Korea AI Strategy and Policy

2019.08.

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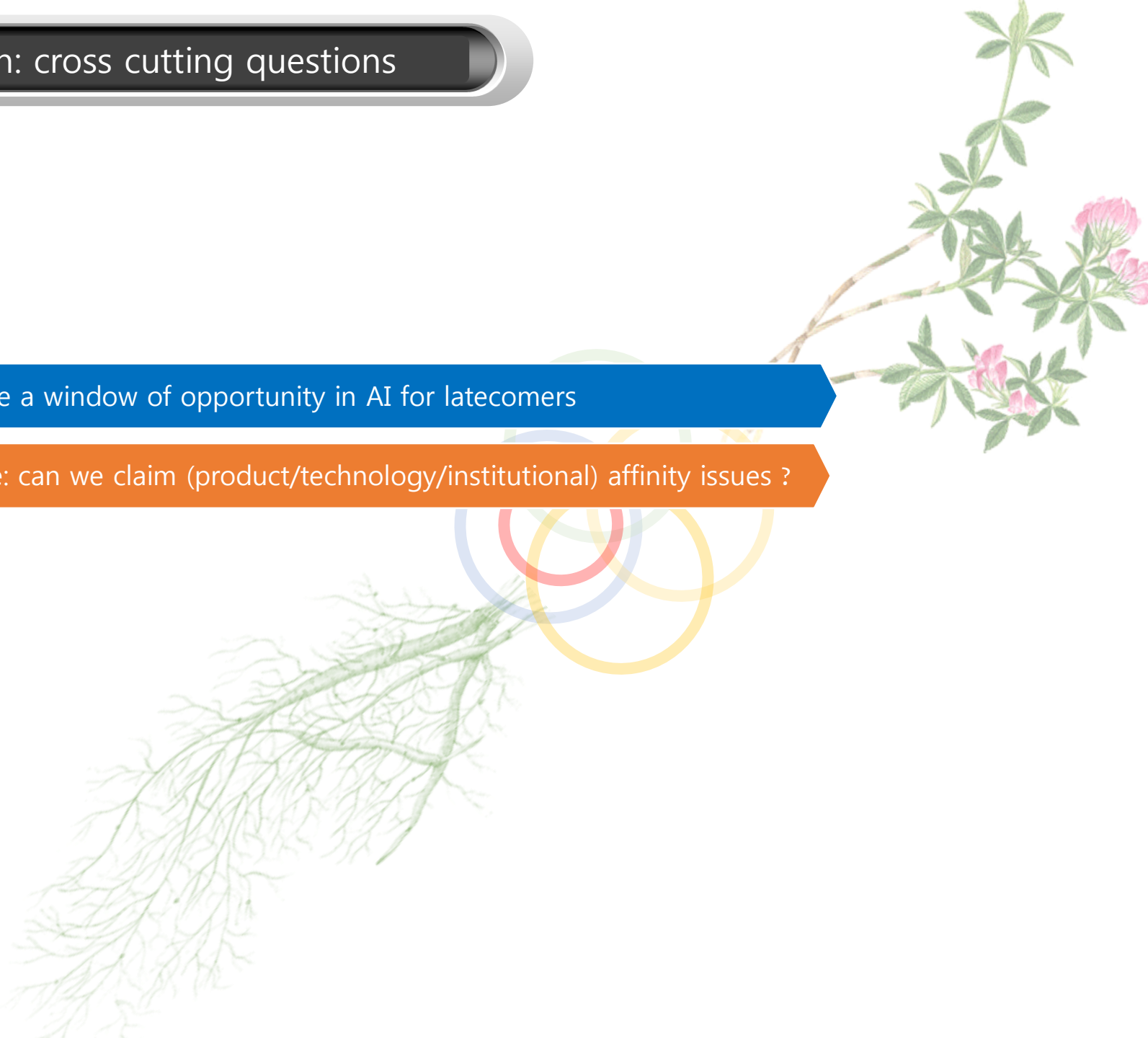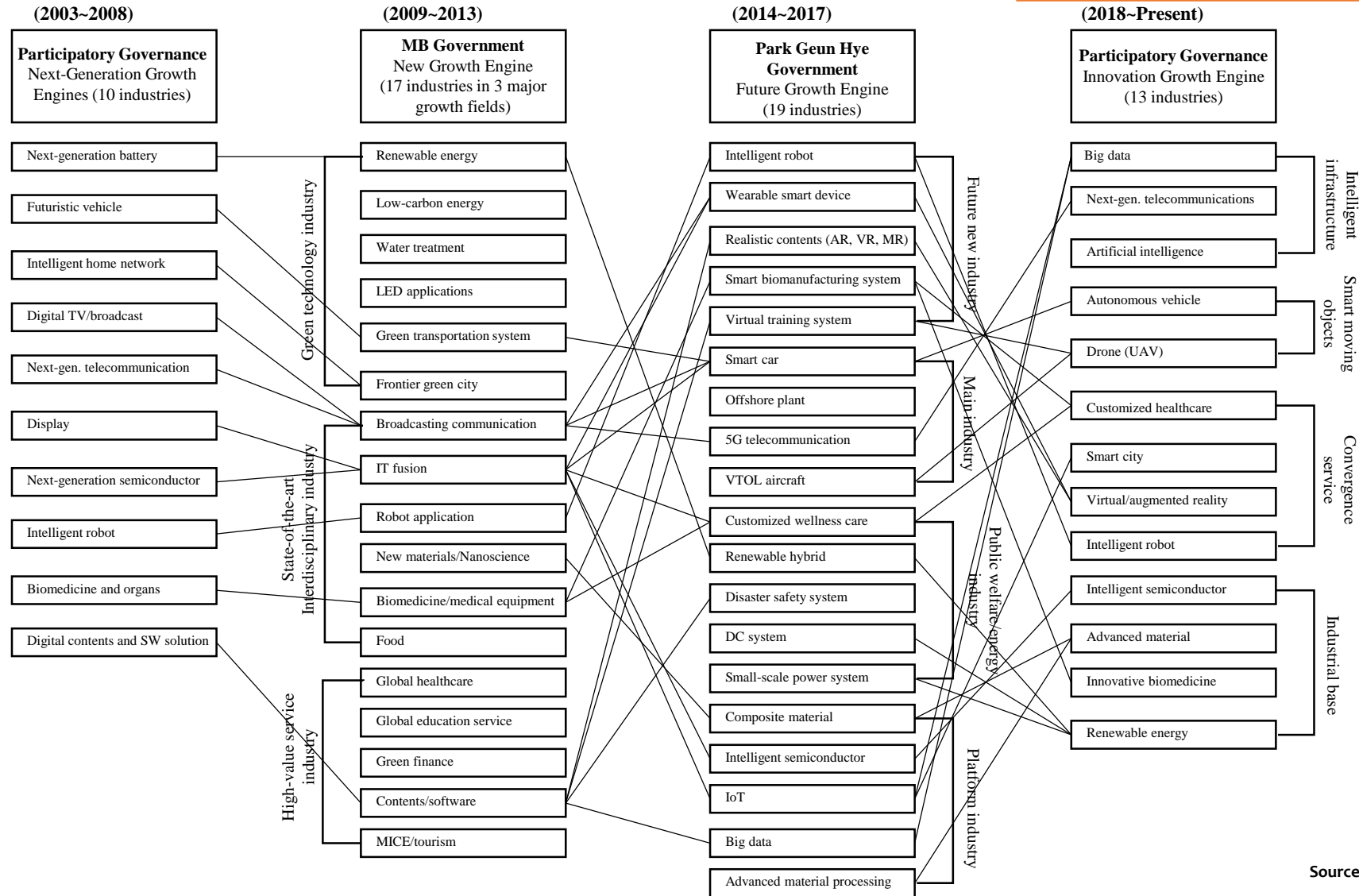
KAIST

Contents

I. Embarkation: cross cutting questions

❶ Do we have a window of opportunity in AI for latecomers

❷ Old debate: can we claim (product/technology/institutional) affinity issues ?

