Software Oriented Society

2015. 6. 19.

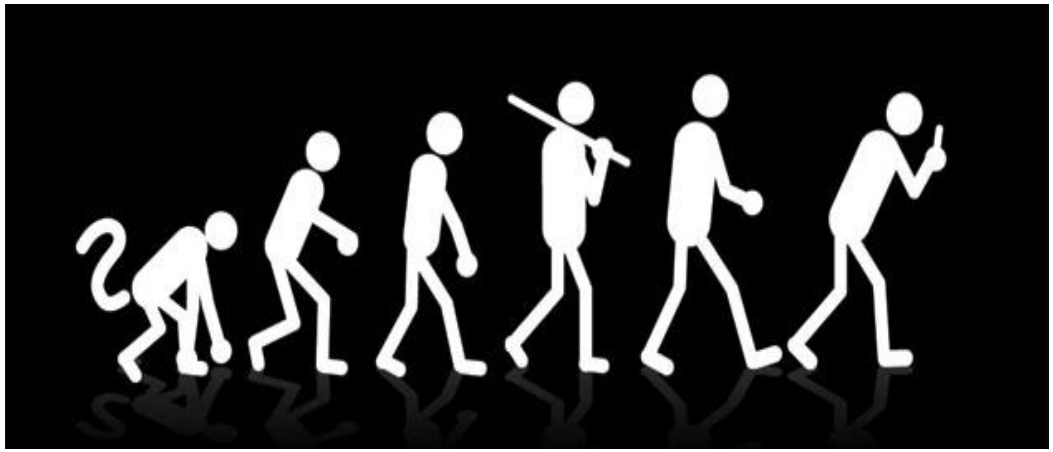
SEOK WON KIM
Software Policy & Research Institute

SPRi Software Policy & Research Institute

Software is important

Software is different

Smartphone:



http://onehumanjourney.blogspot.kr/2013/10/smartphone-addicts-anonymous.html
http://ibnlive.in.com/news/a-smartphone-app-to-help-you-cure-your-smartphone-addiction/483062-11.html,

Monumental change in civilization history

The smartphone has changed our lives.

88%
communication

86%
stay informed

95%
entertainment

http://think.withgoogle.com/mobileplanet/en/

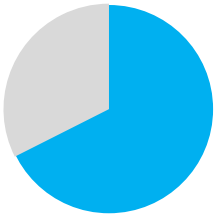
7 billion mobile phone subscribers
2 billion smartphone subscribers
40 apps per smartphone

