science Park

These supporting networks build up Taiwan's high-tech industry clusters and contribute to Taiwan's economic development

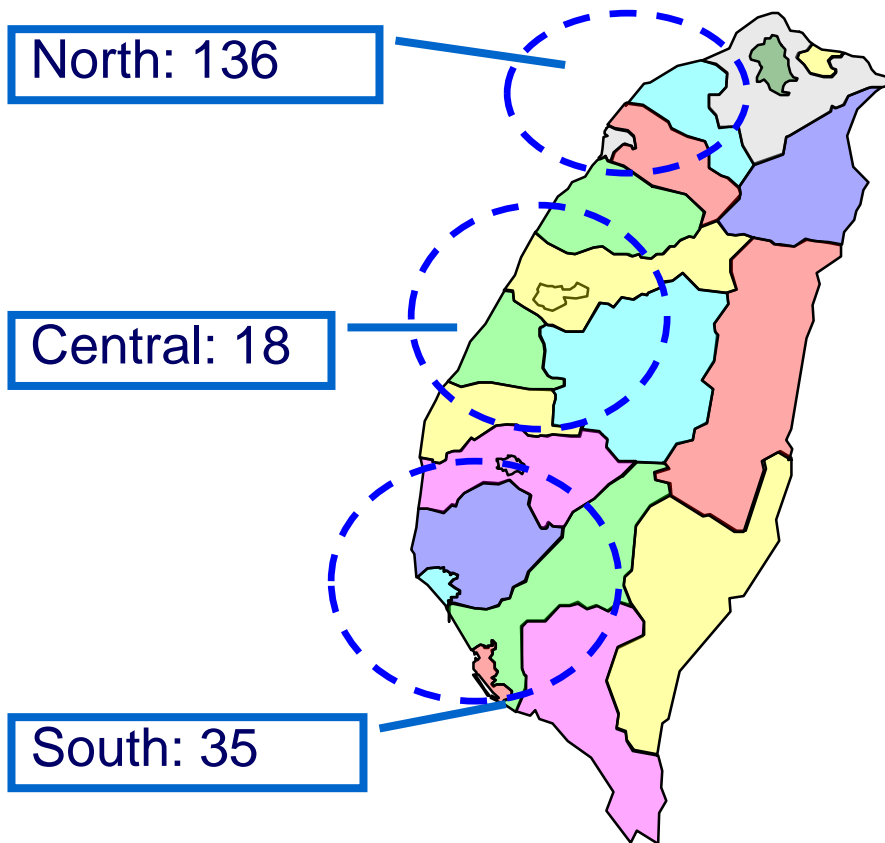
- Semiconductor
- IT Hardware
- IT Software
- Biotech



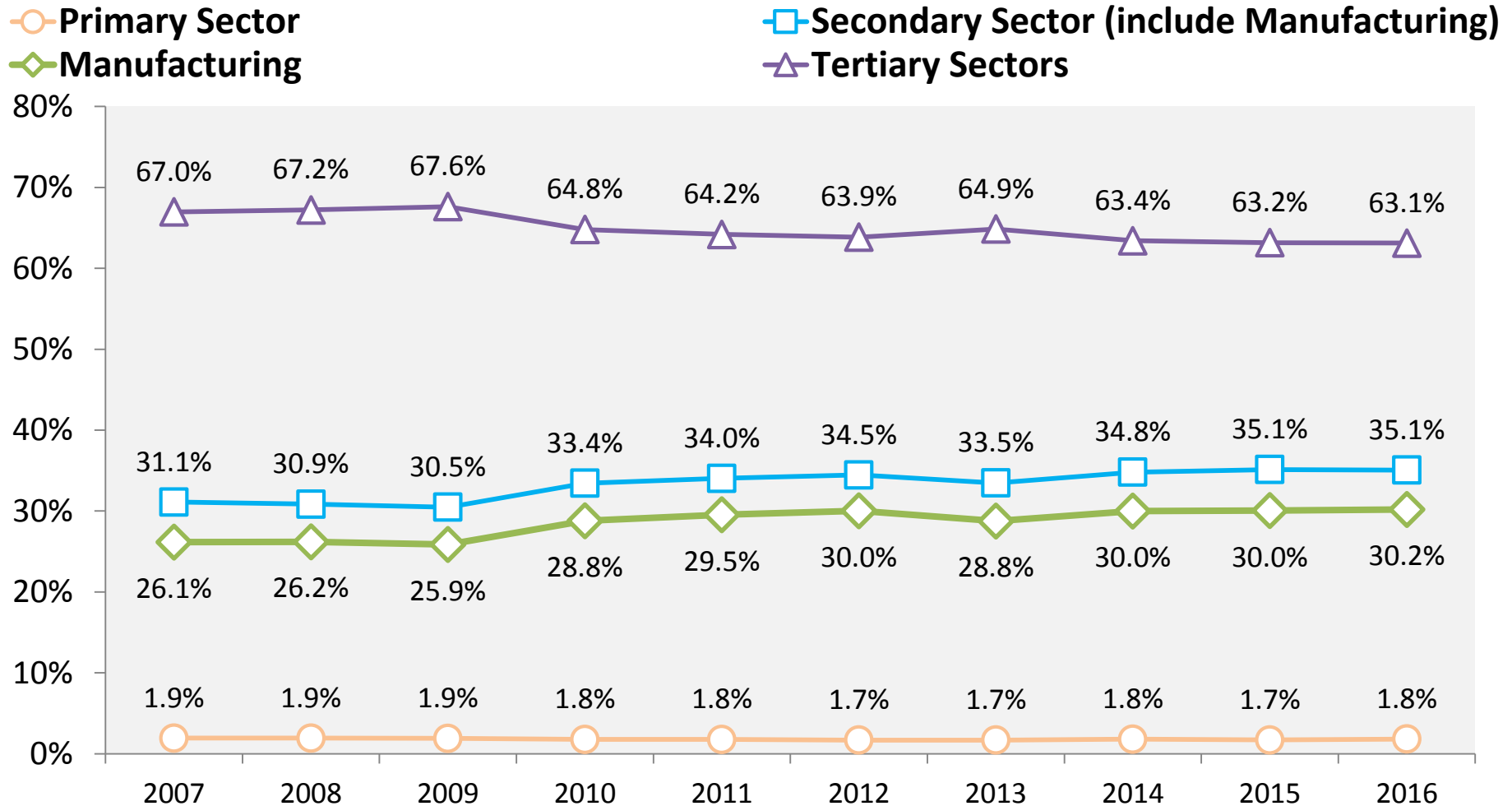
# Many Innovation Research Centers in Taiwan

◆ 189 domestic R&D centers

◆ 63 international R&D centers



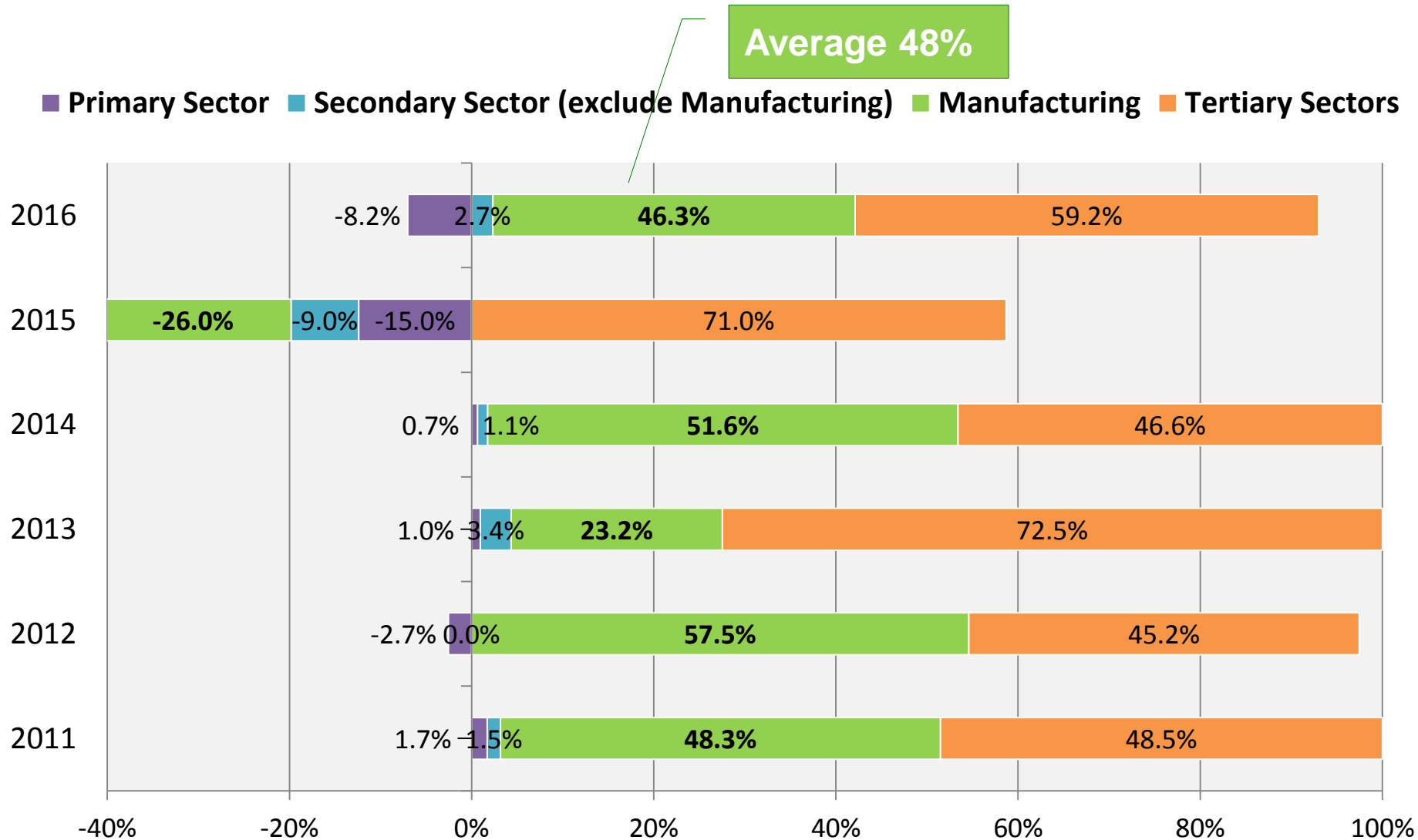
# Manufacturing Accounts for About 30% of Taiwan's GDP



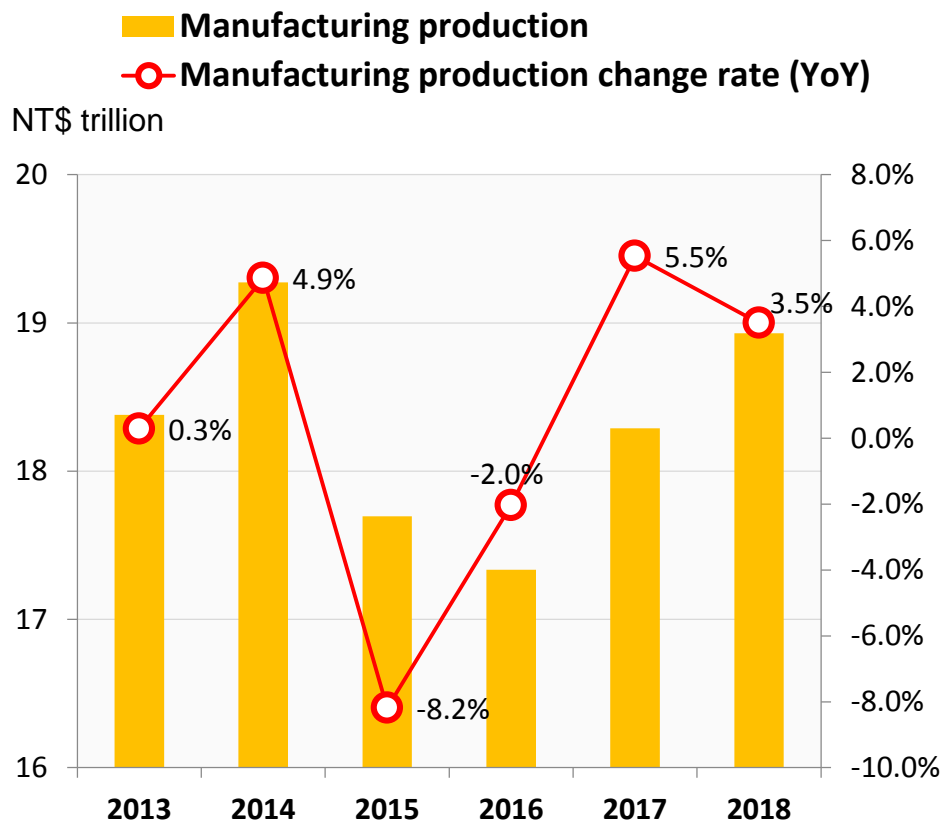
Note: as percentage of GDP



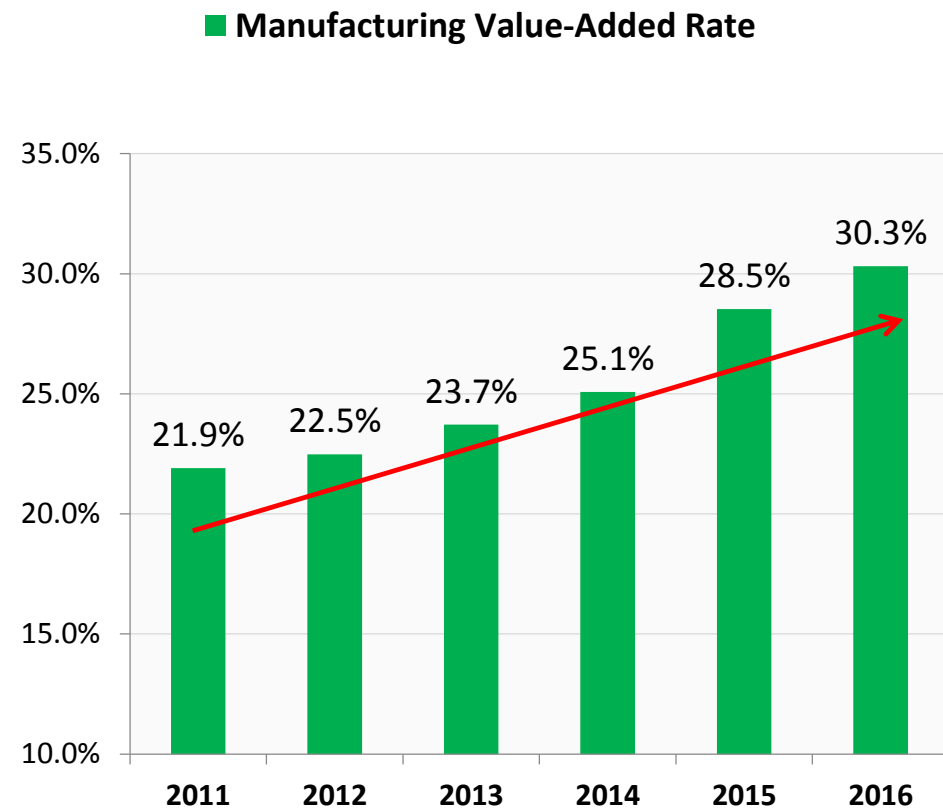
# Manufacturing Contributes Significant Share of Taiwan's Economic Growth



# Manufacturing Production Grows Steadily, Value-add Continues to Improve



Note: (p) Preliminary estimate by ITRI/IEK;  
(f) Forecast by ITRI/IEK

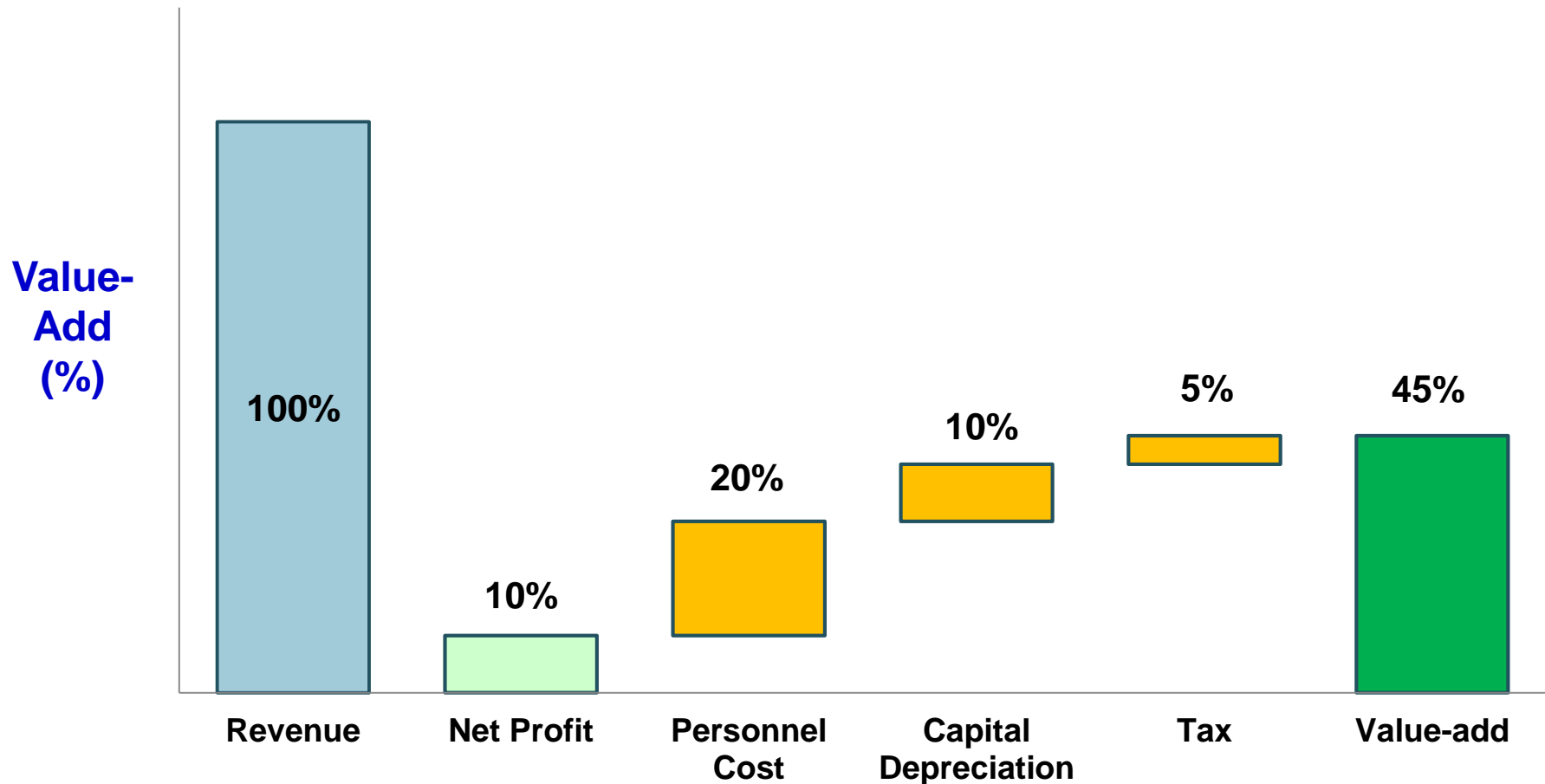


Note: Value-Added primarily consists of profit before tax and interest, personnel expenses, depreciation