I. IB: Technology and Industrial Policies for Growth

2018-:Intelligent infrastructure, Smart mobility, convergence service

(2003~2008)	(2009~2013)	(2014~2017)	(2018~Present)
Participatory Governance Next-Generation Growth Engines (10 industries)	**MB Government** New Growth Engine (17 industries in 3 major growth fields)	**Park Geun Hye Government** Future Growth Engine (19 industries)	**Participatory Governance** Innovation Growth Engine (13 industries)

(2003~2008) — Next-Generation Growth Engines (10 industries)
- Next-generation battery
- Futuristic vehicle
- Intelligent home network
- Digital TV/broadcast
- Next-gen. telecommunication
- Display
- Next-generation semiconductor
- Intelligent robot
- Biomedicine and organs
- Digital contents and SW solution

(2009~2013) — MB Government

Green technology industry:
- Renewable energy
- Low-carbon energy
- Water treatment
- LED applications
- Green transportation system
- Frontier green city

State-of-the-art Interdisciplinary industry:
- Broadcasting communication
- IT fusion
- Robot application
- New materials/Nanoscience
- Biomedicine/medical equipment
- Food

High-value service industry:
- Global healthcare
- Global education service
- Green finance
- Contents/software
- MICE/tourism

(2014~2017) — Park Geun Hye Government

Future new industry:
- Intelligent robot
- Wearable smart device
- Realistic contents (AR, VR, MR)
- Smart biomanufacturing system
- Virtual training system

Main industry:
- Smart car
- Offshore plant
- 5G telecommunication
- VTOL aircraft

Public welfare/energy industry:
- Customized wellness care
- Renewable hybrid
- Disaster safety system
- DC system
- Small-scale power system
- Composite material

Platform industry:
- Intelligent semiconductor
- IoT
- Big data
- Advanced material processing

(2018~Present) — Participatory Governance

Intelligent infrastructure:
- Big data
- Next-gen. telecommunications
- Artificial intelligence

Smart moving objects:
- Autonomous vehicle
- Drone (UAV)

Convergence service:
- Customized healthcare
- Smart city
- Virtual/augmented reality
- Intelligent robot

Industrial base:
- Intelligent semiconductor
- Advanced material
- Innovative biomedicine
- Renewable energy

Source: Bae(2019), STEPI

I. Evidence: Technology

Increase in patenting activities by Chaebol: from six in 2007 to 11 organisaitons in 2017(Among top 100 IPO)

❶ Samsung Group(3), LG Group(4), Hyundai Motors(1), SKH(1), ETRI
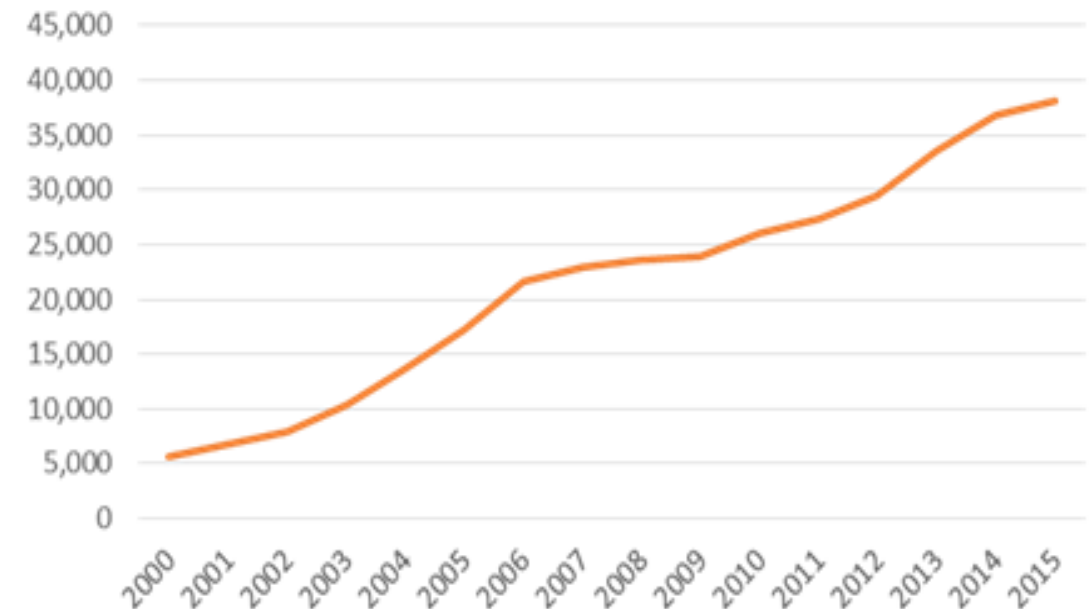❷ Samsung Group contribution:54%, ❸ SEC contribution:36%

Year	2000	2005	2010	2015
Korea	7(3314)	4(5908)	3(11671)	3(17924)
UK	6(3662)	6(3142)	7(4302)	8(6417)
China	24(119)	17(402)	8(2655)	5(8116)
Taiwan	3((4667)	3(5120)	4(8239)	4(11690)

USPTO Patent Granted (Korea)

I. Evidence: Knowledge

The patterns of accumulation of knowledge production in Korea gradually evolved from engineering to scientific activities

The proportion of knowledge production increased from 2% to 3%
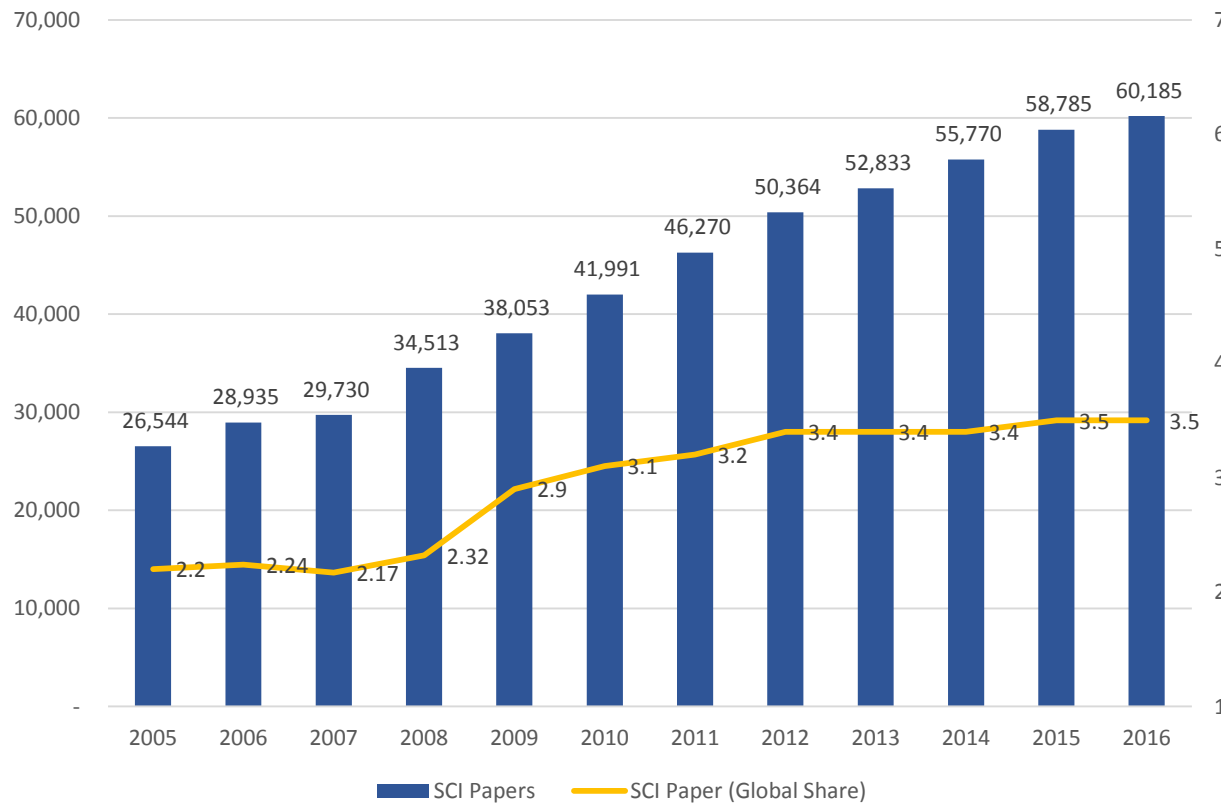
Table 6 Korea's Global Rank of knowledge production by the academic discipline

	2000	2005	2007
Engineering			
IT and communication sys	5	3	4
Electrical and electronics Eng	8	4	5
Material science and Eng	7	6	5
Mechanical engineering	7	6	6
Metallurgy	5	7	6
Engineering Mgt/General	10	8	7
Civil Eng	12	7	8
Nuclear Eng	7	8	8
Aerospace Engineering	9	7	10
Science			
Chemical engineering	8	10	9
Chemistry	9	9	9
Physics	14	13	9
App phy./Conden. Matter/mat. Sci	9	8	7
Optics and Acoustics	13	11	10
Medicine and pharmacology			
Biotech and applied microbiology	7	5	6
Pharmacology/Toxicology	12	6	7
Otolaryngology	17	9	6
General/Internal Medicine	13	10	8
Radiology, Nuclear Med., Imaging	9	9	8