Ericson Mobility Report, 2013; Nielsen Report, 2012

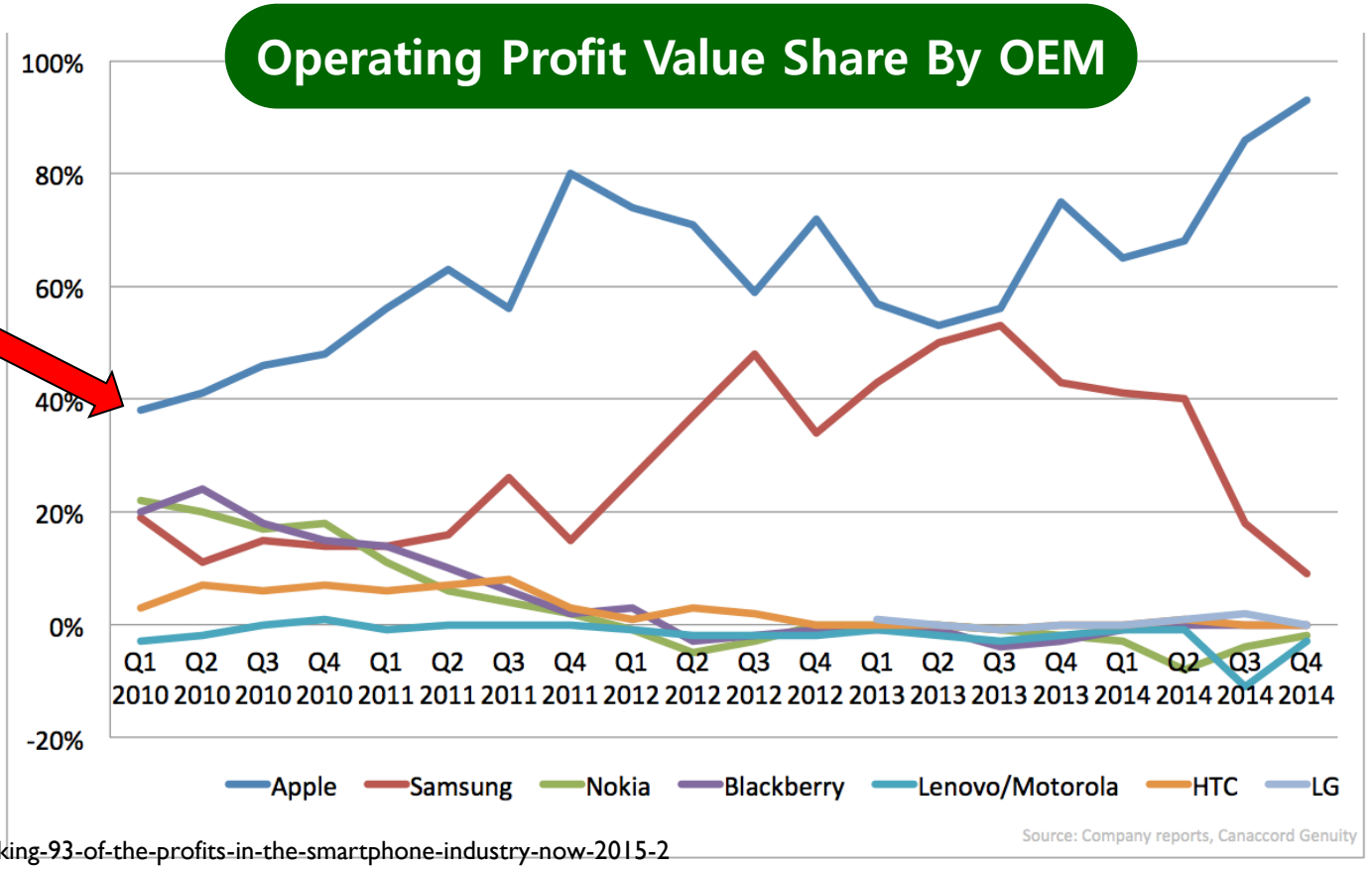
Apple drove smartphone revolution

15% units

- $18 billion profits in smartphone industry (2014/4Q)
- 93% of the profits went to Apple