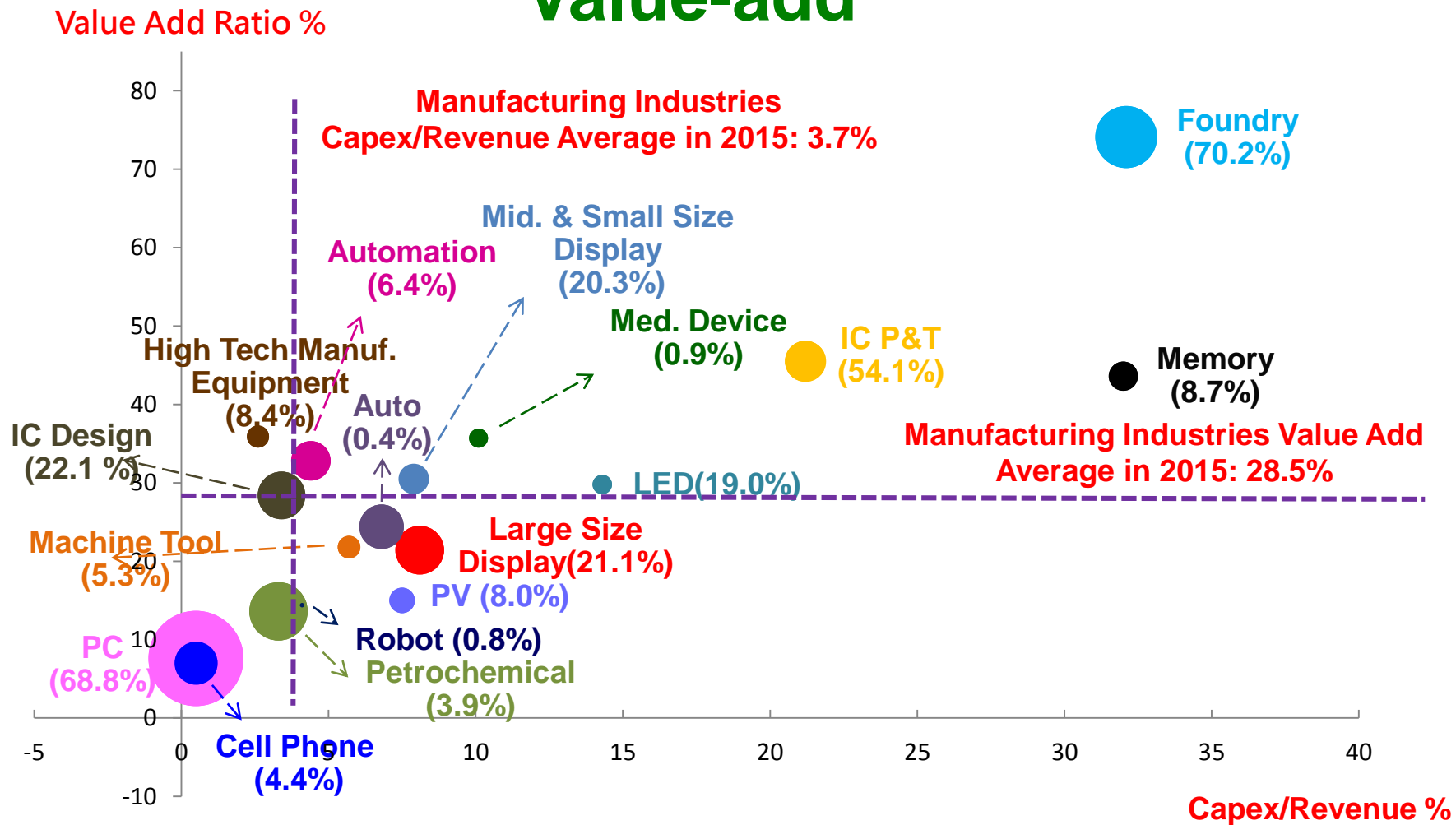
# Average Value-added rate is 45% in 2016

**Value-add** = Net Profit + Personnel Cost + Capital Depreciation + Tax

**Value-add %** = Value-add / Revenue



# Taiwan Manufacturing Industry Portfolio by Value-add



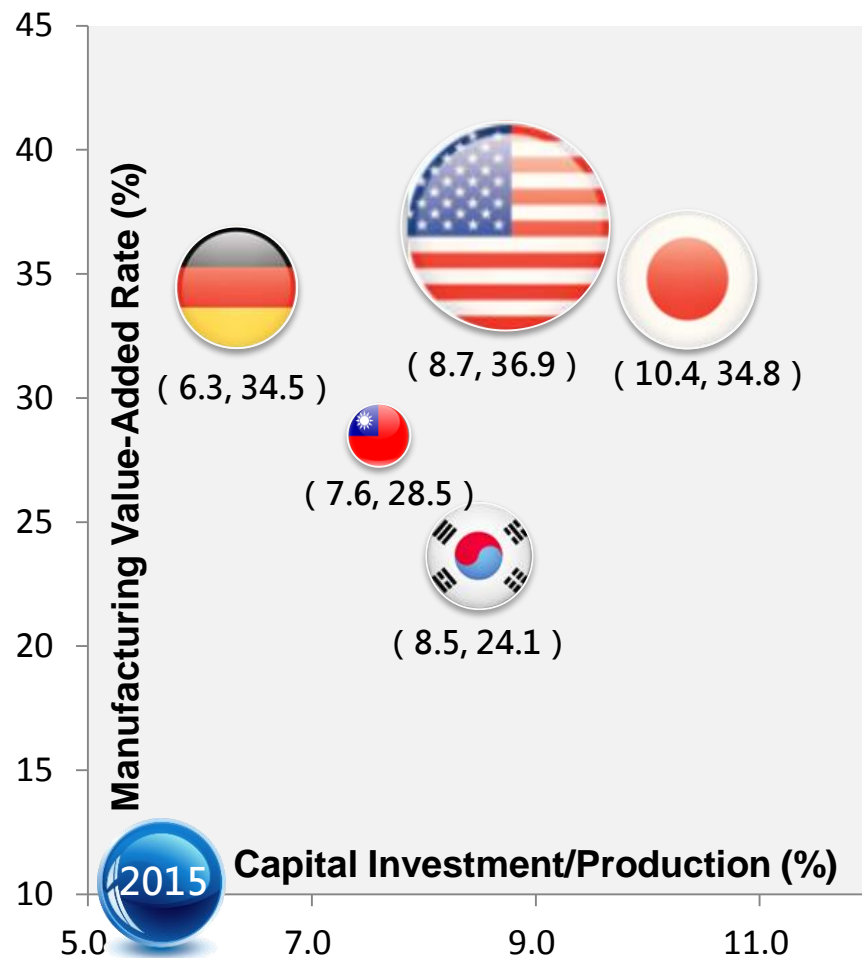
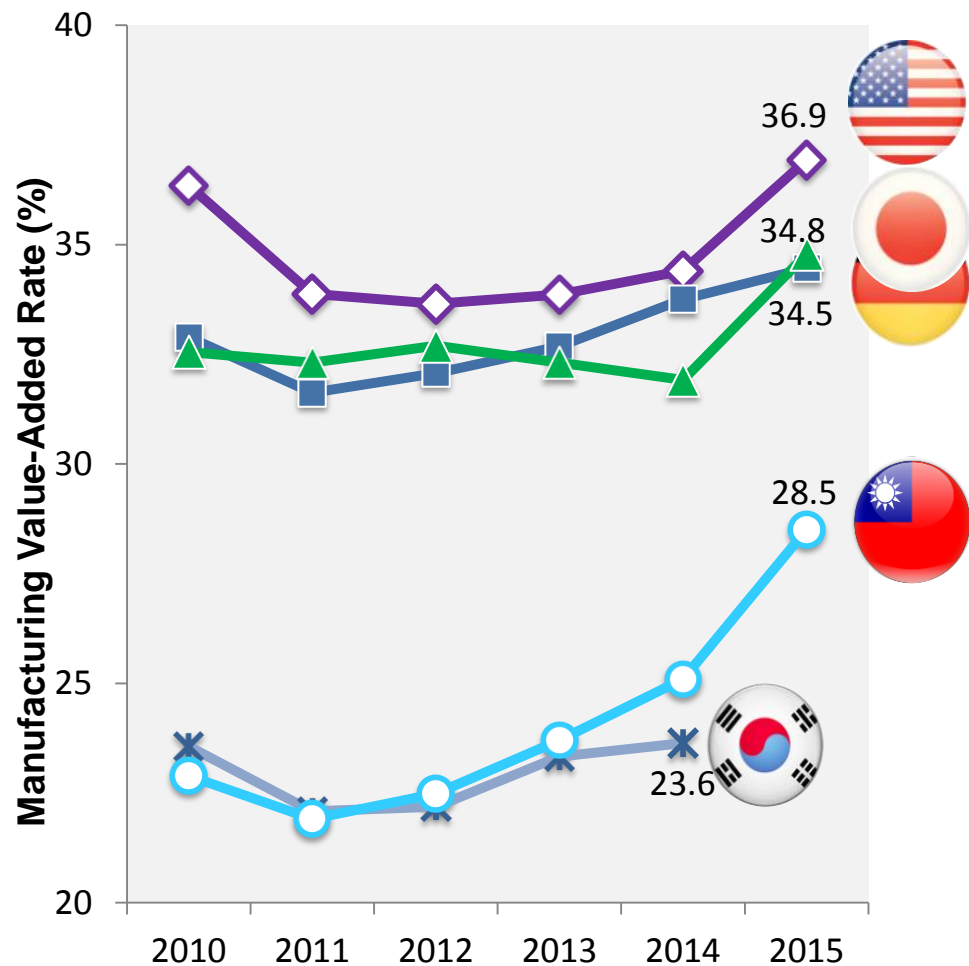
Note 1: x-axis (Capex/Revenue Ratio %) and y-axis (Value Add Ratio %) @2015

Note 2: ( ) 2015 Taiwan industry market share worldwide

Note 3: Manufacturing Industries Value Add Ratio in 2015 calculated based on GDP/gross sum of manufacturing value

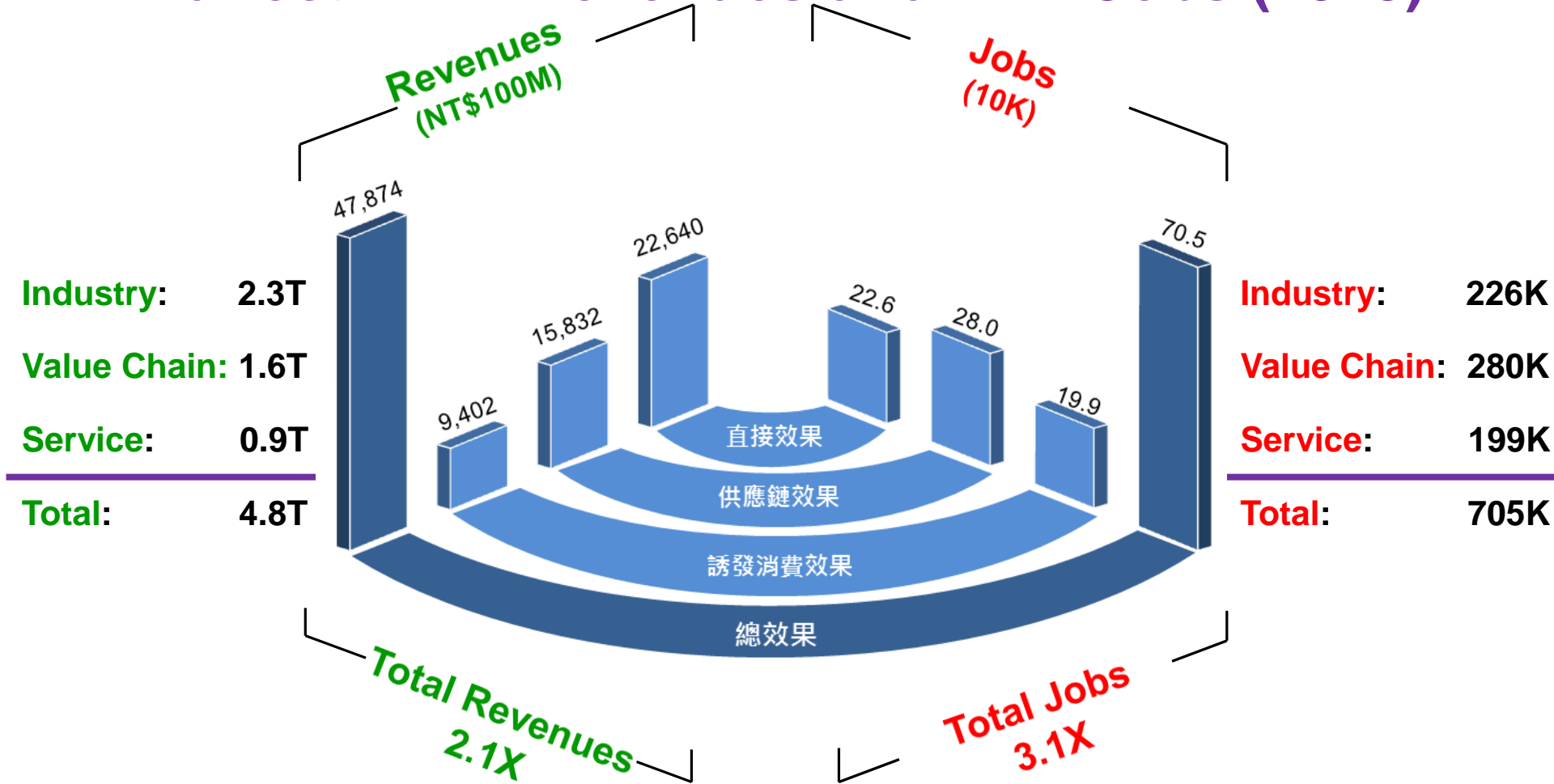
→ Size of the bubble equals revenue and US\$40b.

# Taiwan's Manufacturing Strives Towards Upgrade in Value-add vs. Leading Countries



Note: Data for Korea is 2014; Bubble size represents manufacturing output value.

# Taiwan Semiconductor Industry Creates NT\$2.3T Revenues, 226K Jobs Indirect: 1.1X Revenues and 2.1X Jobs (2015)

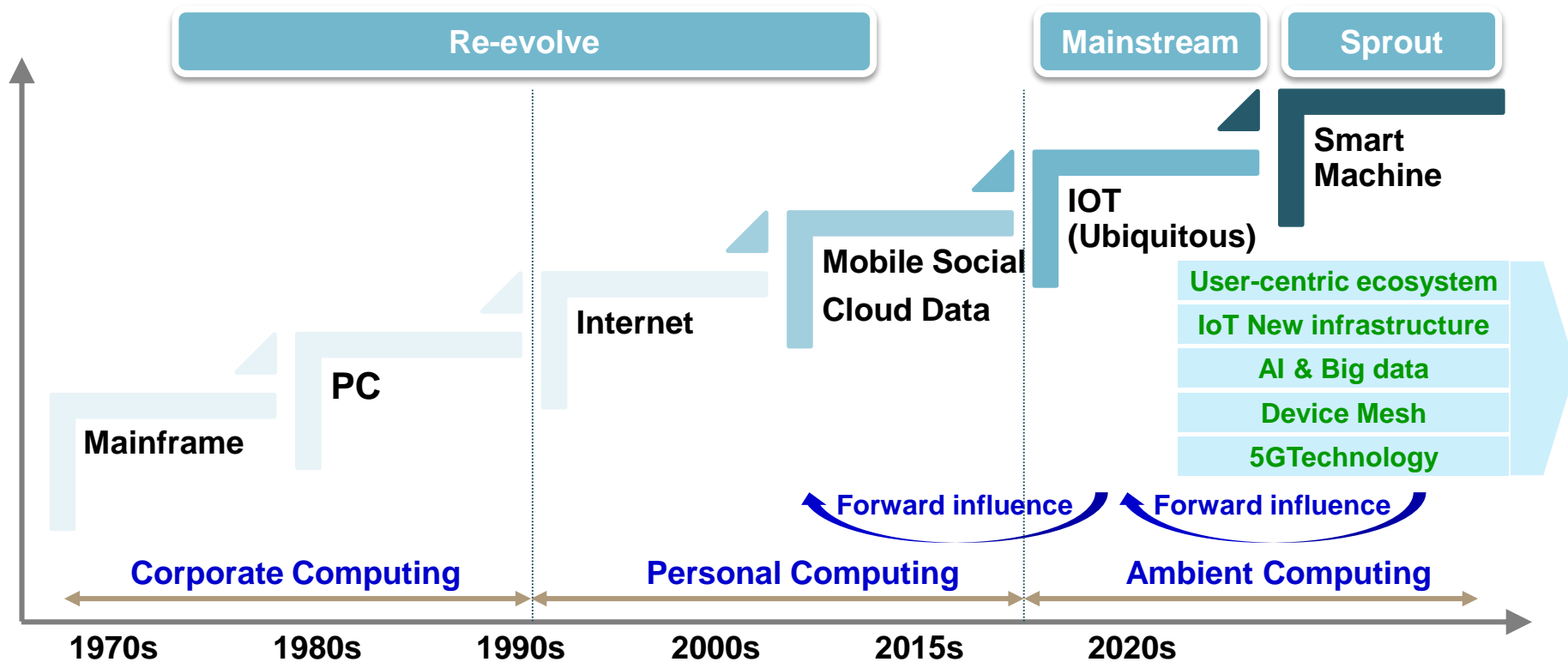


# Outline



# Global ICT Industrial Development Trends

- The smart phones in the world begin to slow down in growth.
- The applications are influenced by the **digital intelligence** to change the related industries and technical innovations.
- The values created by **user-centric ecosystem, IoT new infrastructure, digital intelligence by AI & big data, device mesh and 5G connected** will influence the future product and the network pattern.