Source: MEST (2008)

I. Evidence: Stylised
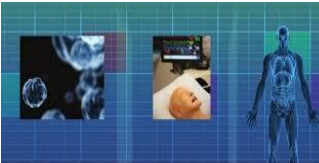
1	**Reverse Product Life Cycle (Process to Product innovation)**
2	**Predictable technology cycle(Memory, LCD)**
3	**Knowledge production: From engineering to Science**
4	**From industry specialization to diversity (System and BioPharma)**
5	**From technological capability to innovation/non-technological capabilities**

Figure 2: Mapping AI research globally
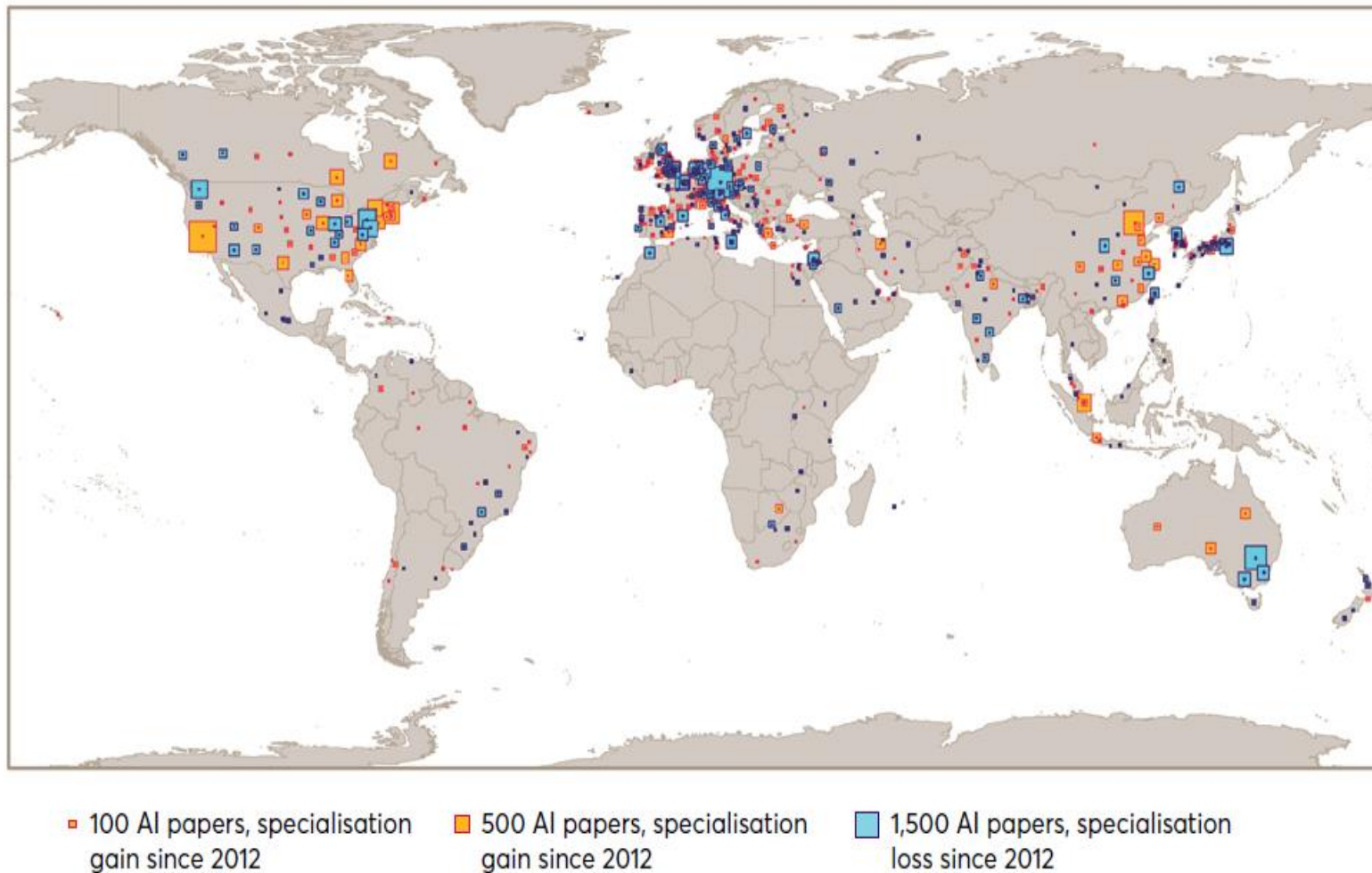
-Gains in competitiveness in China and USA
-Mixed in Europe

-Korea and Taiwan appears less competitive

- 100 AI papers, specialisation gain since 2012
- 500 AI papers, specialisation gain since 2012
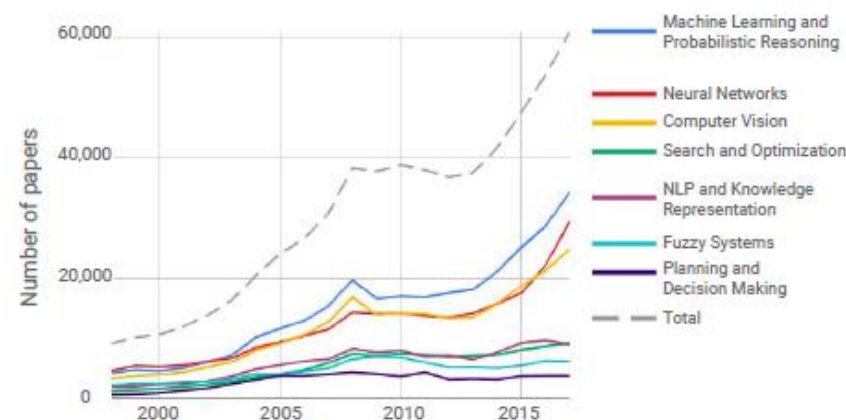- 1,500 AI papers, specialisation loss since 2012

Source: NESTA(2019)

Growth of annually published papers by topic (1996–2017)
Source: Scopus
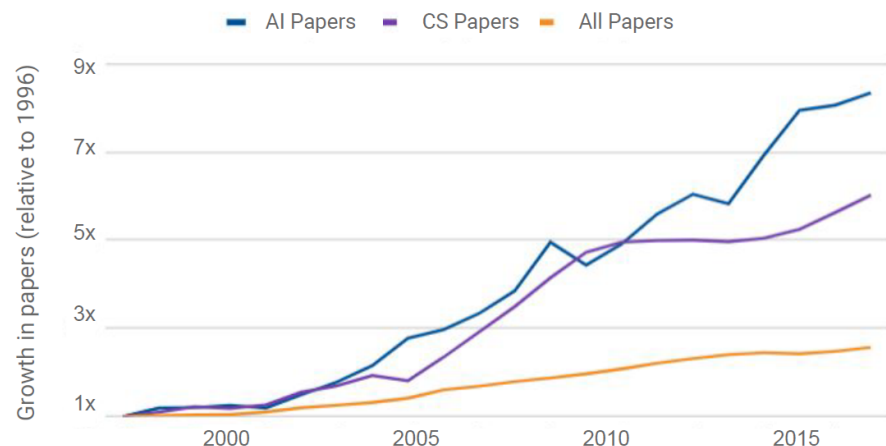
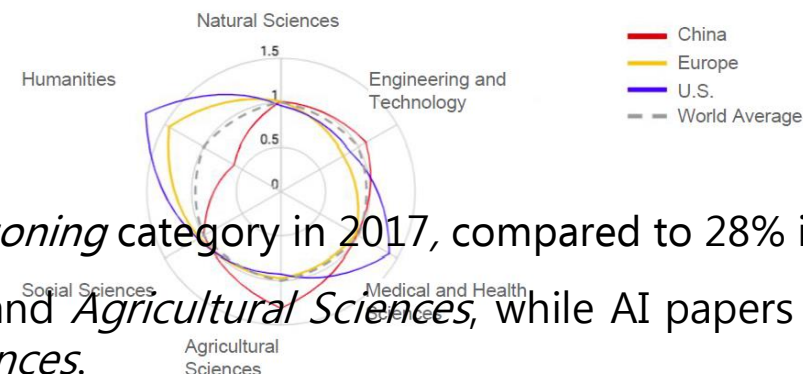Number of AI papers on Scopus by subcategory (1998–2017)
Source: Elsevier