# Taiwan's ICT Industry Strengths

- Completed clusters encompassing ICT industrial value chains
- Center of high-end IT, IC manufacturing and service

## World top-2 products/services made by Taiwan

### World No. 1 in 2017\*

- NB PC (81.00%)
- Desktop PC (27.34%)
- Motherboards (85.30%)
- Foundry (73.73%)
- IC Packaging & Testing(55.84%)
- Cable CPE (77.11%)
- DSL CPE (65.4%)
- WLAN (67.14%)
- PND (79.7%)
- PCB (30.7%)
- Mobile Lens (50.0%)

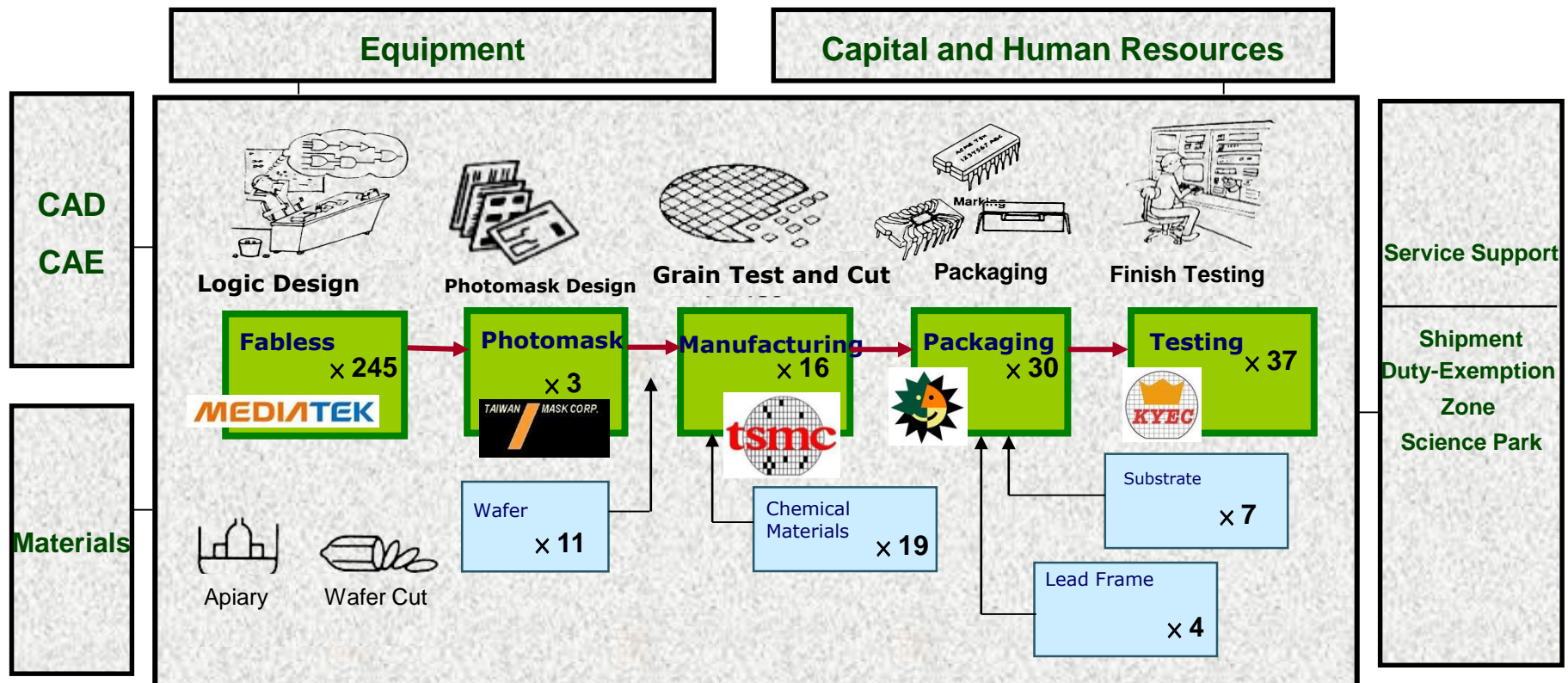
### World No. 2 in 2017\*

- IC Design (17.67%)
- Server (18.3%)
- Large size (>10")TFT LCD (22.6%)
- Medium & Small size (<10")TFT LCD (30.97%)
- IC Substrate (26.4%)
- Tablet (44.8%)

\*rank by value

# Well-developed IC Industry Infrastructures in Taiwan

- Highly integrated value chain with synergy of clusters
- Agile and responsive networks of supply
- Well developed supporting services



# Taiwan's IC Industry in Global Position

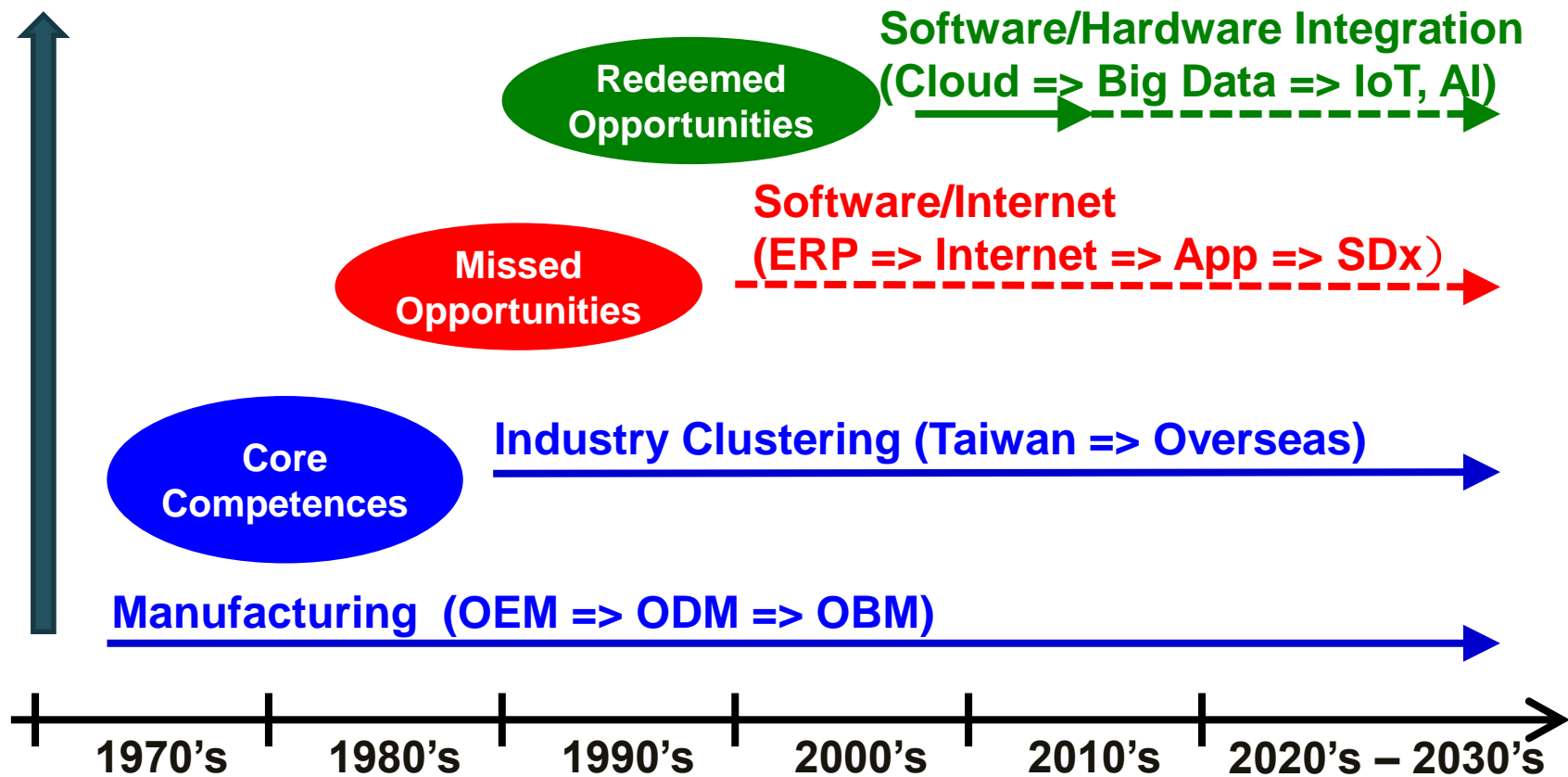
- Taiwan IC Industry output value ranked No.2 in the world 23.3% of global market in 2016. The worldwide leader is US
- Taiwan IC Design Industry ranked No.2 in the world 19.8% of global revenue in 2016, The worldwide leader is US
- Taiwan Foundry service ranked No.1 in the world 75.9% of global revenue in 2016
- Taiwan Memory Industry ranked No.4 in the world 7.9% of global revenue in 2016, The worldwide leaders are Korea, US and Japan
- Taiwan IC Packaging and Testing service ranked No.1 in the world 56.4% of global revenue in 2016
- Taiwan Brand IC Product Revenue ranked No.4 in the world 8.1% of global market in 2016. The worldwide leaders are US, Korea and Japan

	Taiwan (US\$ Billion)	Worldwide (US\$ Billion)	Taiwan Market Share (%)	Rank 2016	Taiwan Leaders	Worldwide Leaders
IC industry Production value	76.5	327.2	23.3%	No.2	TSMC	Intel, Samsung
IC design	20.8	105.0	19.8%	No.2	MTK	Qualcomm
IC Manufacturing	-	-	-	-	-	-
Foundry	35.6	46.9	75.9%	No.1	TSMC	Global Foundries
Memory	5.6	70.9	7.9%	No.4	NANYA	Samsung, Micron
IC Packaging and Testing	14.5	25.7	56.4%	No.1	ASE	Amkor
IC Product Value	26.4	327	8.1%	No.4	MTK	Intel, Samsung

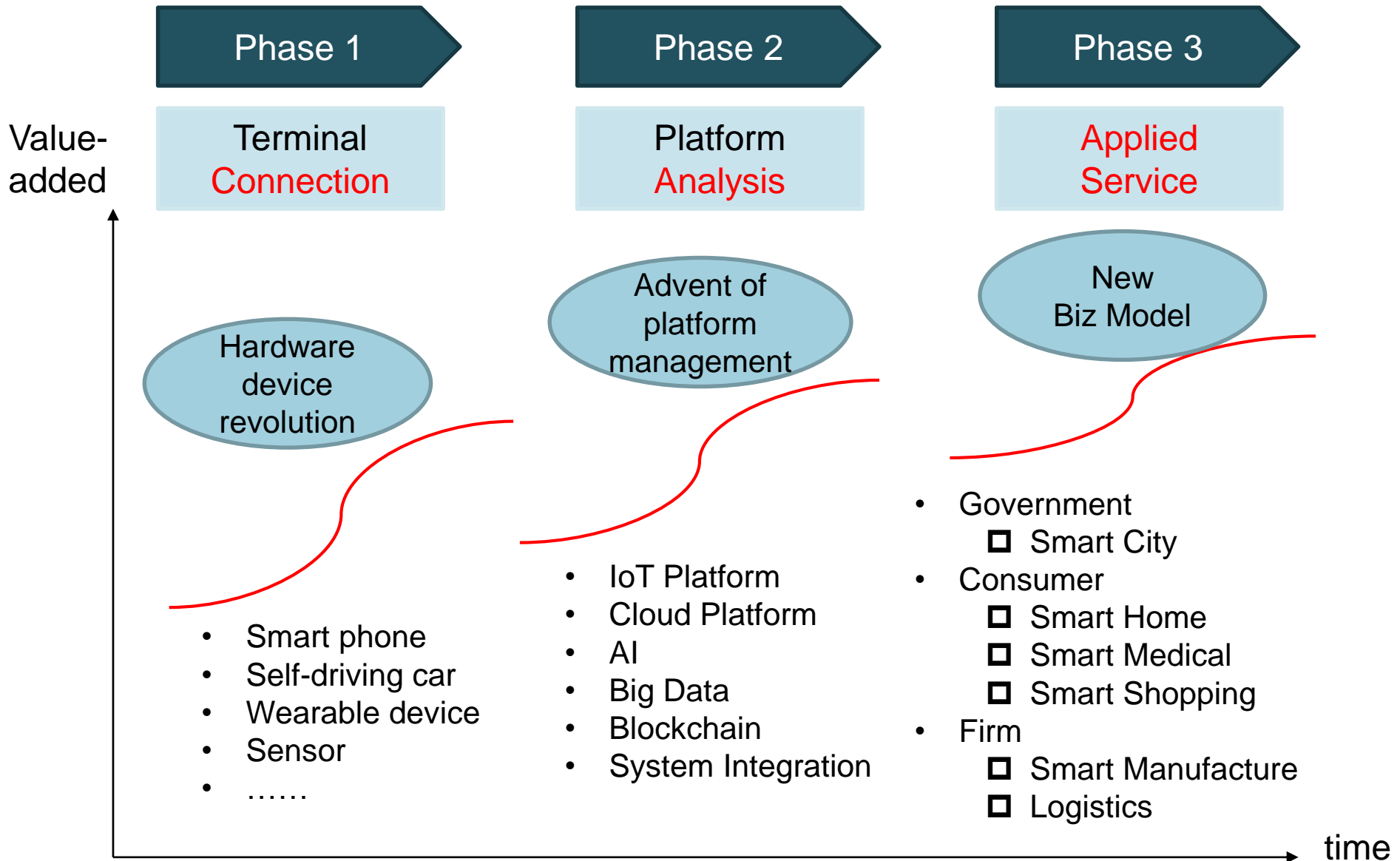
# IoT Gives Taiwan Industries New Opportunity in Software and Hardware Integration

- Leverage past core competences in hardware, but need to make up software competences

## Value Creation



# IoT Provides New Opportunity for Industry



# SMART CITY IN A BOX

SJ has developed a set of apps based on the four pillars of a Smart City - Sustainability, Efficiency, People and Security. These apps can be used independently or in conjunction with other apps for a seamless monitoring and management.

## SUSTAINABILITY



### ENERGY MANAGEMENT

Gathering energy usage data through meters in buildings to advise clients how to mitigate the energy usage.



### WATER MANAGEMENT

Detect water quality by using camera analytics to examine marine life in water.



### CLIMATE CHANGE AND FLOOD MODELLING

Tool that allow users to model flooding and climate change, particularly in cities that are in a conceptual stage.



### SMART LIGHTING

Sensors and controllers in light fittings that allow light to dim if no presence is detected, saving energy and expenditure.



### PREDICTIVE LIFT MAINTENANCE

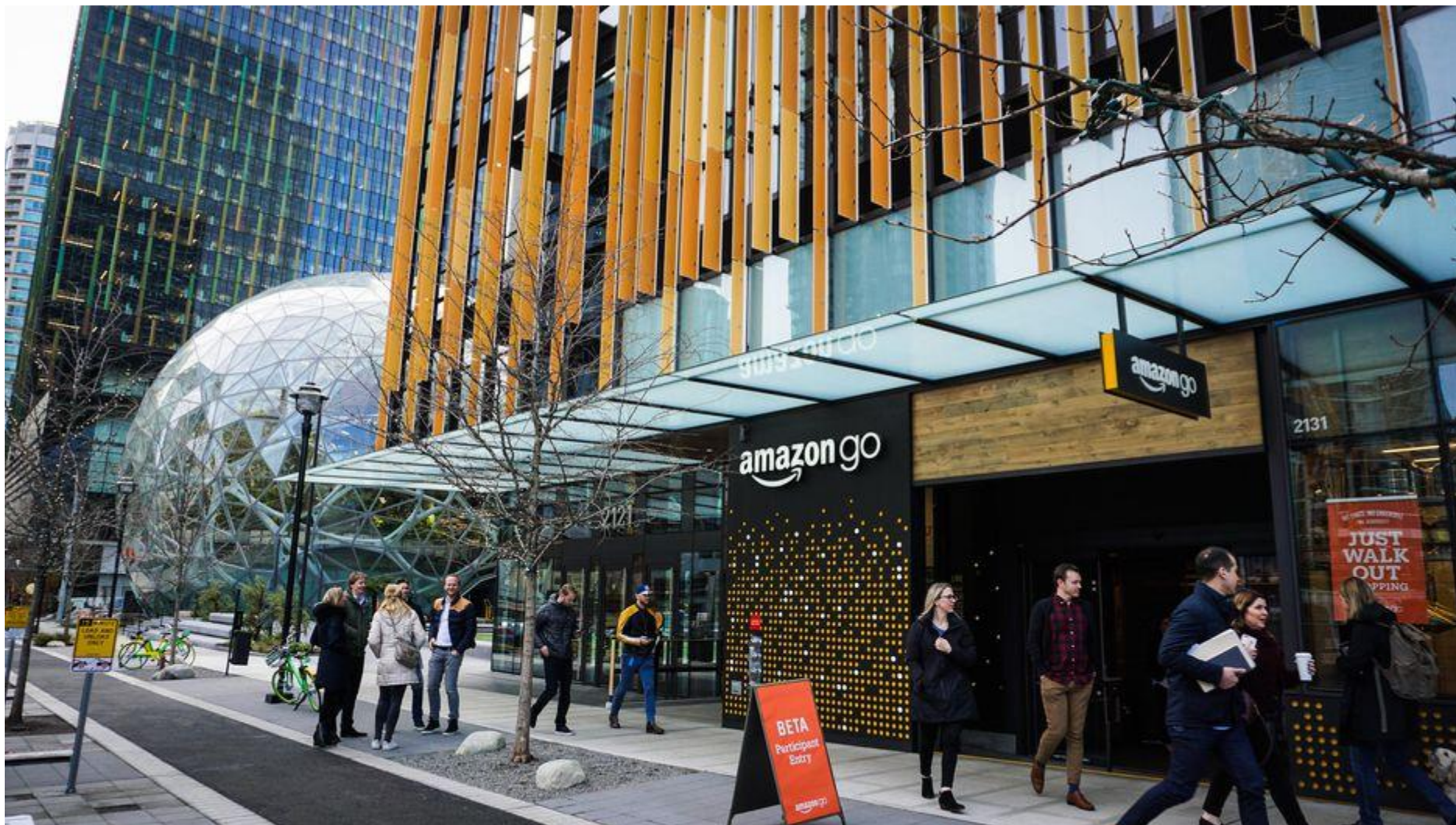
Enables the analysis of data received from sensors installed in lifts to predict breakdowns.



### TRAFFIC MONITORING

Cameras with video analytics installed at highways to detect traffic jams, accidents and other traffic misconduct.

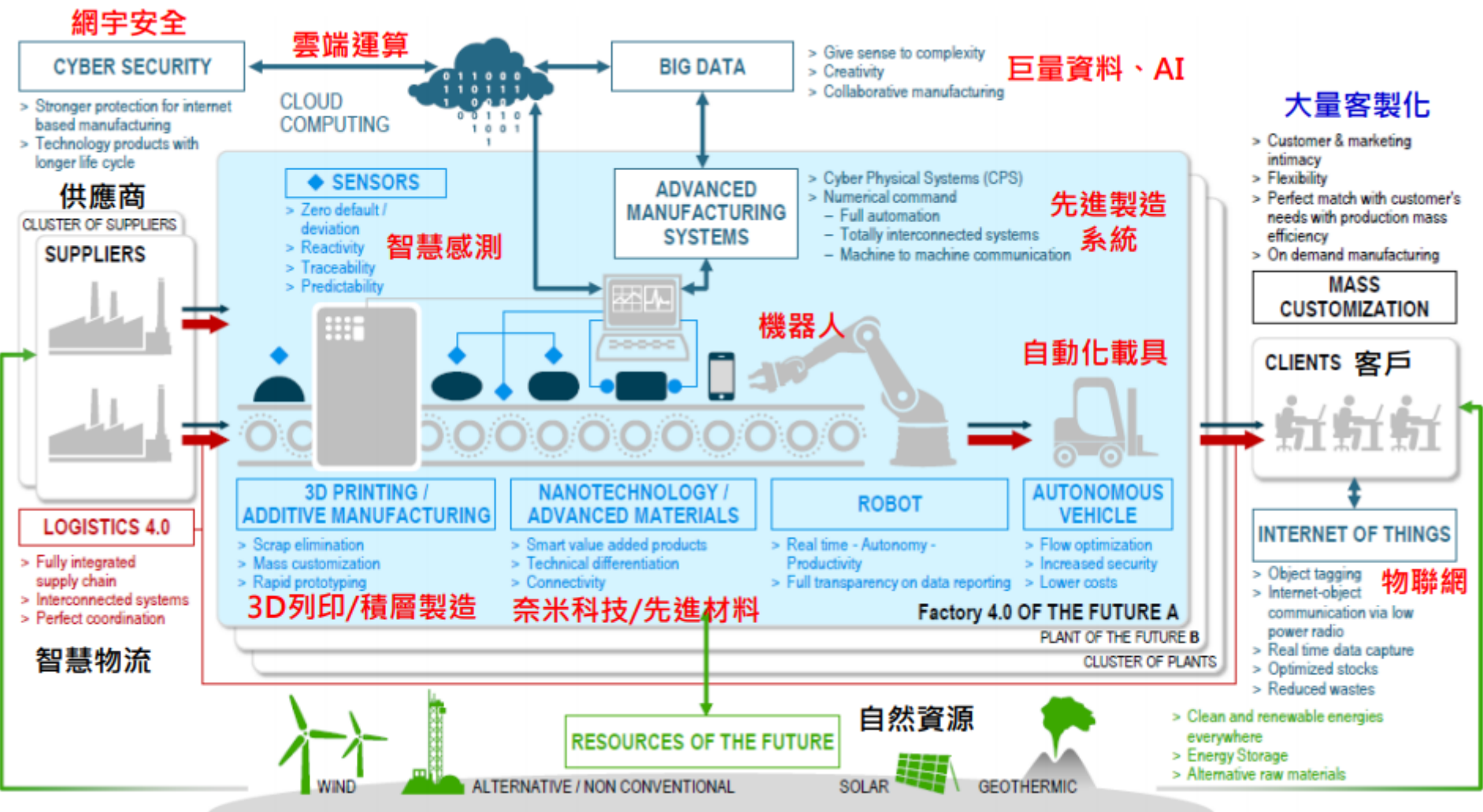
## EFFICIENCY





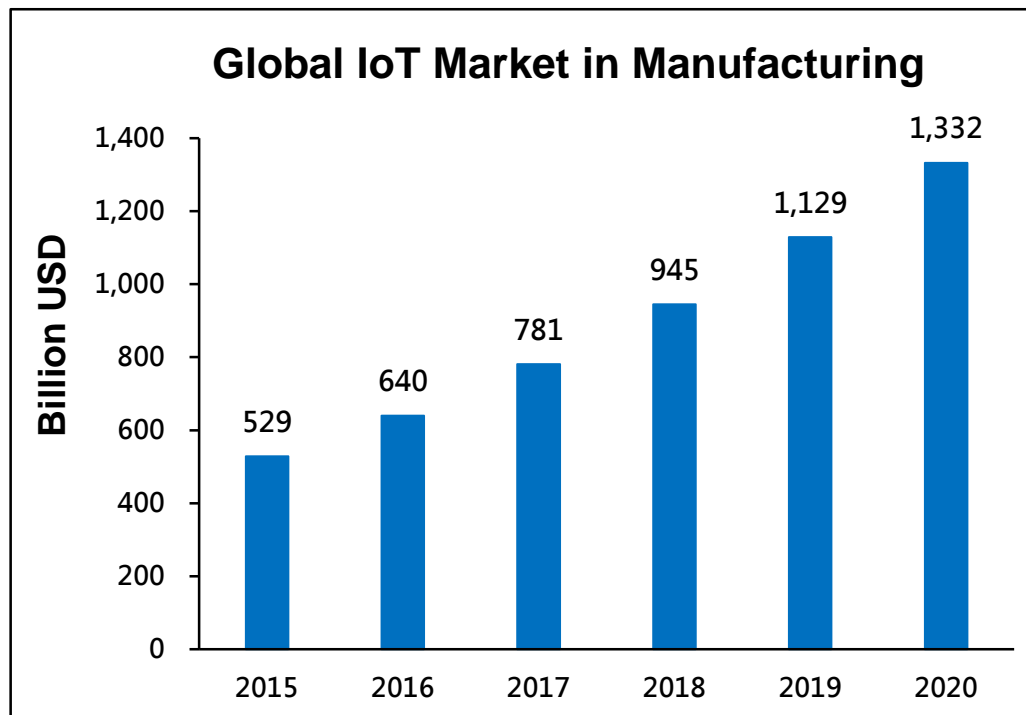






# Global IoT Market in Manufacturing

- Global IoT market to grow to US\$133 billion by 2020 using compound annual growth rate (CAGR) of 20.3%.
- Maintenance alert and operation optimizations are two main applications

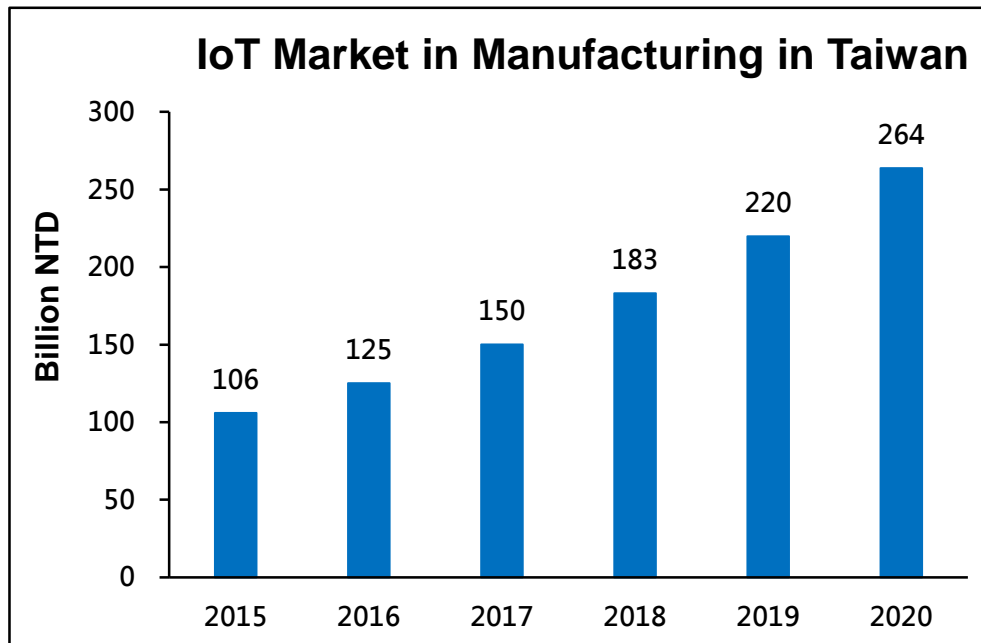


## IoT provides:

- ✓ Increase efficiency improvement
- ✓ Enterprises comprehend the benefits of IoT applications
- ✓ More competitive advantage through the new-designed business models
- ✓ Sensor accuracy due to technology improvement

# Taiwan's IoT Market of in Manufacturing

- Taiwan's IoT market to grow to NTD26.4 billion by 2020 using compound annual growth rate (CAGR) of 20.1%.
- Taiwan's IoT development in manufacturing covers both hardware and software technology
  - timely signal controlling, communicating, collecting and analyzing within factories
  - Hardware and Software for utilities and energy management



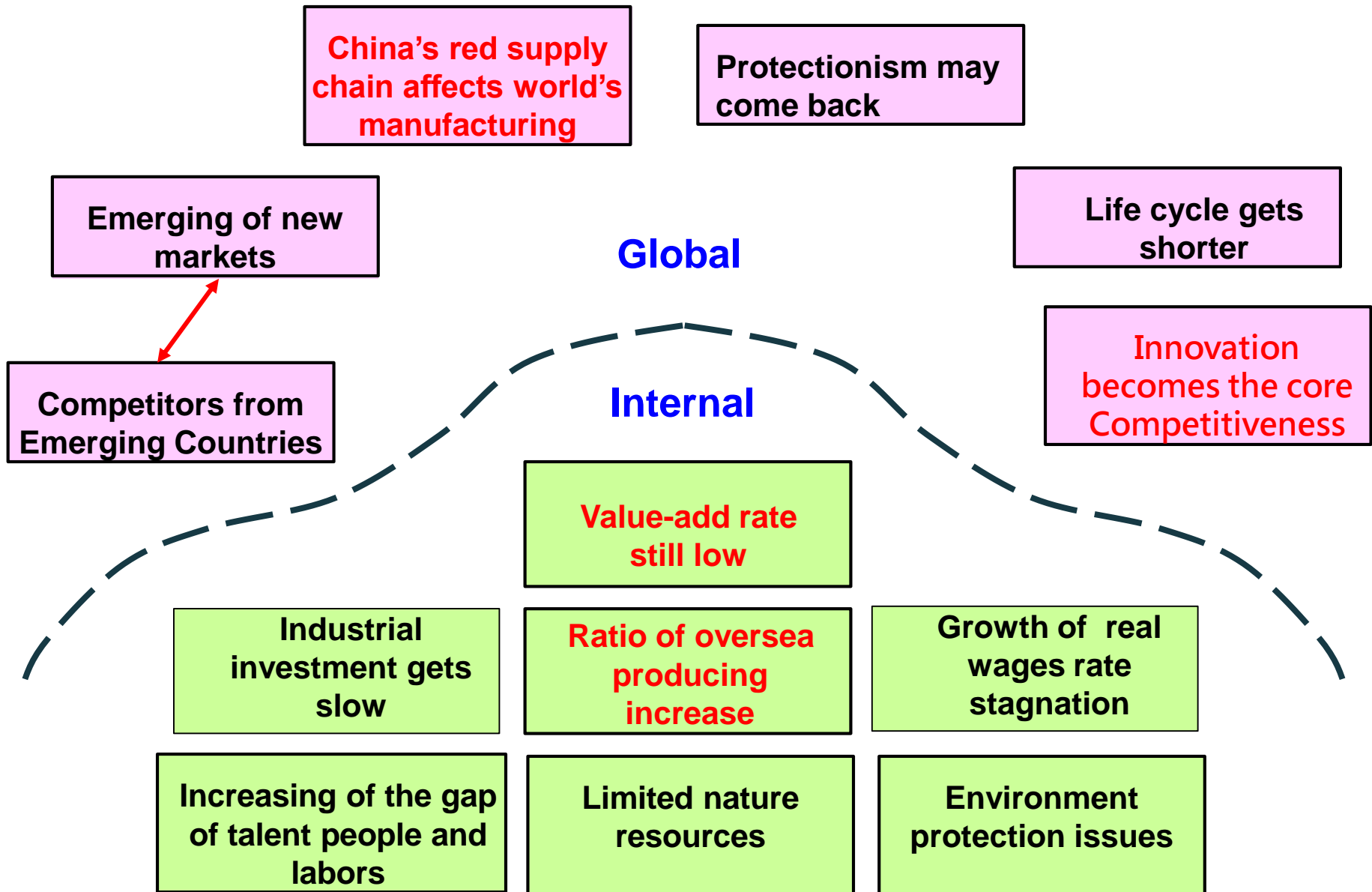
## Future demands:

- ✓ Alert and restoration of devices
- ✓ Smart components and products
- ✓ Solutions using big data analysis for smart equipment and smart manufacturing

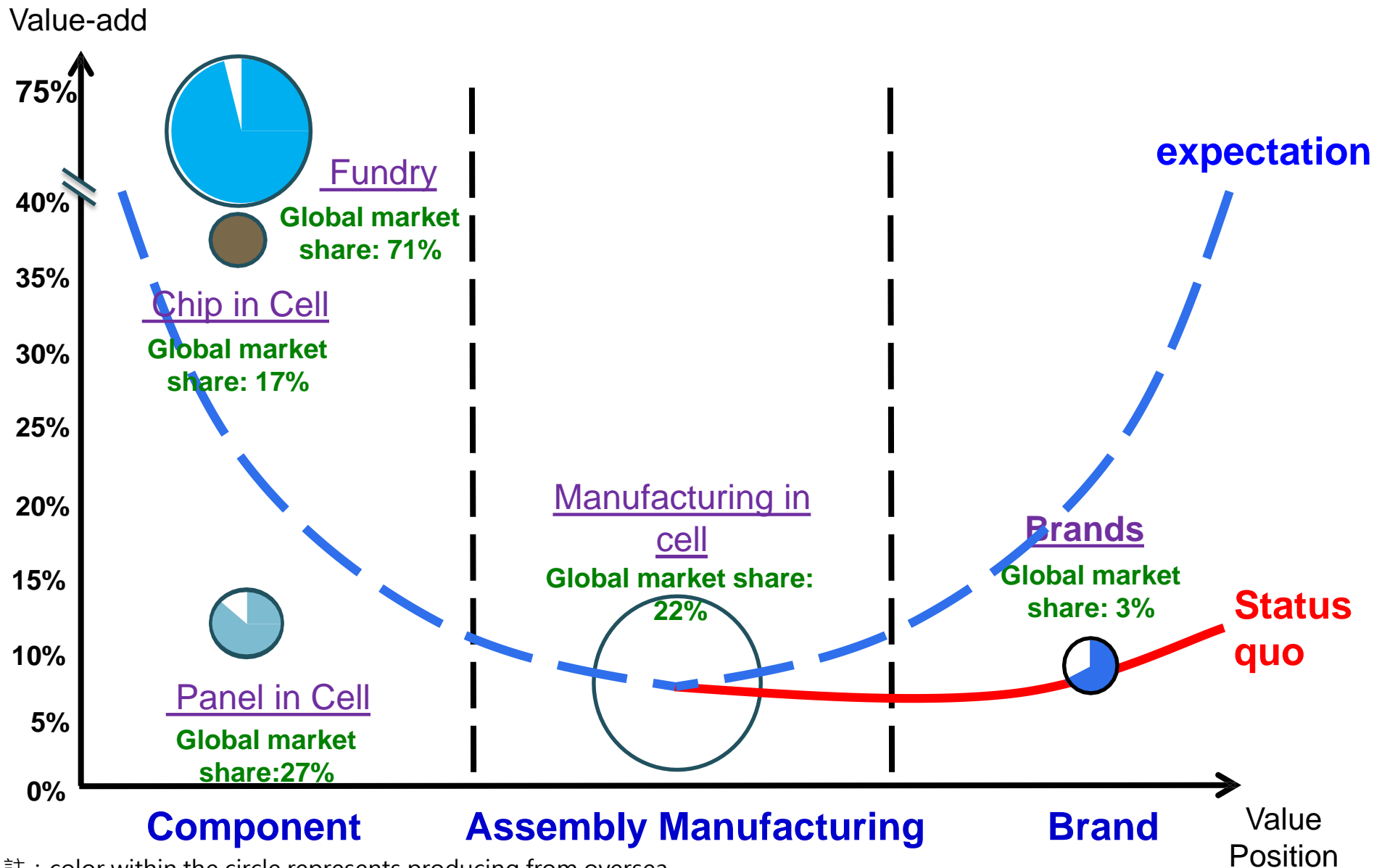
# Outline



# Industrial Challenges that Taiwan Faces



# Short of The High Value-add Part

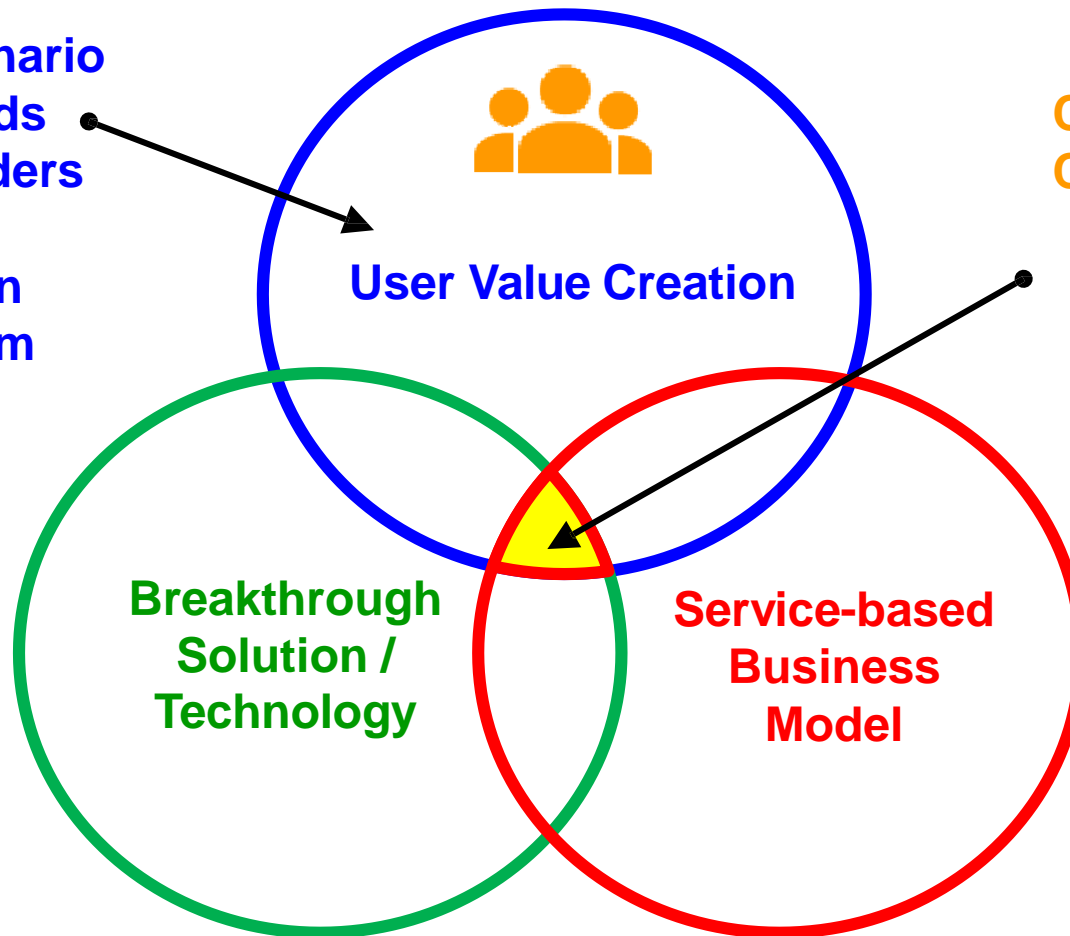


註：color within the circle represents producing from oversea

# Human Centric Innovative Brings the Paradigm Shift and Value Creation

## Value-add:

- User scenario
- User needs
- stakeholders
- Benefit balance in ecosystem



## Core Competitiveness:

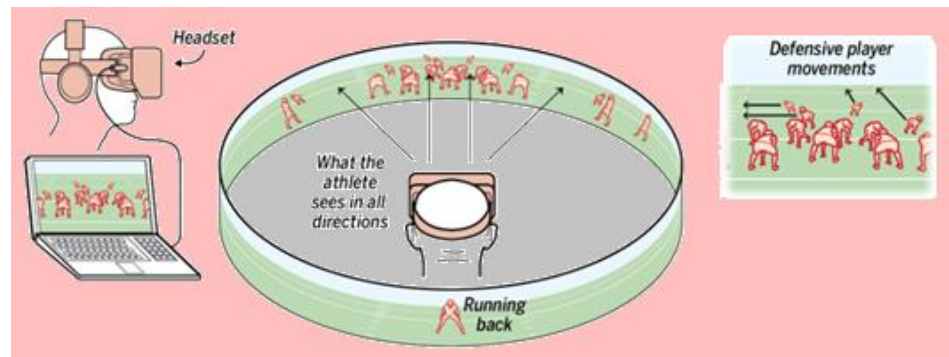
- Talent
- Technology
- Knowledge
- Management
- Partners