Relative activity focus by region and AI research sector (2000)
Source: Elsevier
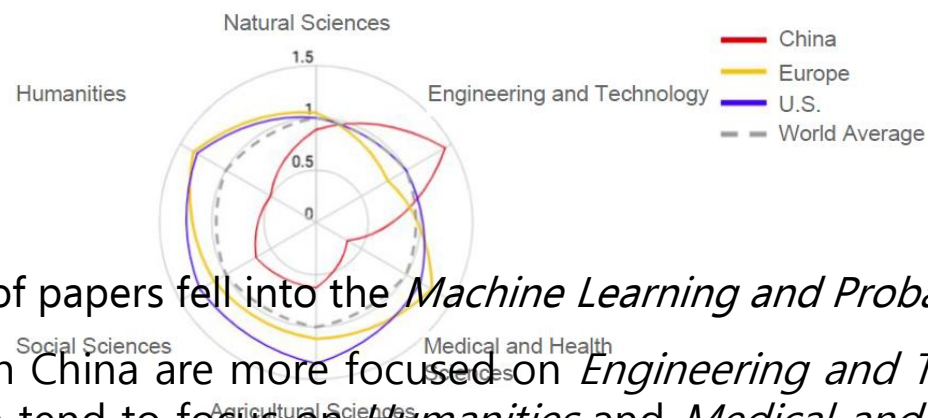
Relative activity focus, by region and AI research sector (2017)
Source: Elsevier

56 percent of papers fell into the *Machine Learning and Probabilistic Reasoning* category in 2017, compared to 28% in 2010.

AI papers in China are more focused on *Engineering and Technology* and *Agricultural Sciences*, while AI papers in the U.S. and Europe tend to focus on *Humanities* and *Medical and Health Sciences*.
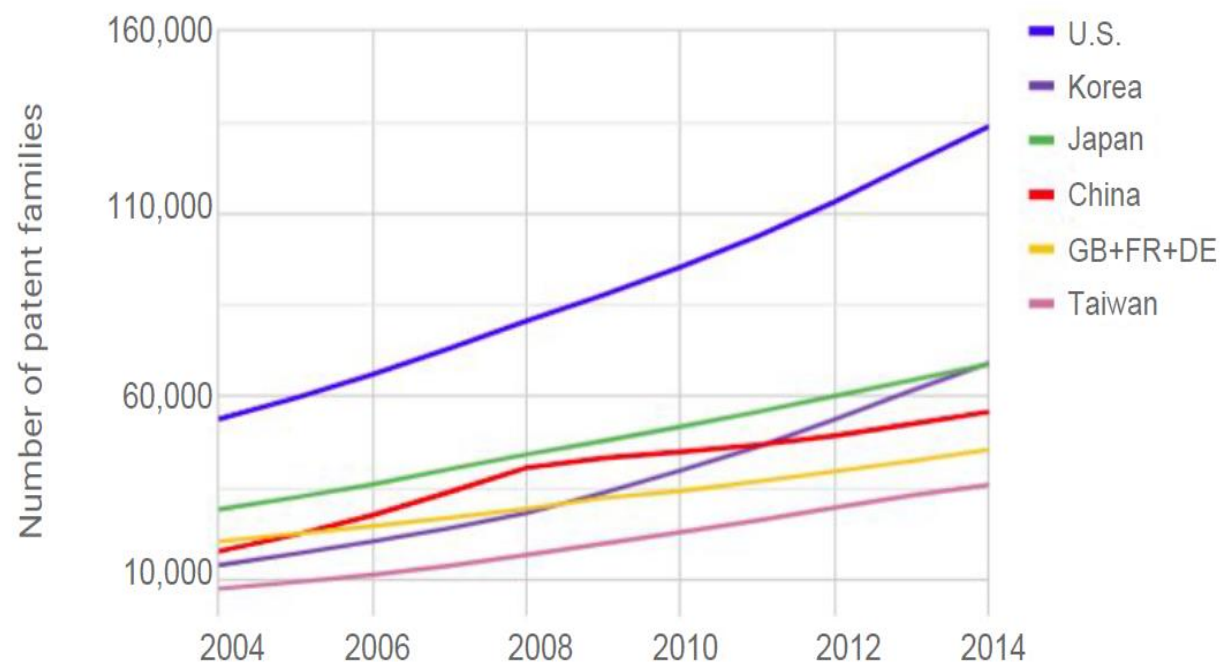
Source: The AI Index 2018 Annual Report(2018)

Of the top inventor regions, South Korea and Taiwan have experienced the most growth, with the number of AI patents in 2014 nearly 5x that in 2004.
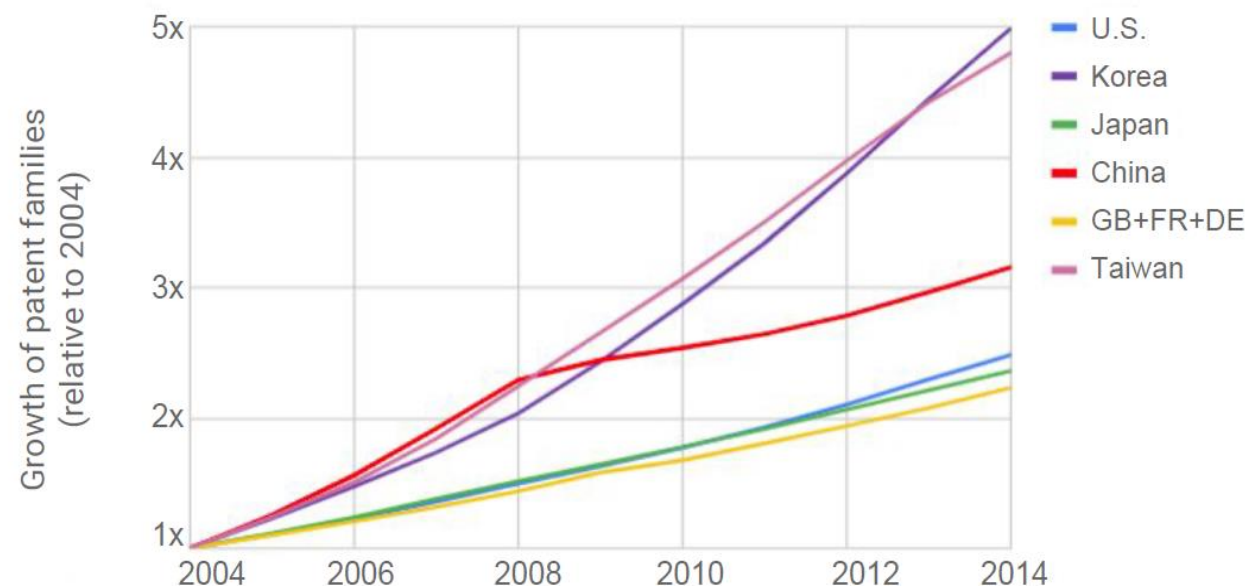