# Successful Case of User Value Creation in Stanford University

Value added: reduce training time and the chance of getting hurt

Impact: success rate of pushing pass **64% => 76%**



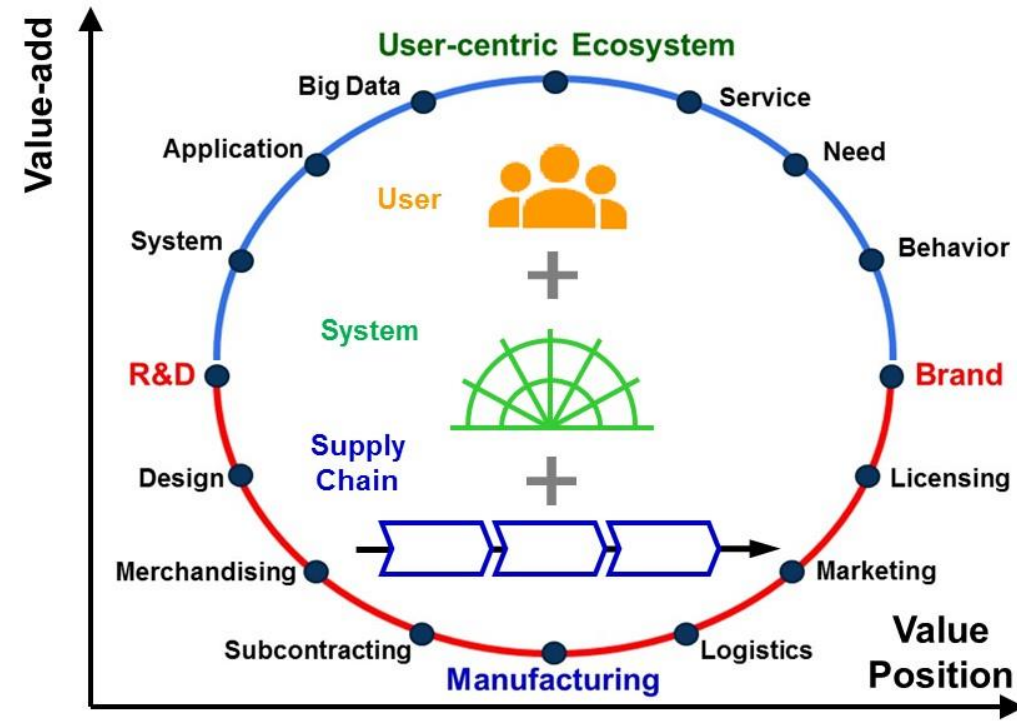
Stanford Professor Jeremy Bailenson



資料來源：Stanford Professor Jeremy Bailenson(2015/04)

# Paradigm Shifts for Taiwan Industry Strategy

## User-centric Ecosystem & Soft/Hard Power Fusion



Software/Hardware  
Integration =

Software + Hardware



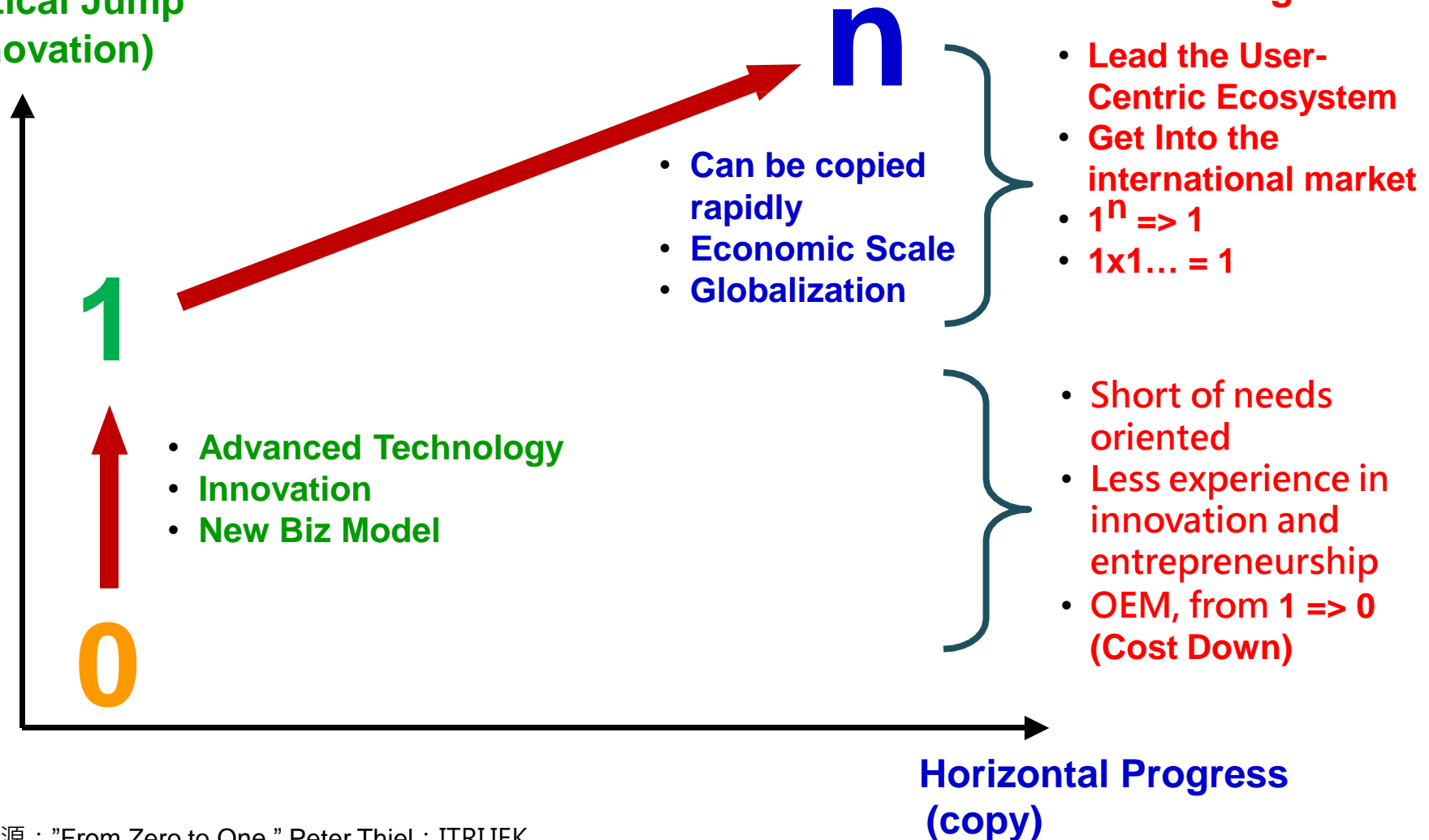
Soft/Hard  
Power Fusion =

Soft Power X Hard Power

# Strategies to Handle Challenges

From 0 to 1 & From 1 to n

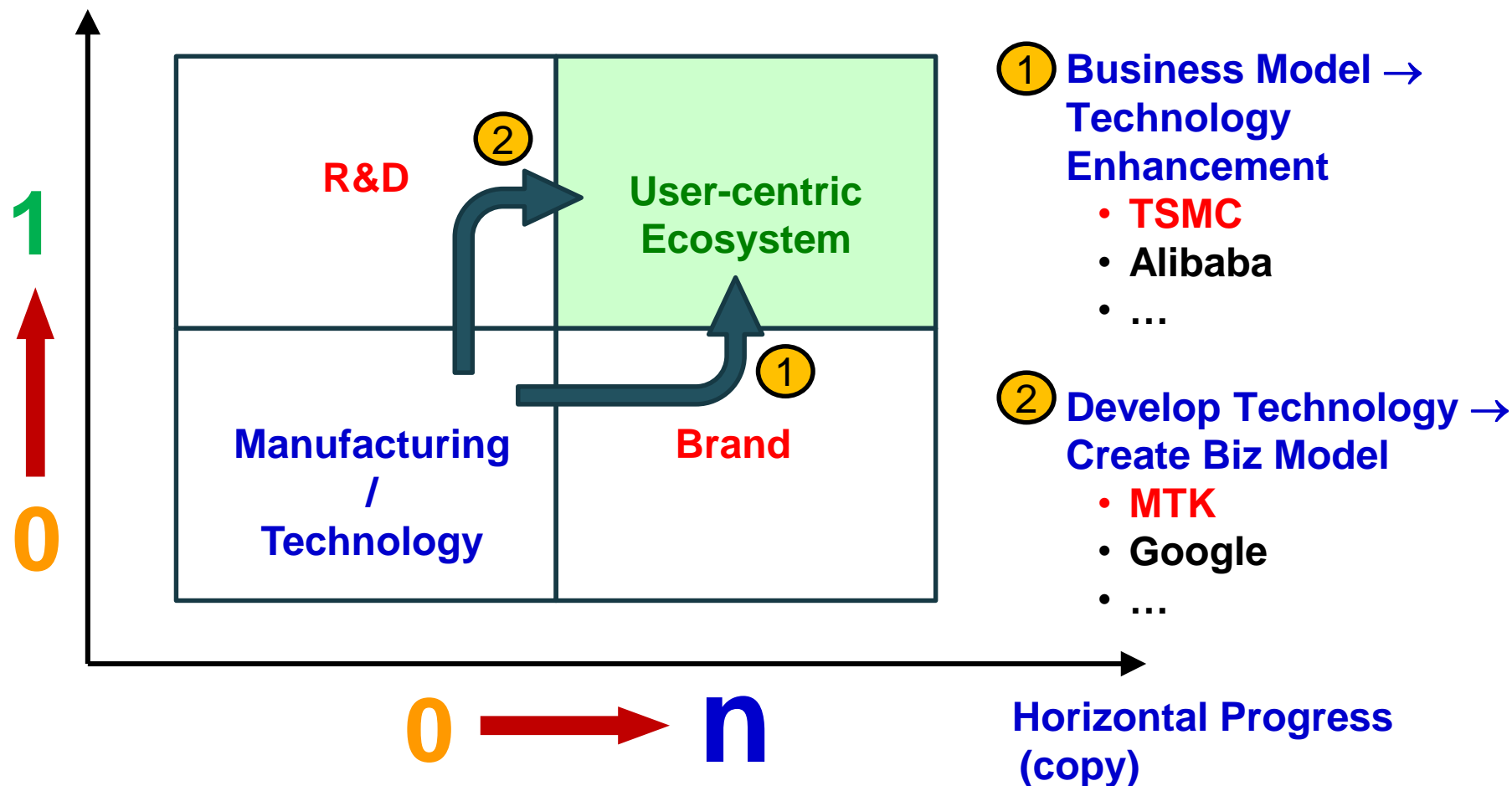
Vertical Jump  
(Innovation)



資料來源："From Zero to One," Peter Thiel ; ITRIIEK

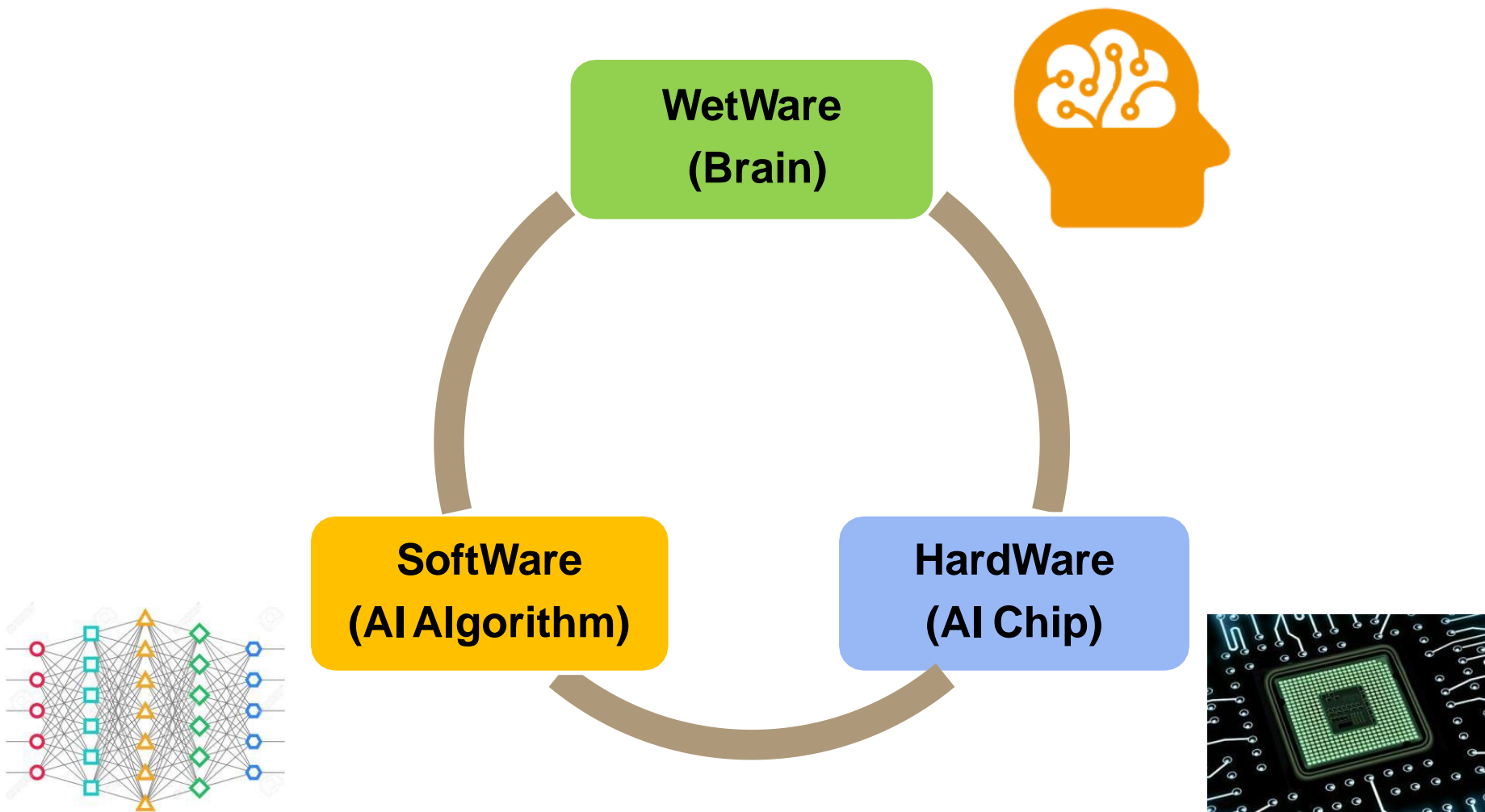
# Advanced Technology and Innovative Biz Model Are Key Factors in Building the Ecosystem

Vertical Jump  
(Innovation)



# Mega Trend of AI

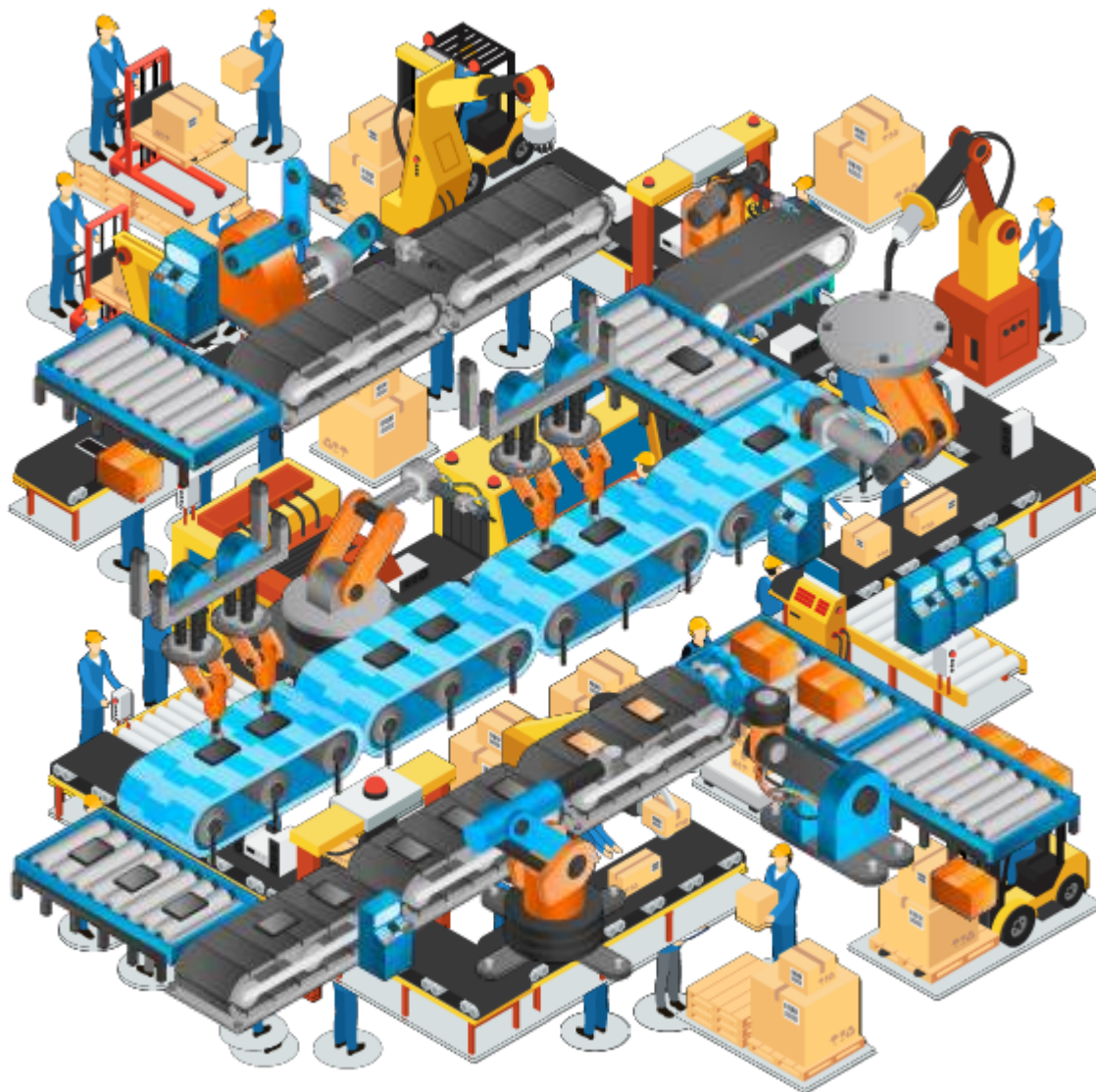
## Software + Hardware + Wetware



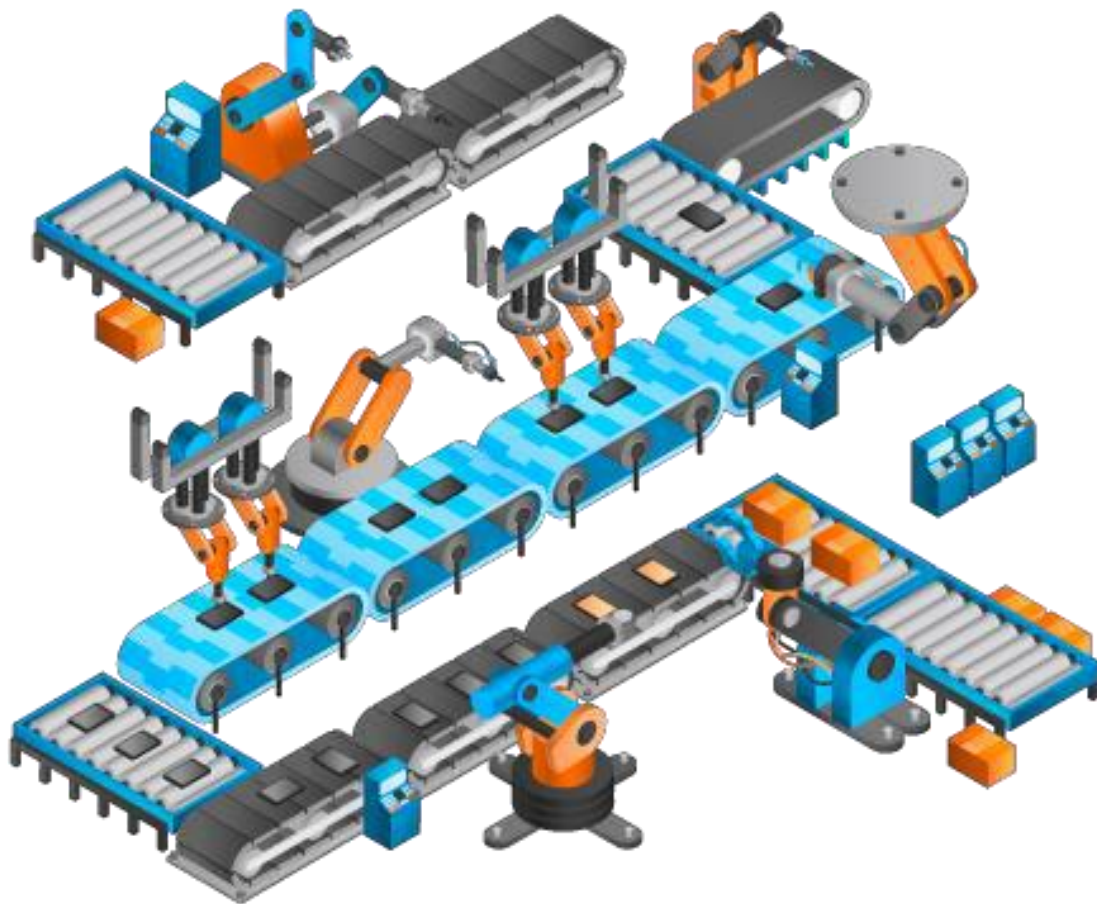
資料來源：Perceptio Founder Nicolas Pinto(2017/06); Internet



# Scenario of Industry 4.0?



# Scenario of AI?



# Adopt AI as a Multiple Factor (AI x) in Applications of Both Manufacturing and Service Industries

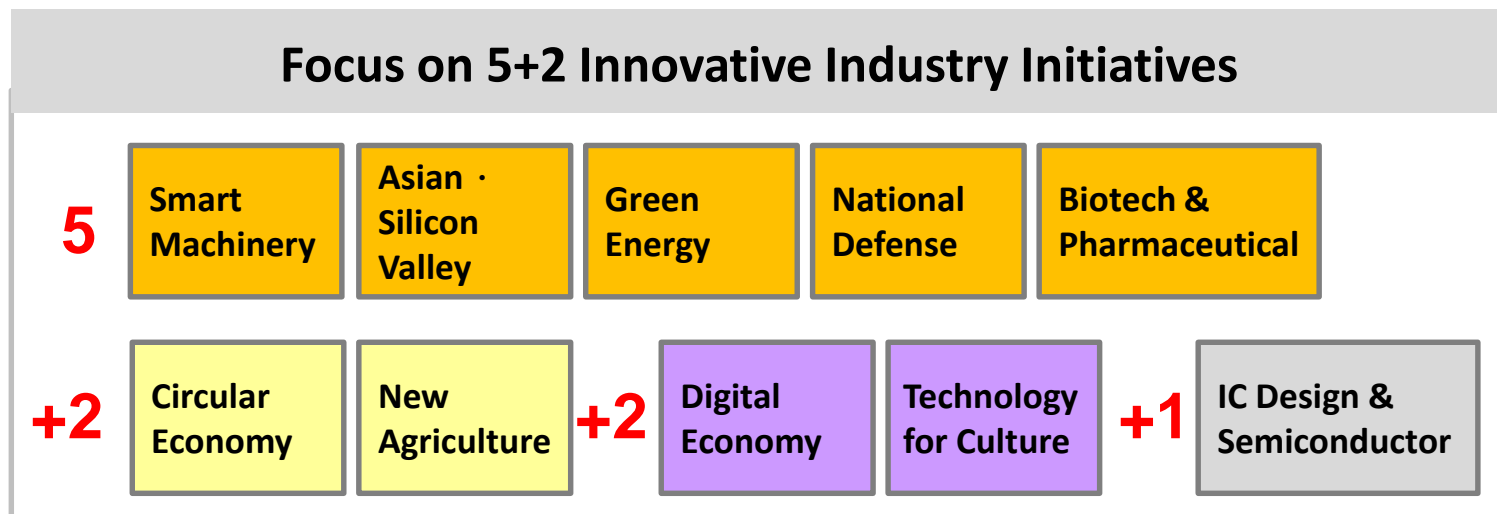
- The government starts a “Digital Country and Innovative Economy Development Program”
  - AI is one of most important items
- Combine with ICT and AI, we have strong competitiveness in many fields such as:
  - AI x Smart Transportation
  - AI x Smart Service
  - AI x Smart Manufacturing
  - AI-PU Chips
  - Others: AI x Smart Retail, AI x Smart Healthcare...etc

**“AI x” will be the key successful factor to master the opportunity in digital economy**



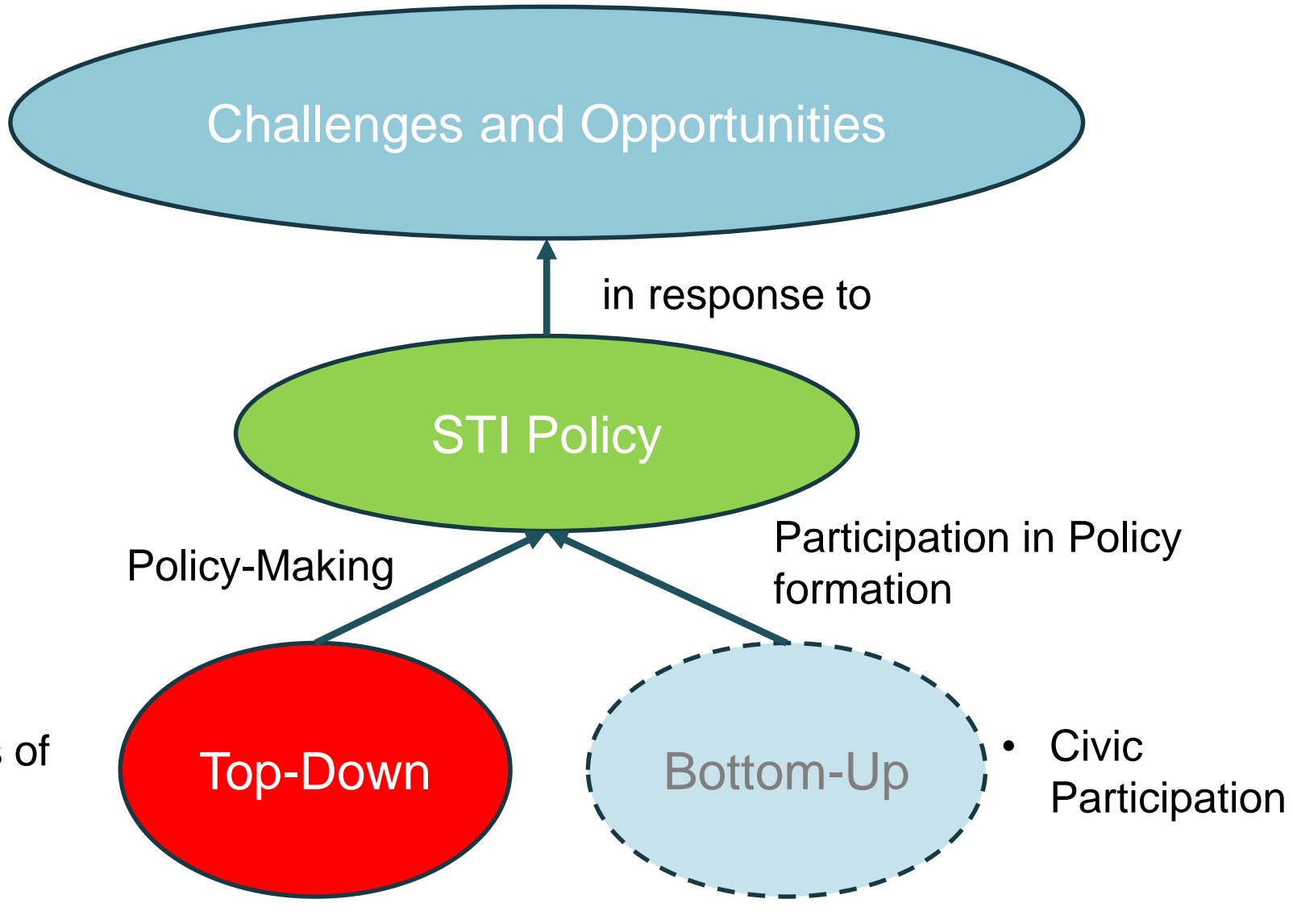
# 5x2 Industry Innovation Programs

- **Vision:** Focus on core concepts of innovation, employment and distribution
- **3 Links:** Link with local resources, to the future, with global markets
- **5x2 Industry Innovation Programs:**



# Outline

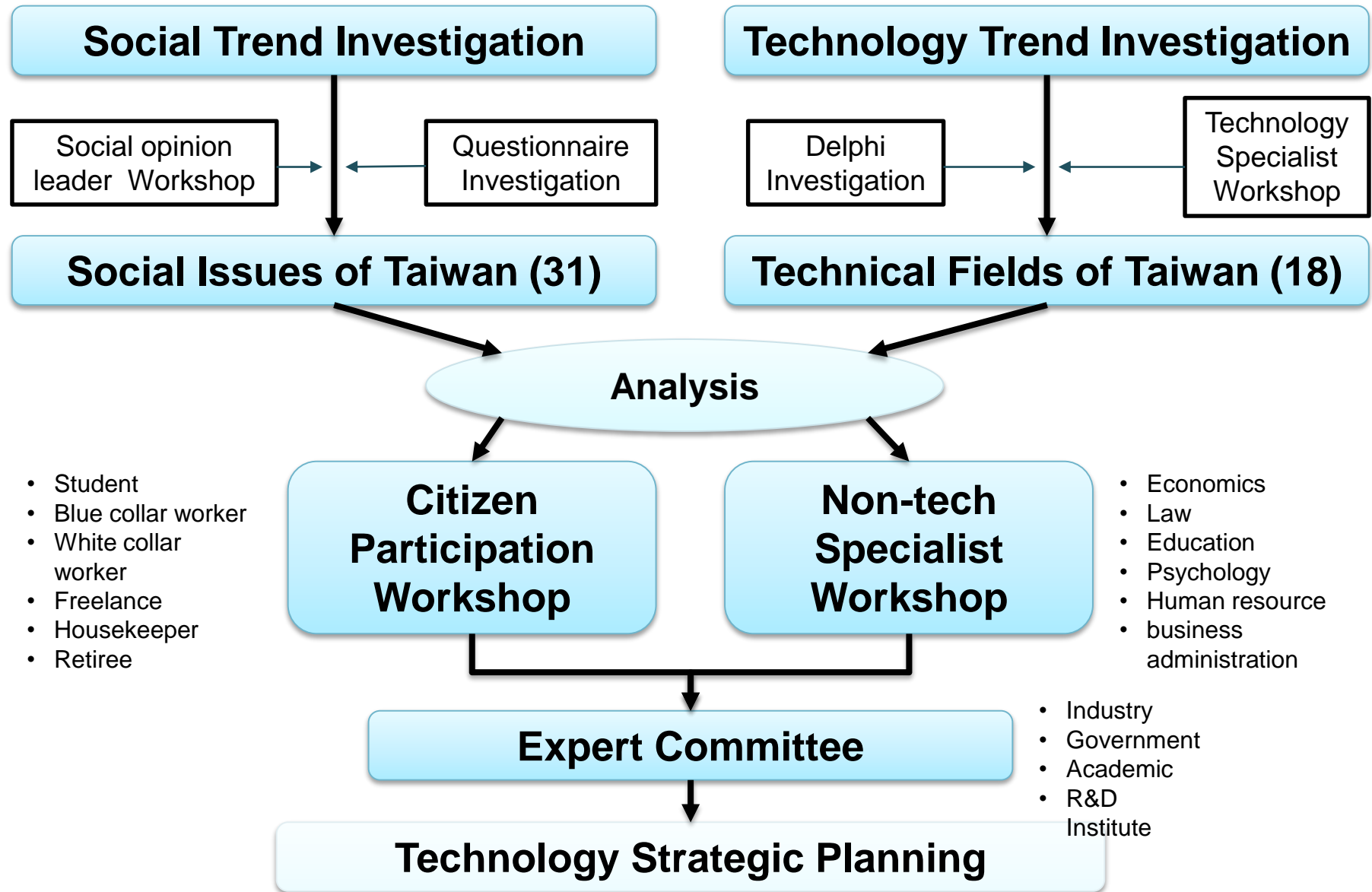




- Experts
- Ministers of Cabinet
- Senior Officials

- Civic Participation

# Taiwan Technology Foresight Research



### 未來科技咖啡館 分組名單 13:20 入座

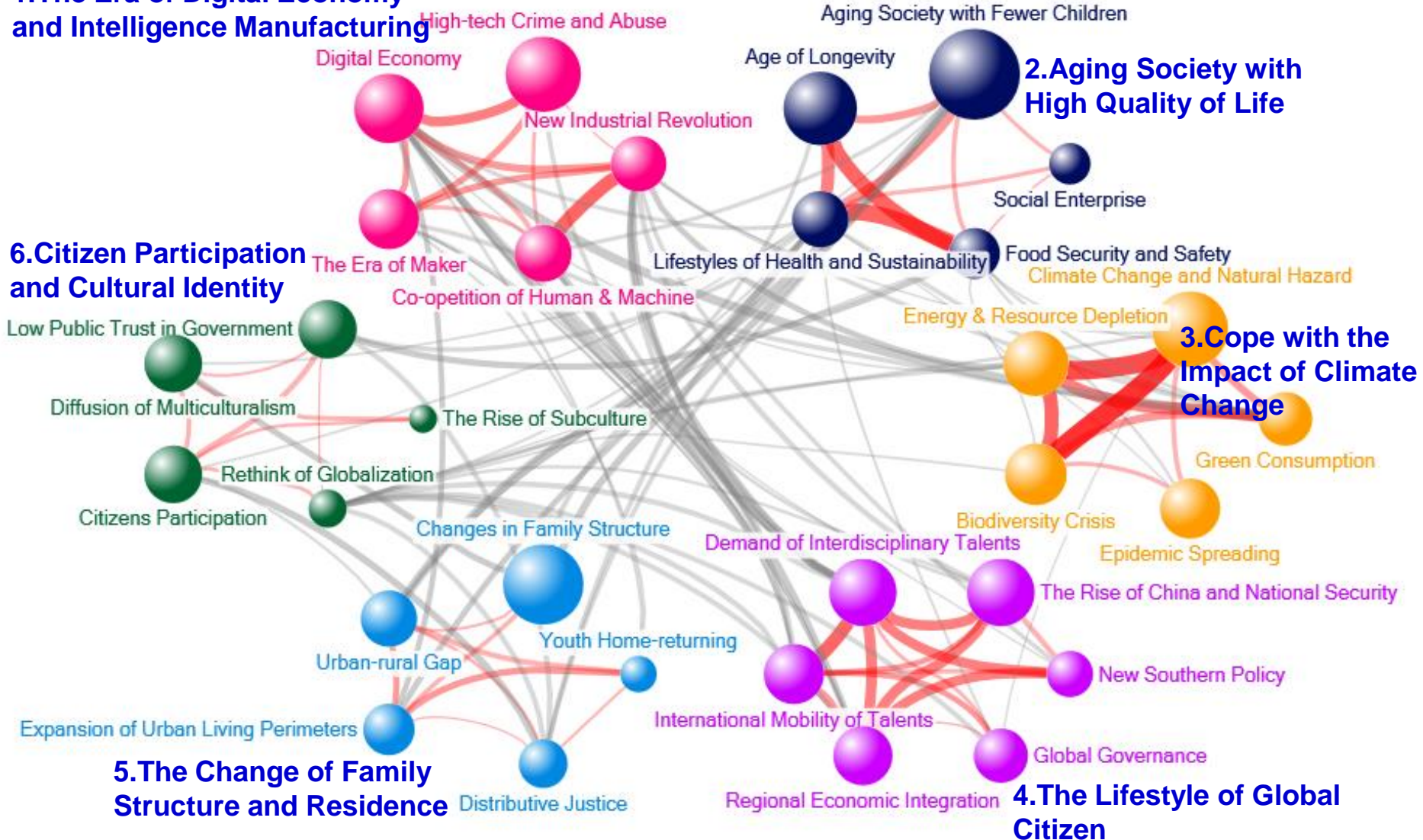
1	<ul style="list-style-type: none"> <li>葉力群</li> <li>林國賢</li> <li>周國輝</li> <li>何遠廷</li> <li>陳慧英</li> <li>林興濤</li> </ul>	2	<ul style="list-style-type: none"> <li>莊尚廉</li> <li>陳建利</li> <li>李樹權</li> <li>林紹奇</li> <li>陳永輝</li> <li>林宗崗</li> </ul>
3	<ul style="list-style-type: none"> <li>黃怡靈</li> <li>余光輝</li> <li>羅怡仁</li> <li>劉國輝</li> <li>陳遠超</li> <li>林潤南</li> </ul>	4	<ul style="list-style-type: none"> <li>鄧國華</li> <li>曹志誠</li> <li>葉偉志</li> <li>趙國榮</li> <li>譚海</li> <li>陳國華</li> </ul>
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WHETHER YOU WANT TO  
BE THE ONLY SACRED IS TO  
BELIEVE IN IT AND SATISFY  
YOUR DREAMS DO IT FOR  
YOURSELF.  
KodaKang