AI patents by inventor region (2004–2014)
Source: amplified
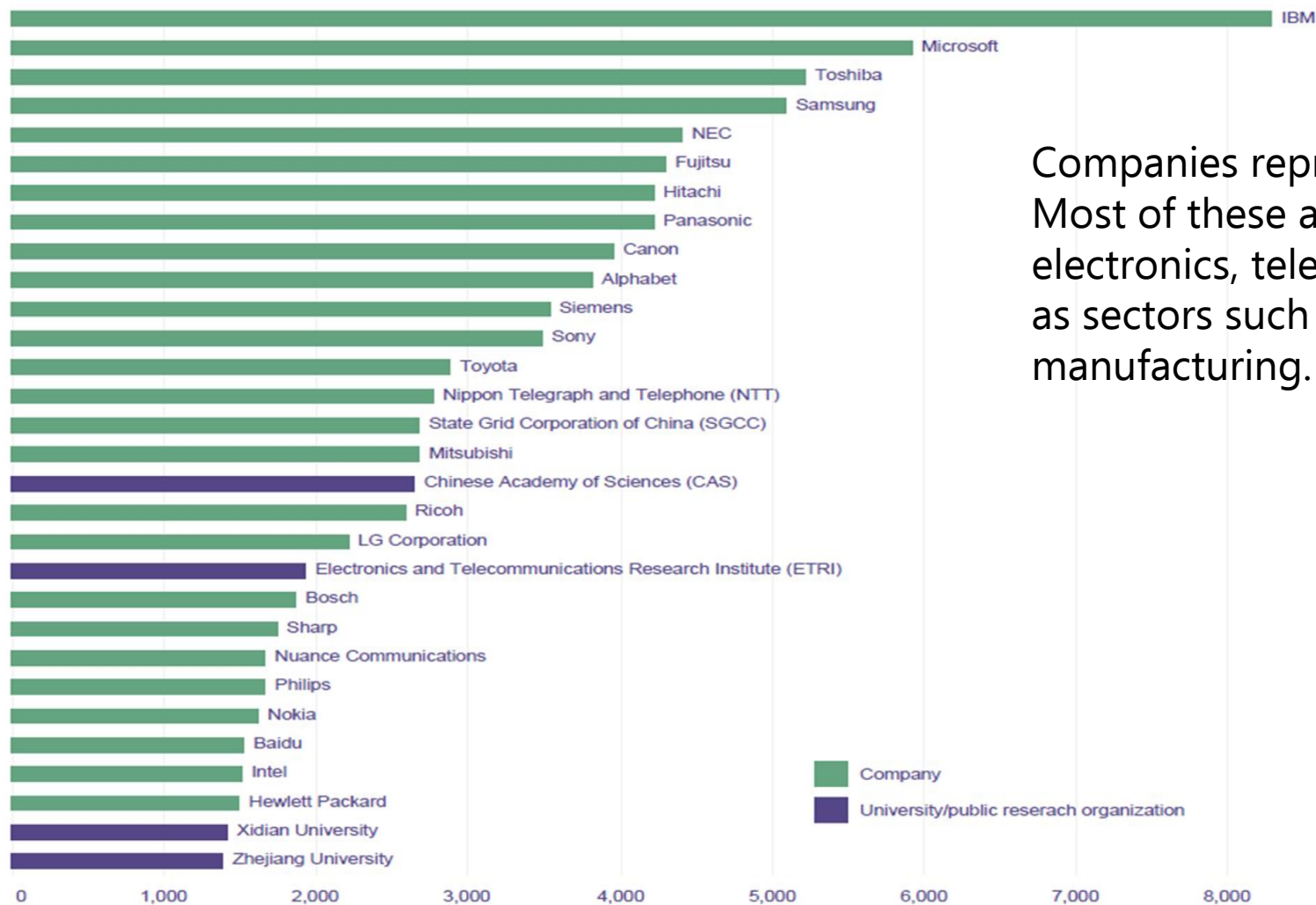
Growth of AI patents by inventor region (2004–2014)
Source: amplified

Note: GB + FR + DE refers to a combined number of patents from Great Britain, France, and Germany

Source: The AI Index 2018 Annual Report(2018)

Companies represent 26 of the top 30 patent applicants. Most of these are conglomerates active in consumer electronics, telecommunications and/or software, as well as sectors such as electric power and automobile manufacturing.

Note: Fujitsu includes PFU; Panasonic includes Sanyo; Alphabet includes Google, Deepmind Technologies, Waymo and X Development; Toyota includes Denso; and Nokia includes Alcatel

WIPO(2019): Tech Trends 2019, AI

Geographical origin of universities and public research organizations in the top 500 patent applicants, by number of organizations
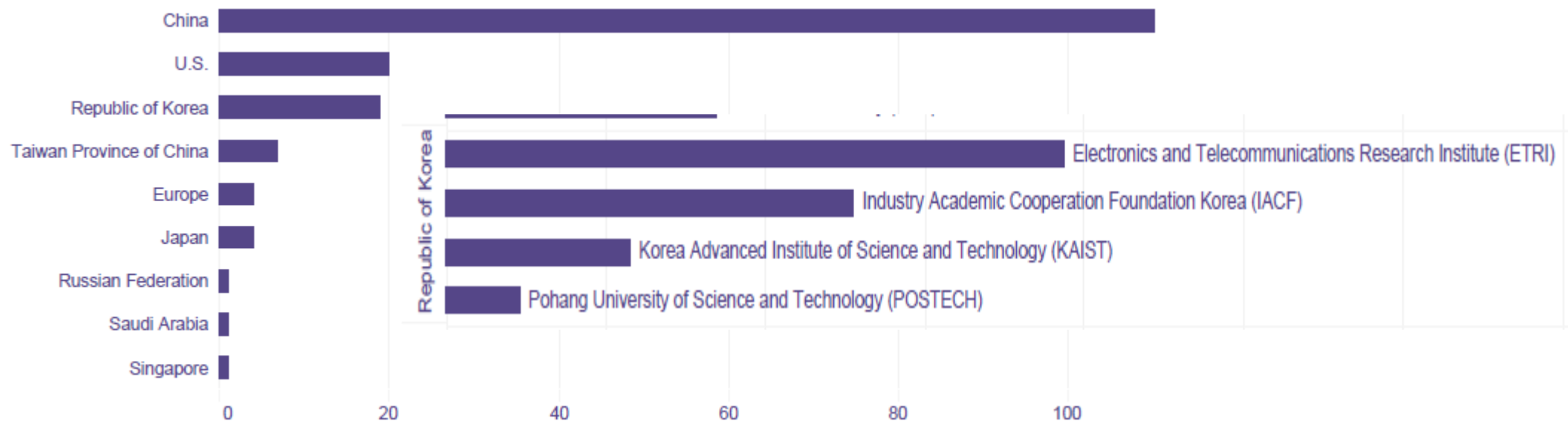
- Out of the top 20 universities and public research organizations in the AI field, the vast majority (17) are in China and the remaining three in the Republic of Korea (ETRI, KAIST, and POSTECH). Outside of China and the Republic of Korea, there are no universities or public research organizations with more than 500 patent families.

WIPO(2019): Tech Trends 2019, AI

News Media

Fintech and Insurance

Robotics

IOT and automobile

2018 "A.I. 100," a list of the most promising A.I. startups globally

www.cbinsights.com

Nation	Company	Sector	FUNDING ($ Mil.)
Canada(4)	Element AI, Kindred Systems, Sportlogiq	ENTERPRISE AI, ROBOTICS, SPORTS	152
China(7)	Bytedance, Cambricon, Face++, Liulishuo, Mobvoi, SenseTime, BTECH Robotics,	NEWS & MEDIA, HARDWARE FOR AI, EDUCATION, ROBOTICS	5,325
France(1)	Shift Technology	CYBERSECURITY	39
Israel(4)	OrCam Technologies, Prospera, Twiggle, Workey,	IOT, AGRICULTURE, COMMERCE, HR TECH,	113
Japan(2)	LeapMind, Preferred Networks	ENTERPRISE AI. IOT	126
Spain(1)	Sher.pa	PERSONAL ASSISTA	8
Taiwan(1)	Appier	COMMERCE	81
UK(4)	babylon, Darktrace, Onfido,Tractable,	HEALTHCARE, CYBERSECURITY, RISK & REGULATORY COMPLIANCE,	336
US(76)	AEYE....	AUTO TECH...	6558

China's Bytedance leads in funding with $3.1 billion, but 76 of the 100 startups are U.S.-based.

www.cbinsights.com

2019 AI 100: Startups outside the United States

Graphcore, Onfido, Medopad, Behavox,
Eigen Technologies, Prowler.io

TwentyBN   Mapillary

Element AI

SenseTime
Face++
YITU Technology
4Paradigm
Horizon Robotics
Momenta

Habana Labs, BioCatch, Nexar,
Taranis, Anodot, LawGeex

Niramai

Abeja
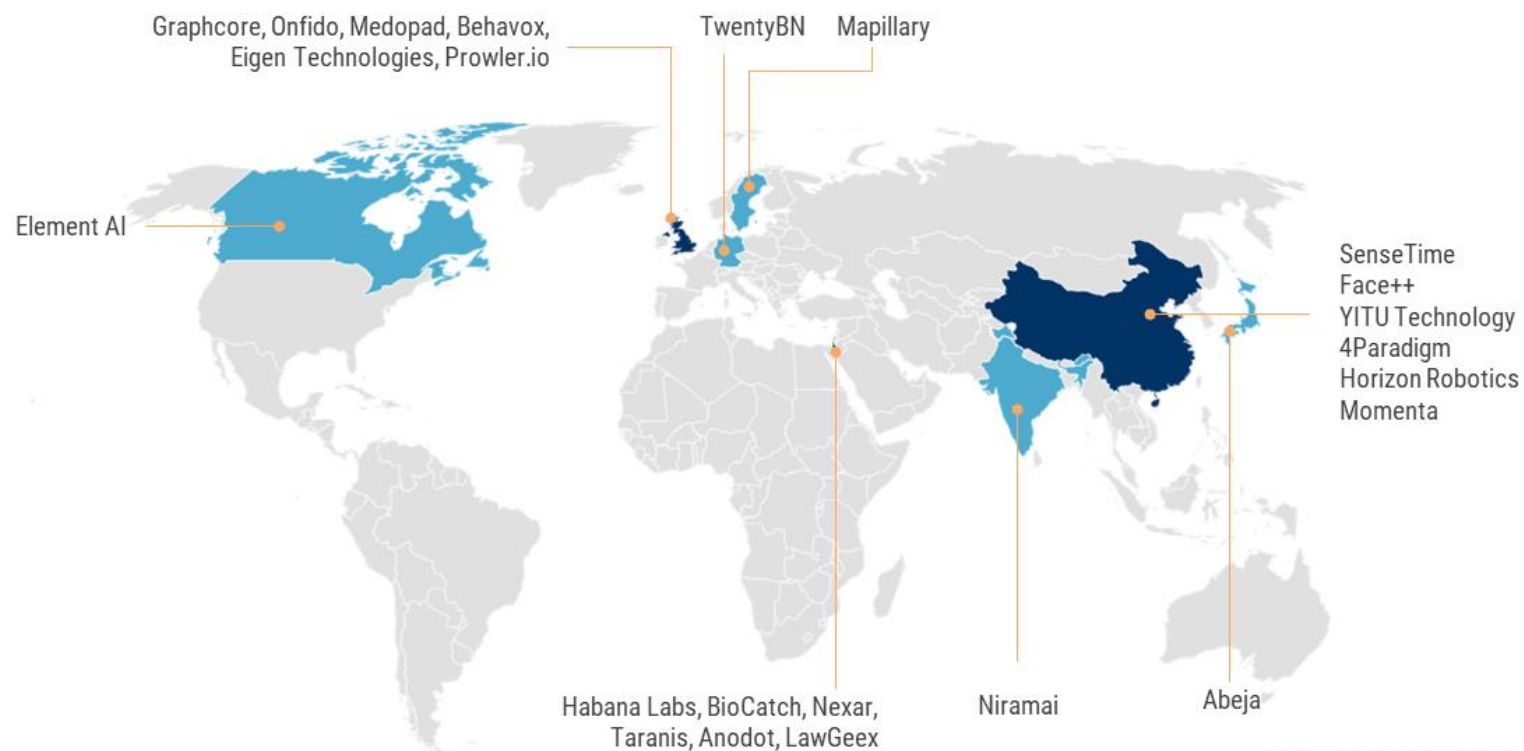
Source: cbinsights.com

CBINSIGHTS

www.cbinsights.com

Lee Sedol (李世乭)

Masayoshi Son (孫正義)

NAEK The National Academy of Engineering of Korea (2019)

❶ downturn of MFG competitiveness with 5 years

❷ 3 strategic sectors

❸ Sustaining(eg. Semi), new growth(eg bio, batteries, 5G), convergence basic tech(CBT)

❹ CBT: General purpose: AI platform, SW, Smart factory

Korean professional Go player of 9 dan rank and Google Deepmind Challenge match(2013.03)

Two days later the country announced it would invest ₩1 trillion (US$863 million) in AI research over the next five years.

•Masayoshi Son founded and runs SoftBank, a mobile telecom and investment firm with $81 billion in 2017 revenue.

•Softbank invested $35 billion across 100 deals in 2017, including making investments in office rental firm WeWork and ride hailing company Uber.

NEWS MOON TO MEET KOREAN-JAPANESE CEO (2019)

III. Korea's response to AI

AI policies

❶ Exobrain project (2013-2023), 330 manpower and equivalent to IBM Watson

❷ Development strategy for Intelligent Information(II) industry(2016.03)

1)R&D: Flagship project, Supercomputer, Neuroscience
2)Human resource, 3)Data infrastructure

❸ AI Research Institute Est and Mid-Long term master plan II Society (2016.12)

❹ I-Korea 4.0(2017)

4TH INDUSTRIAL REVOLUTION COMMITTEE (2017)

PRESIDENTIAL COMMITTEE ON THE FOURTH INDUSTRIAL REVOLUTION

❺ AI R&D capability enhancement plan (US$2 billion inv. by 2022)(2018)

❻ 5 Year plan for Data, AI economy revitalization(2019)

P Plan
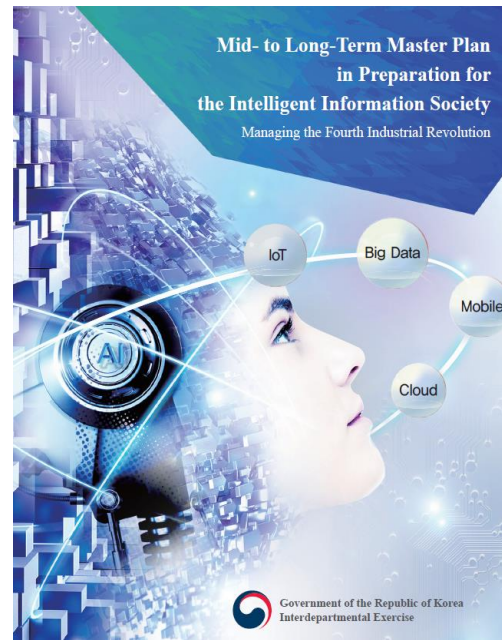
Ministry of Science and ICT

Mid- to Long-Term Master Plan in Preparation for the Intelligent Information Society
Managing the Fourth Industrial Revolution

IoT Big Data Mobile Cloud

Government of the Republic of Korea
Interdepartmental Exercise

People-Centered "Plan for the Fourth Industrial Revolution" to Promote Innovative Growth
I-KOREA 4.0

The Government of the Republic of Korea   PRESIDENTIAL COMMITTEE ON THE FOURTH INDUSTRIAL REVOLUTION

– 혁신성장 전략투자 –
데이터 · AI경제 활성화 계획
['19~'23년]

2019. 1. 16.

관계부처 합동

< Analysis of Government's Role in Strategic Policy Tasks and their Urgency >

Strong

Government's role

Weak

Urgency

Weak → Strong

10 Strengthen the social security net in response to the rise of the intelligent information society

9 Proactively manage automation and the diversification of employment types

4 Proactively apply Intelligent IT to public services

8 Achieve innovation in education for the future

5 Become a partner in private-sector innovation

1 Generate value from data, the source of future competitiveness

11 Reform laws and ethics to ensure harmonious human-machine coexistence

3 Establish a super-connected networking environment centered on data and services

2 Achieve competitiveness in Intelligent IT

12 Counter downsides (e.g., cyber threats and AI failures)

6 Generate new value through intelligent healthcare services

7 Ensure the digital innovation of manufacturing

Technology   Industries   Society

2. South Korea's current status: A SWOT analysis

Strengths	Weaknesses
• Topnotch ICT infrastructure	• Reluctance to invest in startups with innovative technologies or potential for M&A deals
• Tech-savvy people	• Lack of entrepreneurial spirit and will to rise to challenges and take risks
• Aggressive government investment in R&D	• Lack of quality data infrastructure
• World-class manufacturing infrastructure	• Monolithic education and hiring-centered employment policy
• Zeal for education	• Rigid, vertical regulatory system
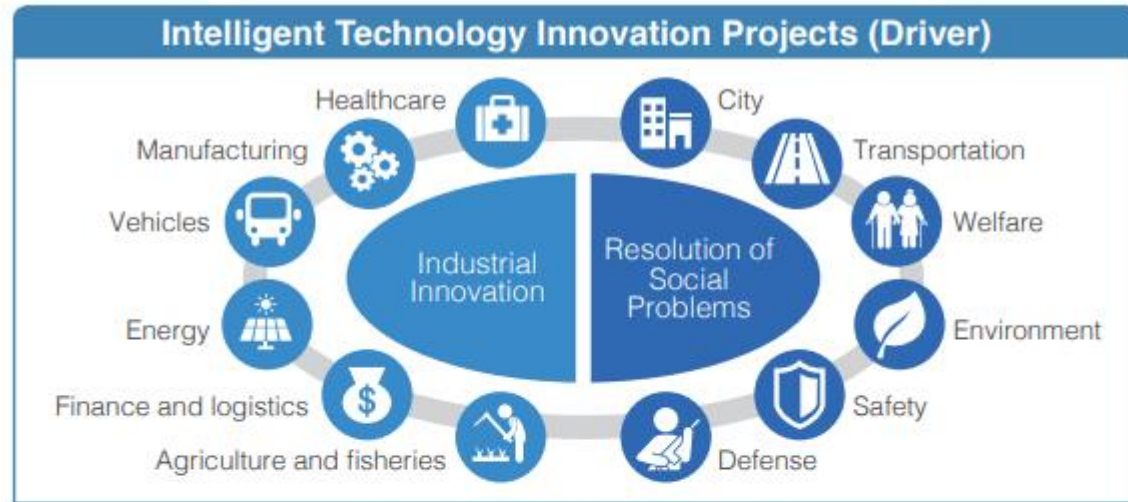
Create a virtuous cycle by
1. Using basic technologies (industrial mathematics, neuroscience, nanotechnology, material science, etc.) to advance intelligent technologies (AI, computing, data, etc.)
2. Expand convergence based on accumulated technological capacity.