# Social Topics in the Next 20 years

## 1. The Era of Digital Economy and Intelligence Manufacturing



# Technical Fields links to Social Topics

**1. The Era of Digital Economy and Intelligence Manufacturing**

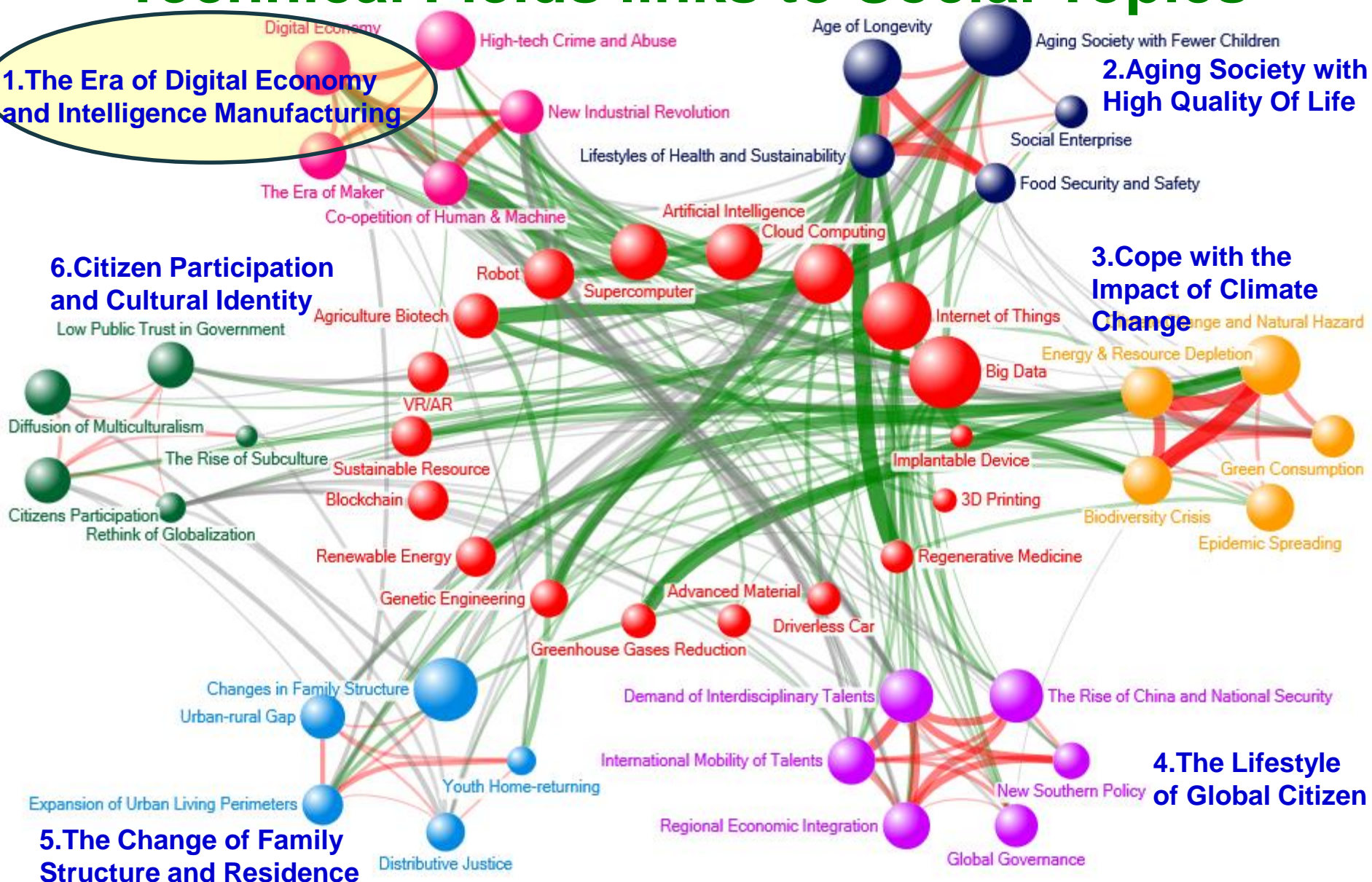
**2. Aging Society with High Quality Of Life**

**3. Cope with the Impact of Climate Change**

**6. Citizen Participation and Cultural Identity**

**5. The Change of Family Structure and Residence**

**4. The Lifestyle of Global Citizen**



# Technology Strategic Planning

## Topic

**The Era of Digital Economy and Intelligence Manufacturing**

## Goal

1. Taiwan become important industrial base of advanced manufacturing in the world.
2. Promote business model and ICT technology fusion, and open a new economic situation for Taiwan.
3. Take advantage of big data, AI, robot technologies for service industry instead of service staff.

## Task

### Technology R&D

- Artificial Intelligence
- Big Data
- Internet of Things
- Robot
- Cloud Computing
- Supercomputer
- 3D Printing

### Value Creation

- Mass customization with high efficiency, high quality, and low cost.
  - Robot with more metal abilities, such as thinking, emotion, learning.
  - High-value customized service — better than you know yourself.

### Management System

- Set up legal mechanism for balance between the disclosure of open data and the protection of privacy.
  - Make population policy for social impact by new tech, especially AI.
  - Harmonize the conflict of interest between digital and traditional economy

## Workshop

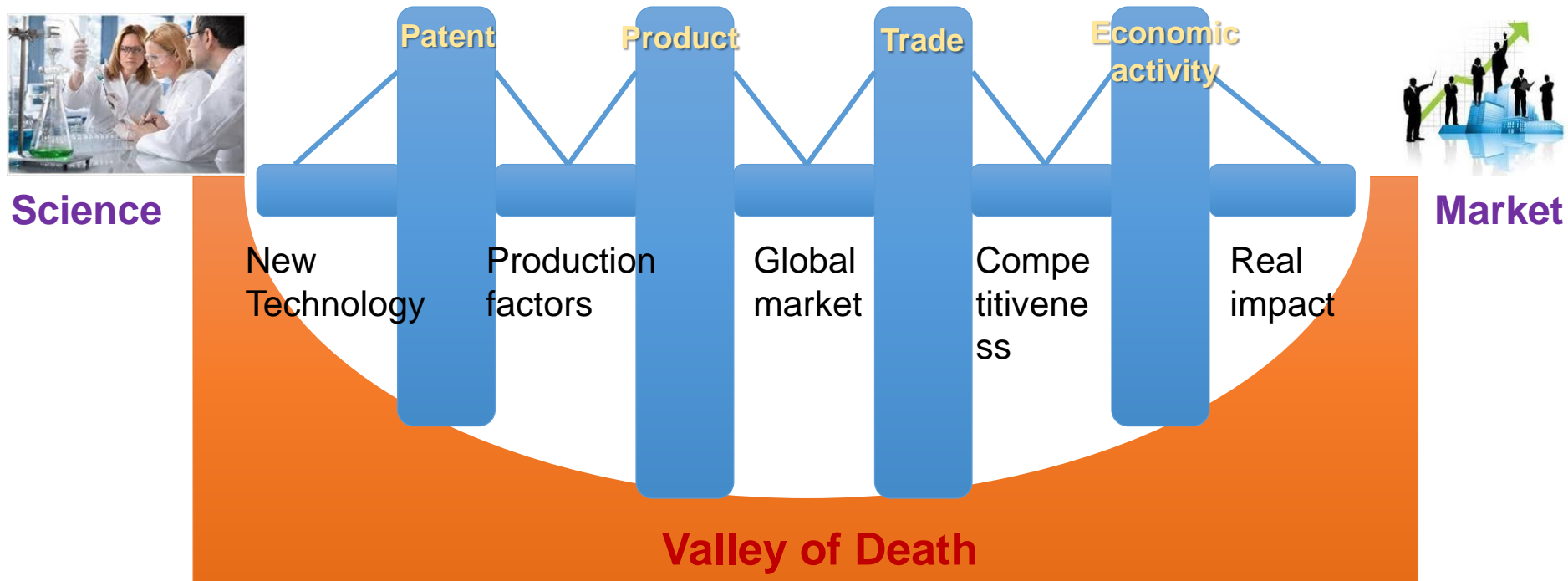
**Technology Specialist**

**Citizen Participation & Non-tech Specialist**



# KETs Observatory: Technology deployment monitoring mechanism to across the valley of death

- KETs was first proposed by EU commission.
- Four indicators are designed based on different phases of technology deployment value chain to understand the evolution process of given technology.



# Indicator framework: Trial on semiconductor

## Deployment Value Chain

### Technology generation and exploitation

New Technology

Competitive Innovation

Commercialization

Patent

Production

Trade

Businesses

IPC

TW  
Classification/PROD  
COM

HS

TW data/NACE/IPC

Thomson Innovation

MOEA/ITIS/  
PRODCOM

MOF  
UNCOMTRADE

IEK  
IDEA Consult

Significance  
Specialization  
Market Share

Significance  
Specialization  
Market Share

Significance  
Specialization  
Market Share  
Trade Balance

Significance  
Specialization  
Market Share

TW, CN, JP KR, US,  
EU-28

TW, EU-28

TW, CN, JP KR, US,  
EU-28

TW, CN, JP KR, US,  
EU-28

2002-2013

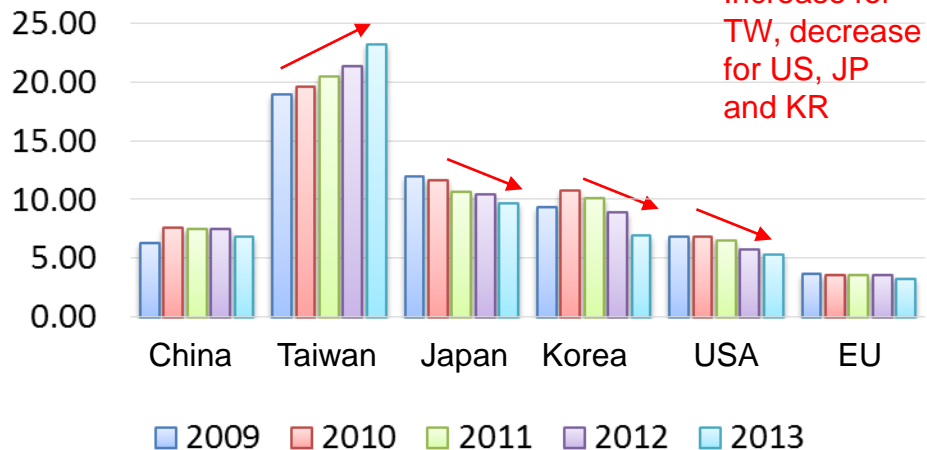
2003-2015(TW)  
2007-2015(EU)