Intelligent Technology Innovation Projects (Driver)

Healthcare   City
Manufacturing   Transportation
Vehicles   Welfare

Industrial Innovation   Resolution of Social Problems

Energy   Environment
Finance and logistics   Safety
Agriculture and fisheries   Defense

Secure Growth Engine Technologies
- Secure competitiveness in intelligent technology
- Foster innovative growth engines
- R&D Improve R&D system

Create Industrial Infrastructure and Ecosystem
- Create a hyper-connected intelligent technology network
- Strengthen basis for data creation and sharing
- Improve new industry regulations
- Transform SMEs and venture-backed companies/regional hubs into growth engines

Make Preparations for Future Social Changes
- Support the development of key personnel
- Innovate educational system in preparation for future social changes
- Expand the employment security net
- Strengthen measures for addressing adverse cyber effects and cyber ethical issues

AI policies

❻ 5 Year plan for Data, AI economy revitalization(2019)

Big data and artificial intelligence (AI)

❶ 100 big data centers, 10 big data platforms, comprehensive AI hub

❷ Develop 10 AI-based unicorn companies with 10,000 employees working in both fields

❸ By 2030, it intends to build 2,000 AI-based factories

data value chain	global ecosystem	convergence between AI and Data
Openness, quality, my data	AI hub, tech inv (semicon. and quantum computing),	cluster, AI X flagship project, AI graduate school, regulations

AI patent examination bureau(2019)

KIPO
KOREAN INTELLECTUAL PROPERTY OFFICE

Exobrain(2013-2023) Project: national R&D project for artificial intelligence (AI), with an aim of developing AI technology in the language-processing field

❶ Development of language intelligence SW

❷ Development of knowledge learning and accumulation technologies
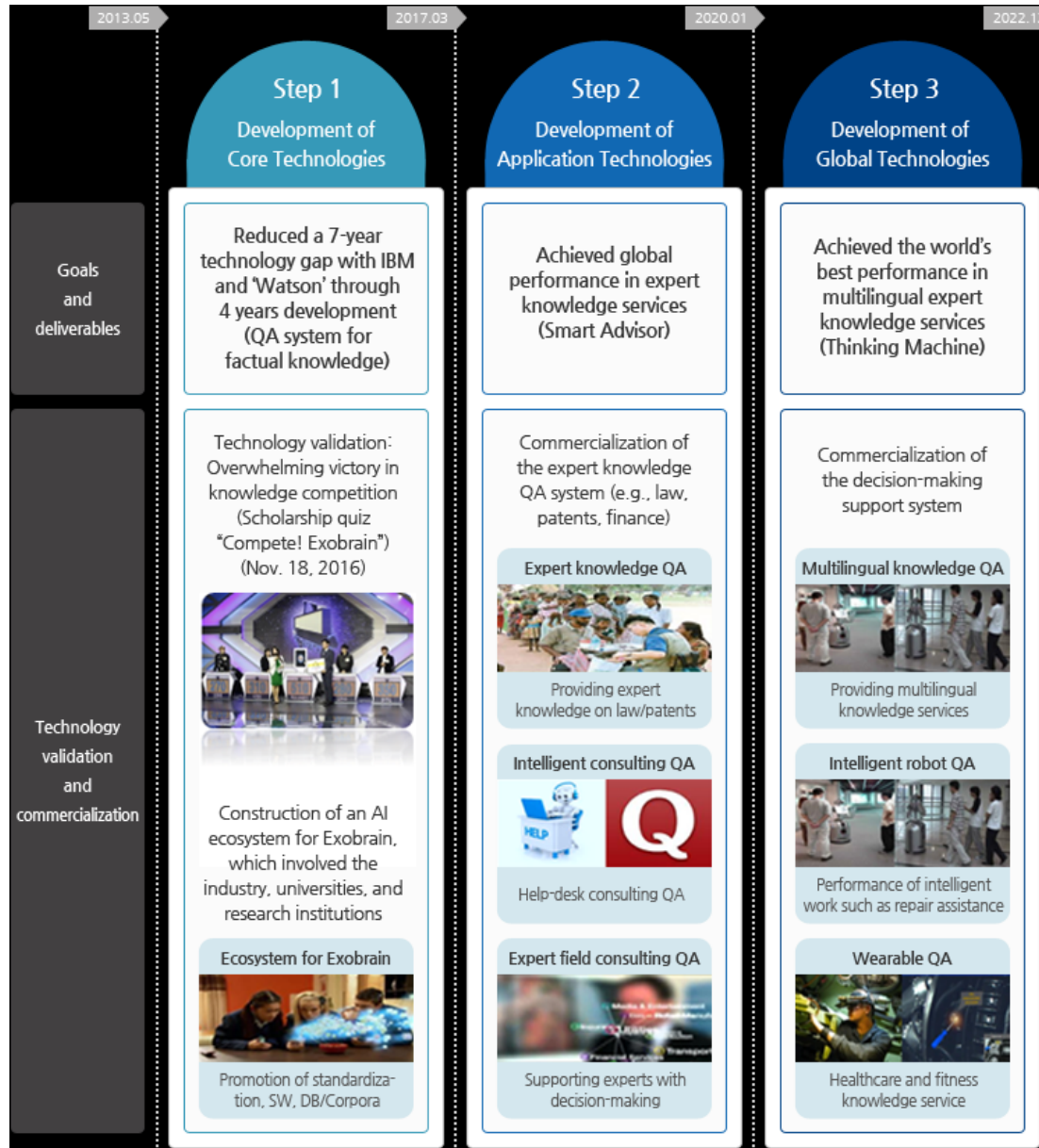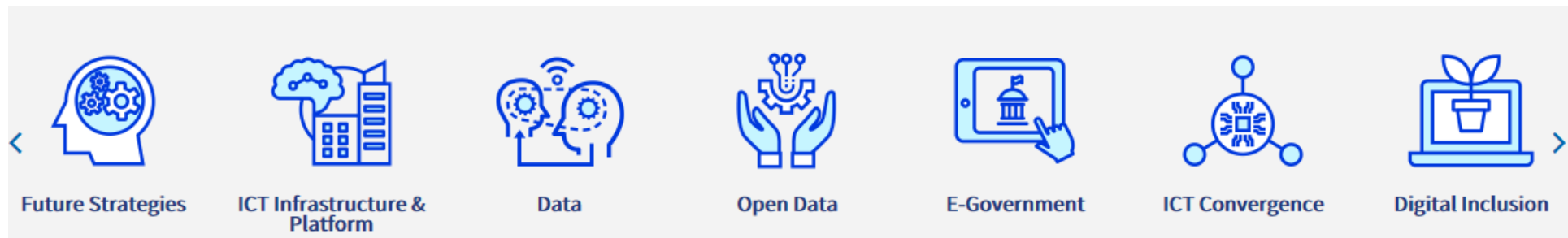
❸ Development of deep question answering technologies;

(2019-, Kim M-J)

Dream Team

450/1800 focus on AI

National Intelligence Research leader

KBERT(Korea Bidirectional Encoder Representations from Transformers) development in 2019

2013.05	2017.03	2020.01	2022.12

Step 1 — Development of Core Technologies

Step 2 — Development of Application Technologies

Step 3 — Development of Global Technologies

Goals and deliverables

Step 1: Reduced a 7-year technology gap with IBM and 'Watson' through 4 years development (QA system for factual knowledge)

Step 2: Achieved global performance in expert knowledge services (Smart Advisor)

Step 3: Achieved the world's best performance in multilingual expert knowledge services (Thinking Machine)

Technology validation and commercialization

Step 1: Technology validation: Overwhelming victory in knowledge competition (Scholarship quiz "Compete! Exobrain") (Nov. 18, 2016)

Step 2: Commercialization of the expert knowledge QA system (e.g., law, patents, finance)

Step 3: Commercialization of the decision-making support system

Step 1: Construction of an AI ecosystem for Exobrain, which involved the industry, universities, and research institutions