2002-2015

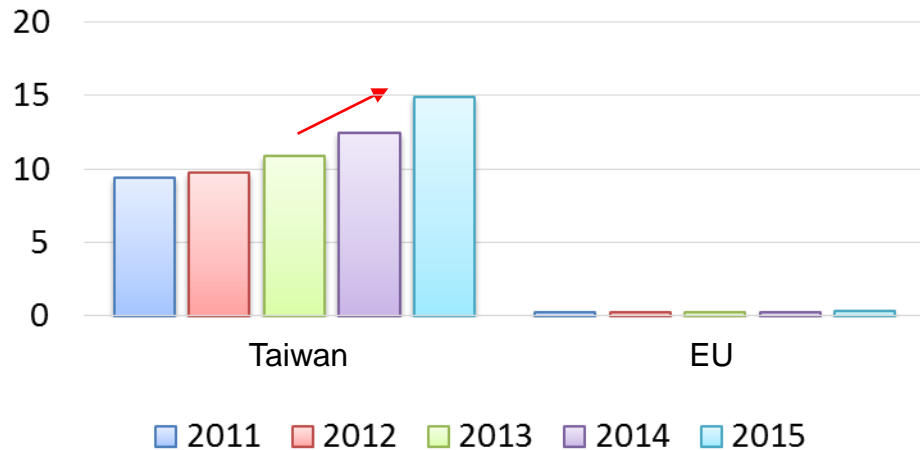
2005-2013

# Observatory on semiconductor: significance

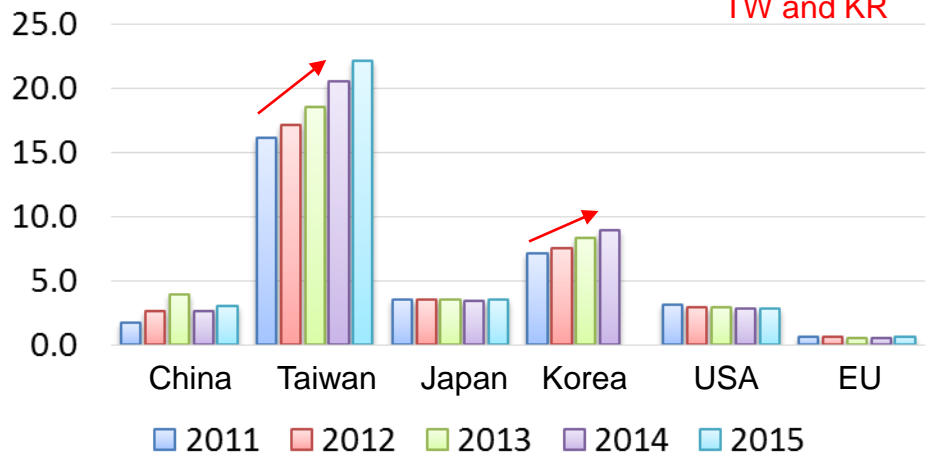
### Technology significance



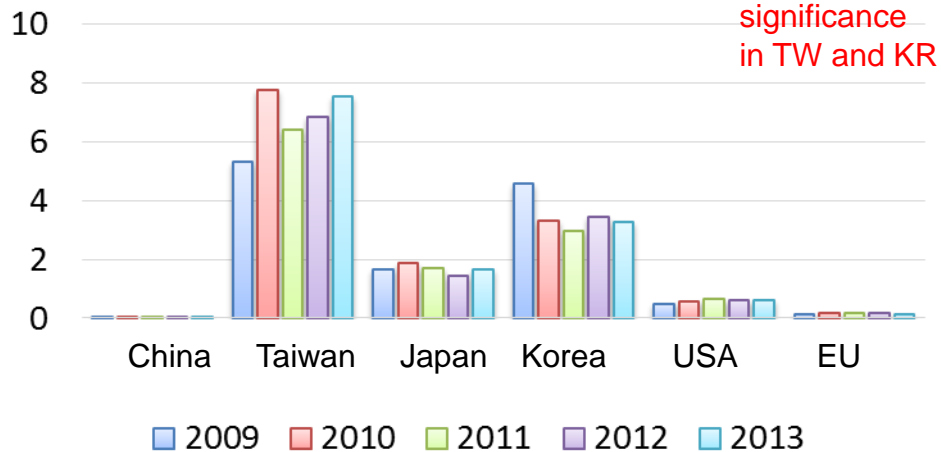
### Production significance



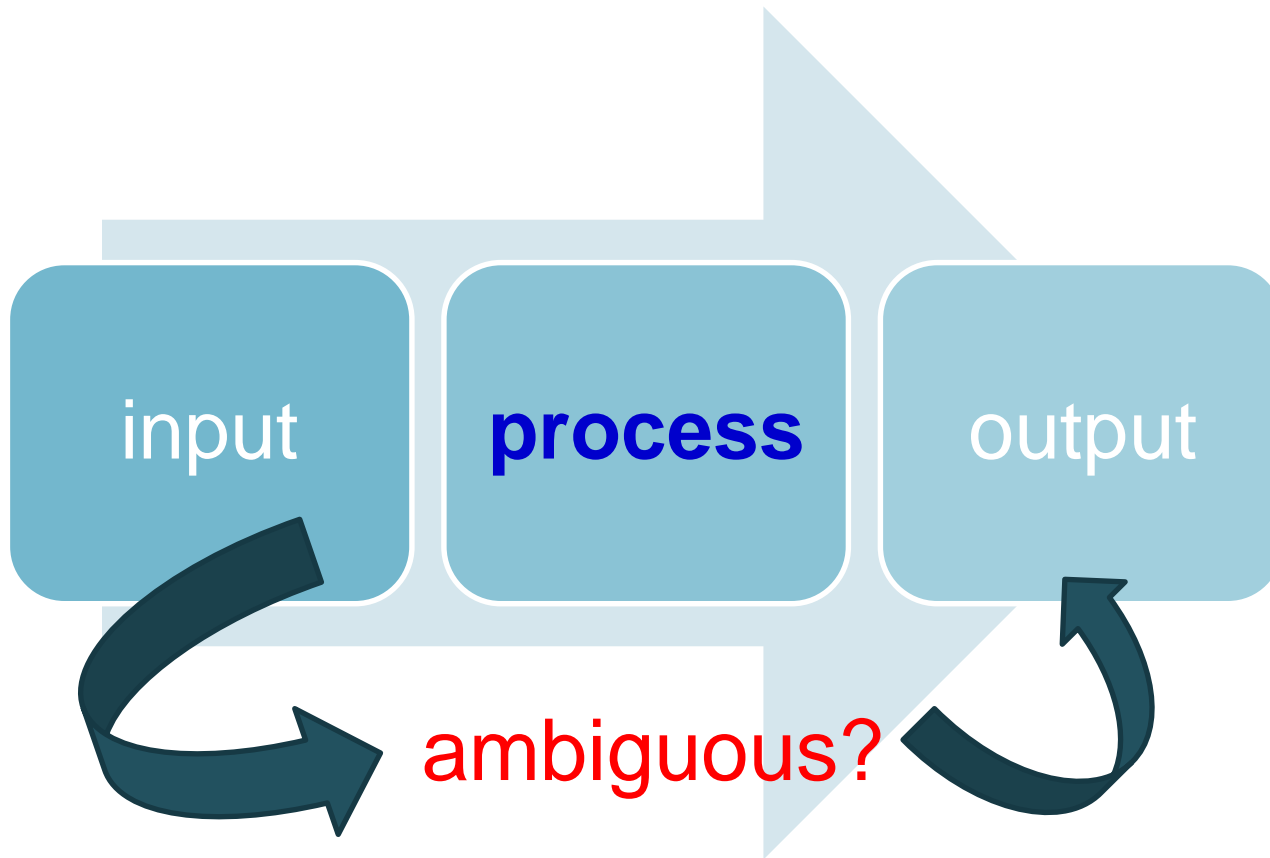
### Trade significance



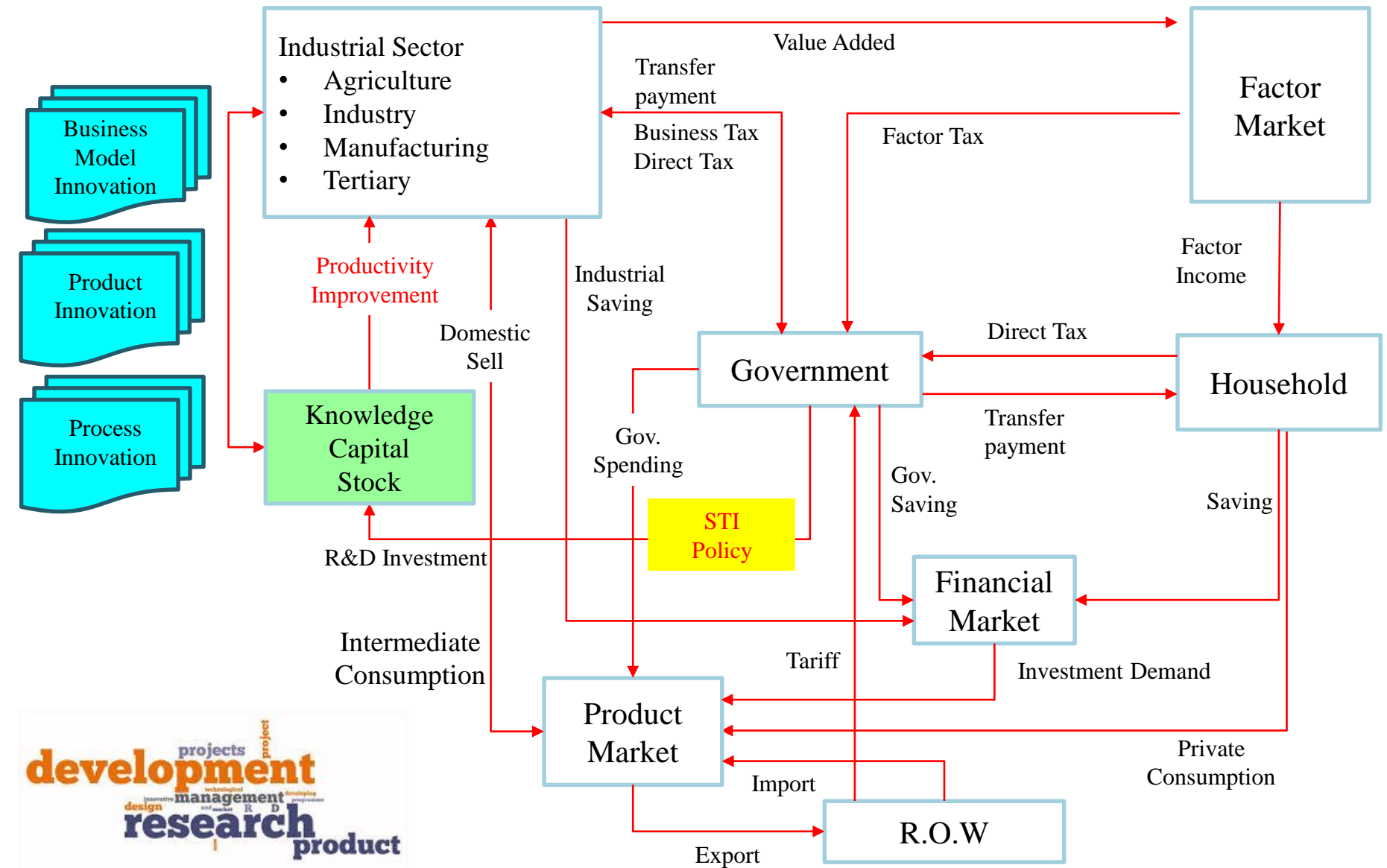
### Turnover significance



# Model framework for STI policy evaluation

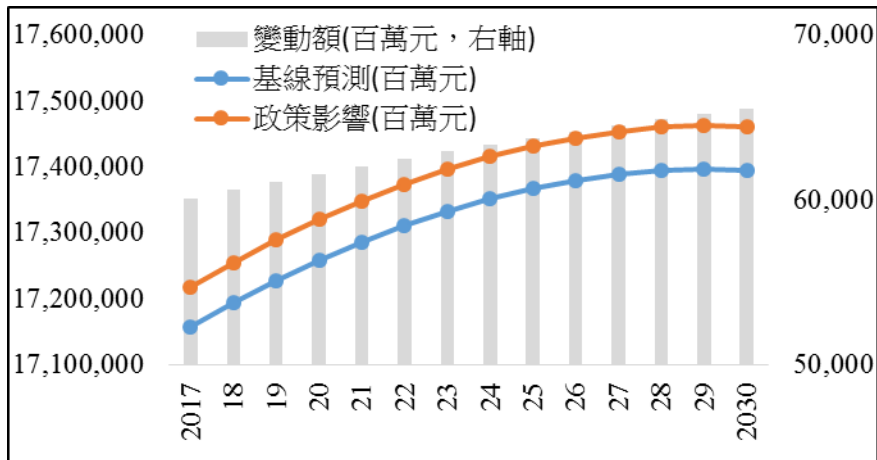


# Model framework for STI policy evaluation

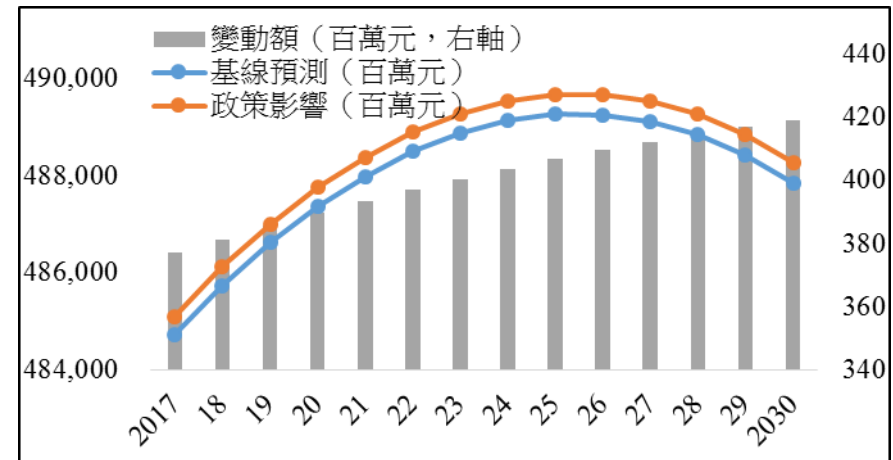


# Economic Impact of STI Policy Investment

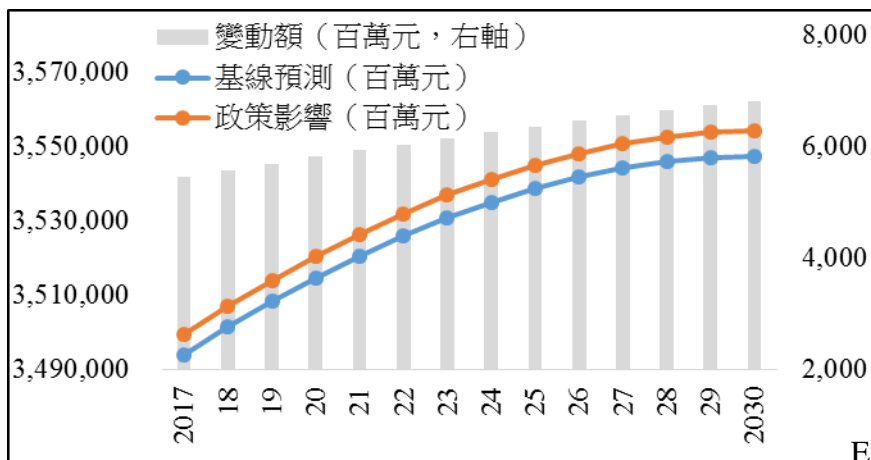
## Real GDP



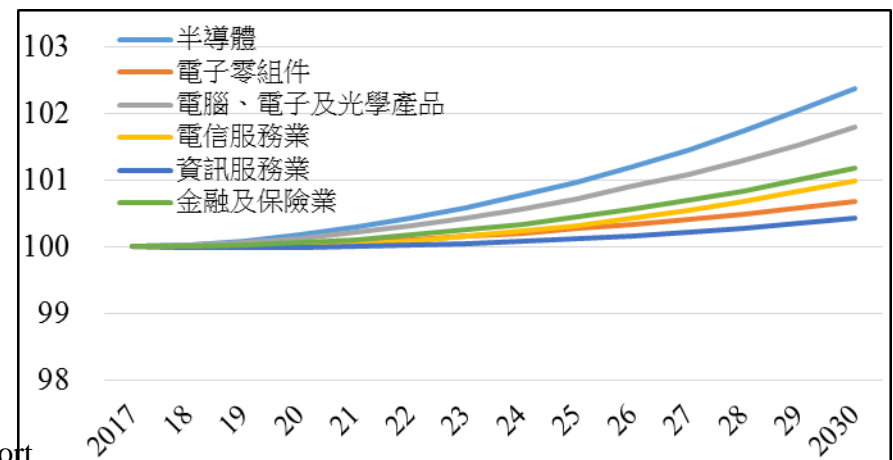
## Tax Revenue



## Capital Formation



## Industrial Productivity



Export

# *Better Policies for Better Life*

## World-class Think Tank to Lead Taiwan Industries in Value Creation

**IEK View**<http://ieknet.iek.org.tw>

# Thank you

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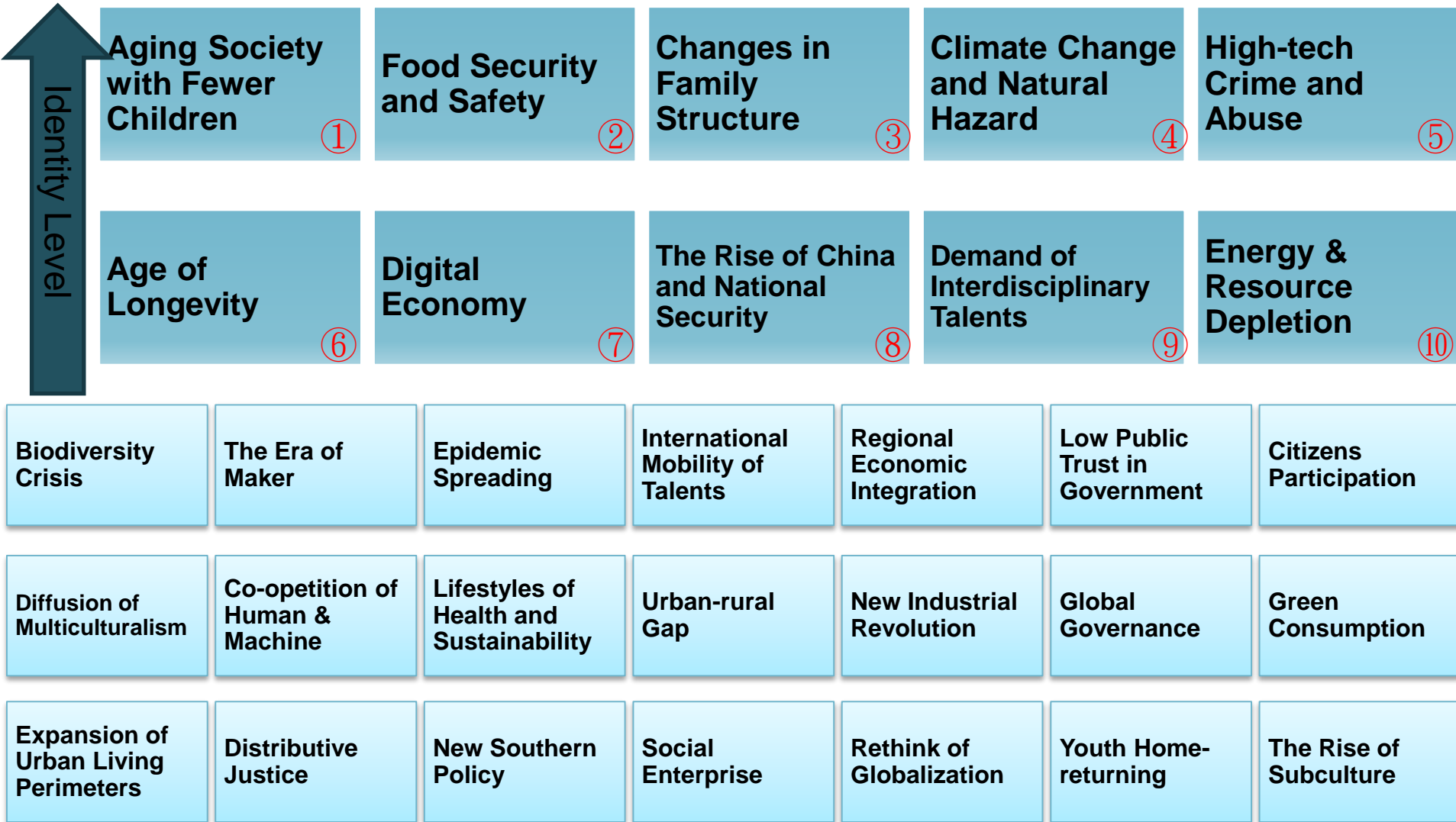
**Our location:**

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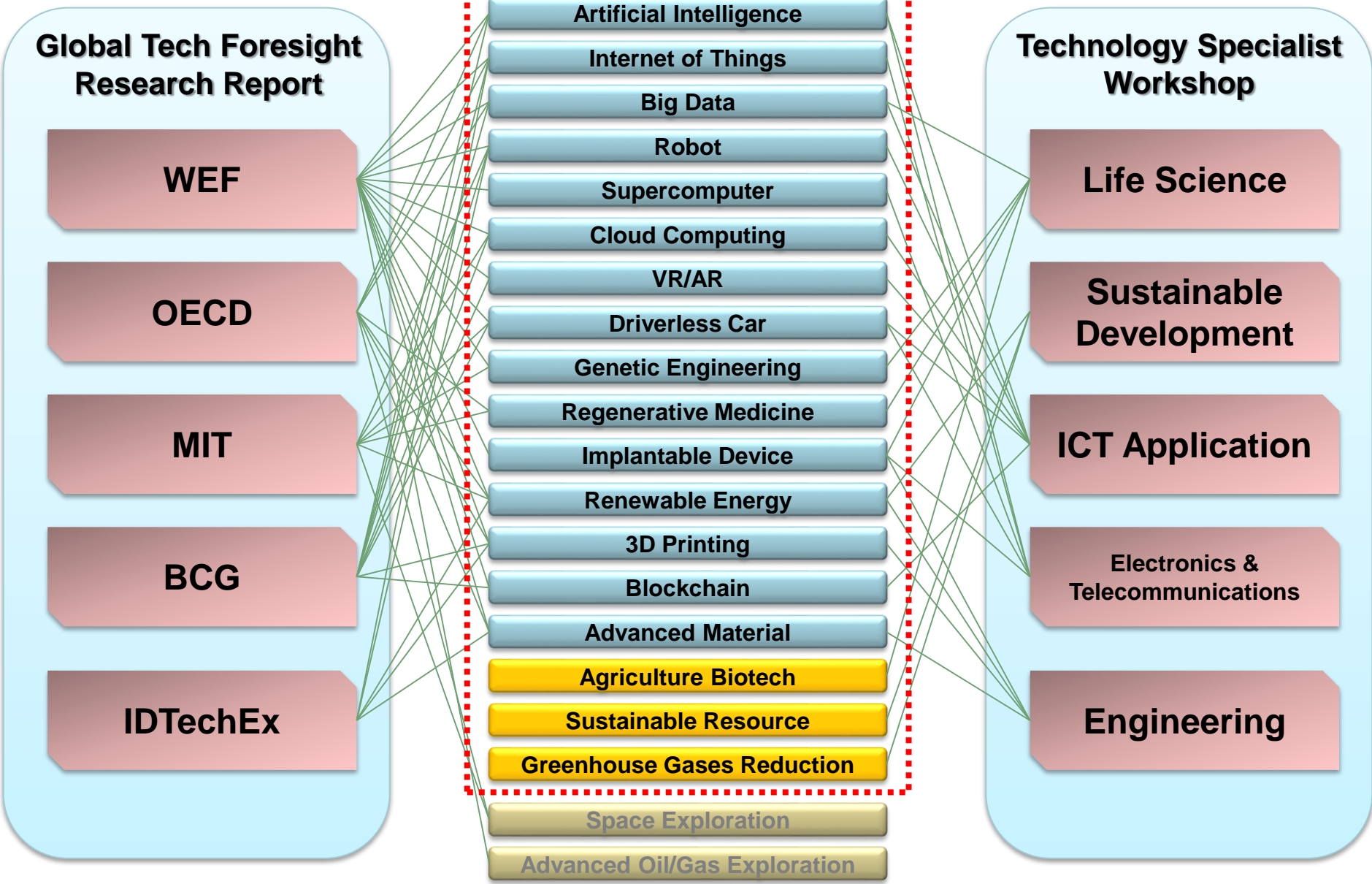
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# 31 Social Issues of Taiwan in the Next 20 years



# 18 Technical Fields of Taiwan



# Comparison of Social Topics

Social Topic	Identity Level	Influence on social issues within topic	Influence on social issues of other topics	Influence on Tech
The Era of Digital Economy and Intelligence Manufacturing	High	High	High	High
Aging Society with High Quality Of Life	High	High	Medium	High
The Lifestyle of Global Citizen	High	High	Medium	Medium
Cope with the Impact of Climate Change	High	High	Low	Medium
The Change of Family Structure and Residence	Medium	Low	Low	Low
Citizen Participation and Cultural Identity	Low	Low	Low	Low