Ecosystem for Exobrain
Promotion of standardization, SW, DB/Corpora

Step 2:
Expert knowledge QA — Providing expert knowledge on law/patents
Intelligent consulting QA — Help-desk consulting QA
Expert field consulting QA — Supporting experts with decision-making

Step 3:
Multilingual knowledge QA — Providing multilingual knowledge services
Intelligent robot QA — Performance of intelligent work such as repair assistance
Wearable QA — Healthcare and fitness knowledge service

Public research institute

NIA NATIONAL INFORMATION SOCIETY AGENCY

| Future Strategies | ICT Infrastructure & Platform | Data | Open Data | E-Government | ICT Convergence | Digital Inclusion |

OECD(2019): Council Recommendation on Artificial Intelligence

2019.03 KOREA-OECD AI conference

1)Follow-up OECD and national level development required

2)Long and short term counter measure for labor replacement

3) Flexible means of policy aimed at promoting innovation and user benefits

Principles for responsible stewardship of trustworthy AI

1.1. Inclusive growth, sustainable development and well-being

1.2. Human-centred values and fairness

1.3. Transparency and explainability

1.4. Robustness, security and safety

1.5. Accountability

**National policies and international cooperation for trustworthy AI**

2.1. Investing in AI research and development

2.2. Fostering a digital ecosystem for AI

2.3. Providing an enabling policy environment for AI

2.4. Building human capacity and preparing for labourtransition

2.5. International cooperation

Firm's response

SAMSUNG
INTELLIGENCE BECOMES A UTILITY

1)M&A: Whisk(2019, food platform), Fluenty(2018, language), VIV Labs(2017, AI Platform)

2)Set up AI Lab(Montreal. 2017)

3)Strategy: AI semiconductor(NPU, Neural Processing Unit) and System on chip, own platform(bixby)

4) Human resource on AI(2,000) by 2030

NAVER CLOUD PLATFORM
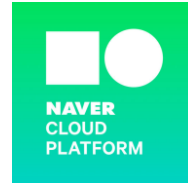
1)D2 Start-up factory: Furiosa AI, Deepixel, CrowdWorks

2)M&A: Naver Labs Europe(former Xerox)

3) Strategy: Ambient Intelligence

SK telecom

1)SNU, Hanyang Univ-SKT AI curriculum

2)Microsoft-SKT(2019), Deutsche Telekom-SKT(2019) collaborations

3)Strategy: 5G

Is South Korea(latecomer) Poised To Be A Leader In AI?

MISSION: IMPOSSIBLE

KORANDO C LET 2.2
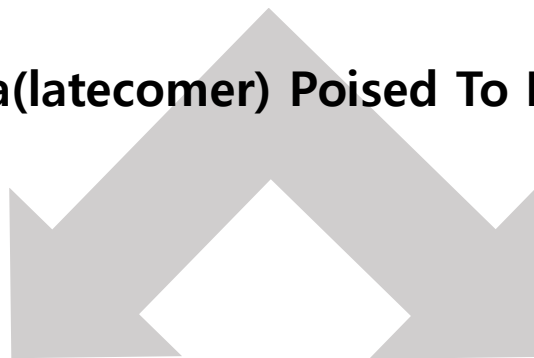
Successful catch-up

Joining the ICT paradigm and bandwagon

Deployment of Internet and mobile

Large number of IT firms

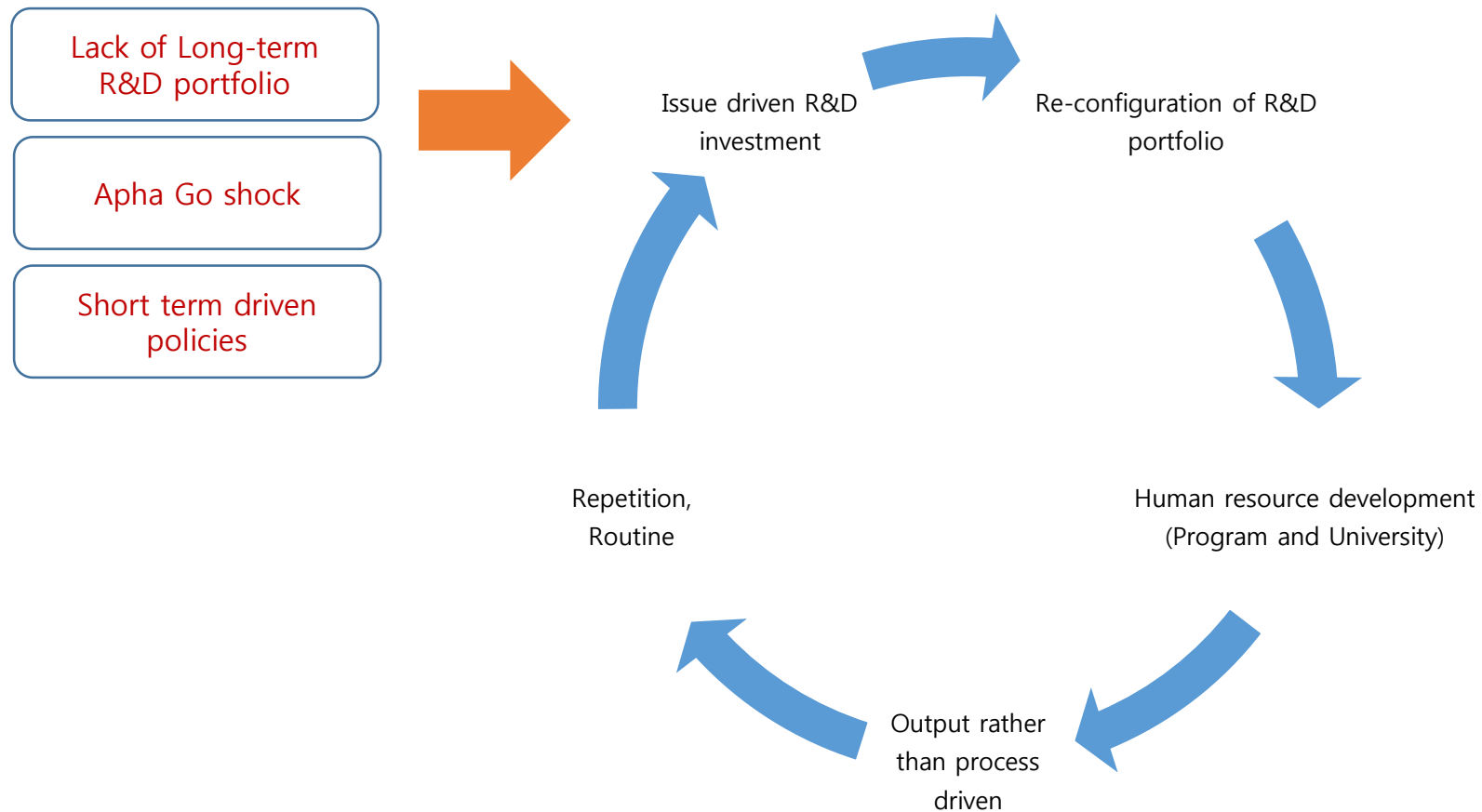HW/SW → Infra/Data → Short term/ Long term investment → Capabilities/non capabilities

IV. Discussion: cycle

Lack of Long-term R&D portfolio

Apha Go shock

Short term driven policies

Issue driven R&D investment

Re-configuration of R&D portfolio

Human resource development (Program and University)

Output rather than process driven

Repetition, Routine

Projected shortage of Human resources: 10,000 SW engineers and 7,000 Postgraduates

JP strategy : Yearly 250,000 AI expert , AI program

AI Manpower	
USA	28,000
China	18,000
India	1,7000
Germany	9.400
France	6,300
Japan	3,100
Korea	2,600

Source:KOTRA

Quantum Computing

Innovation theory perspective:
-SW core competence, Fujimoto hypothesis, ASIC vs DRAM
-Divergence and widening the gap for latecomers?
-No more flying geese model?

-Strategic options
1)China like strategy: Technology race with captive/global market but data openness and reliability is essential
2)Local strategy(modular architectural innovation)
3)Joining the IBM-Google-Amazon driven global value chain(black hole)

Infrastructure perspective:
-Investment on R&D, SW and AI human capital(Architect), Openness

Policy design
-Issue driven vs long term driven, 6th techno-economic paradigm
-Role for public research institutes?

Directions
-Consideration of selective strategy with affinity
-Non-technological capabilities (institutional and regulatory innovations)
-Give up AI? and bandwagon for bio?