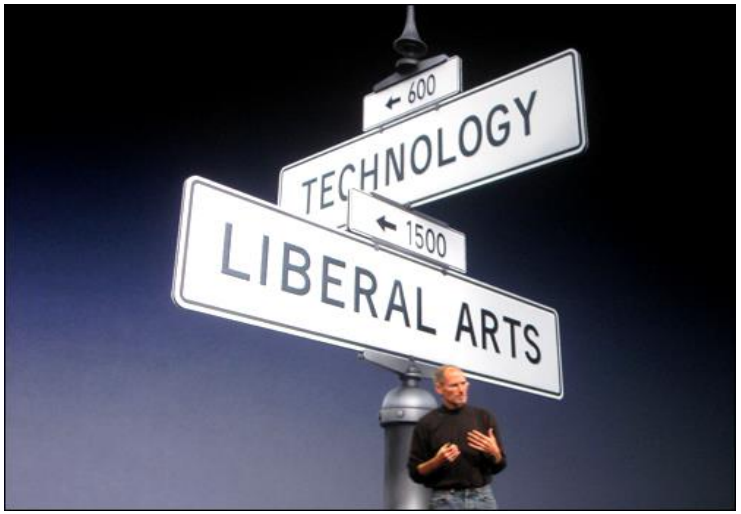
93% profits



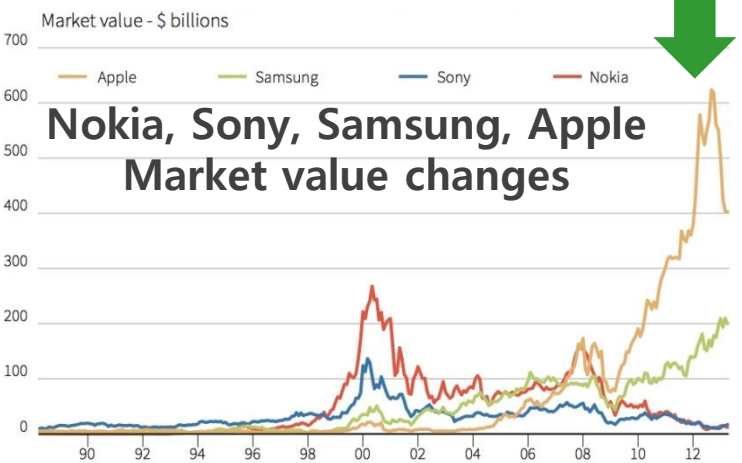
http://www.businessinsider.com/apple-is-taking-93-of-the-profits-in-the-smartphone-industry-now-2015-2

Apple's success factors

- "Mobile phone is a computer"
  - software to control a variety of sensors
  - computer maker with software expertise
- Ecosystem to provide software
  - Leverage external developers through Appstore
  - Supply a large amount of contents
    - Music, videos, apps, online courses



Apple – highest market value



11 SEP 2012 Thomson Reuters
http://blog.thomsonreuters.com/index.php/tag/apple/page/7/

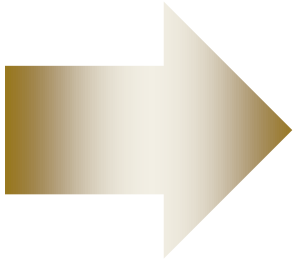
Software revolution

"Software is eating the world"

소프트웨어가 세상을 먹어 치우고 있다

By Marc Andressen, Wall Street Journal, Essay, 2011.8.20

Dominating the market
by Changing the rules of game and
disrupting the existing market order
utilizing Software



Software Revolution

"All companies are now software companies"

이제 모든 기업이 SW기업이다.

Newsweek, The Top Tech Trends for 2015, 2015.1.3

Experiencing rapid changes in economy, society, etc. by SW

Software is Eating the World

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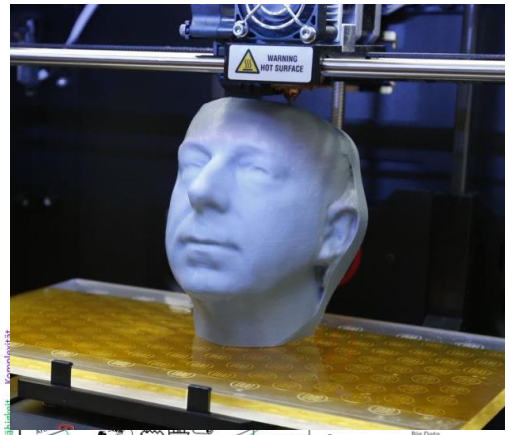
Software Policy & Research Institute



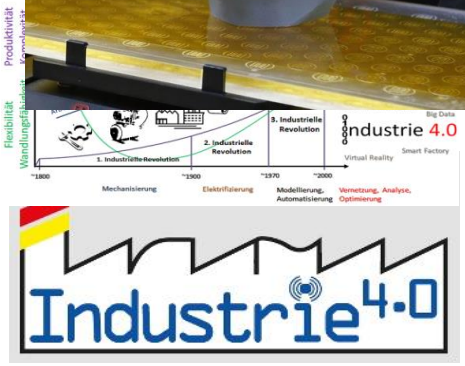
coursera

edX

OPEN EDUCATION
free education for all

UDACITY

Massive Open Online Course



bitcoin
ACCEPTED HERE

Can an Algorithm Write a Better News Story Than a Human Reporter?

Google image search

Automobiles are now run by SW

CEO Diester Zetsche

Hyundai commercial

Mechanical Engineering?

Electronics
+ Chemistry
+ IT
+ New material
= automobiles

Disruptive technologies will give companies a chance to leapfrog existing automotive leaders whose competence lies in established ones

Open Automotive Alliance

Audi, Google, HYUNDAI MOTOR GROUP, GM, HONDA The Power of Dreams, NVIDIA

Source: P Gao, R Hensley, A Zielke, "A Road Map to the future for the auto industry", McKensey Quarterly, Oct. 2014.

Software Revolution: Movie Industry

SPRi Software Policy & Research Institute

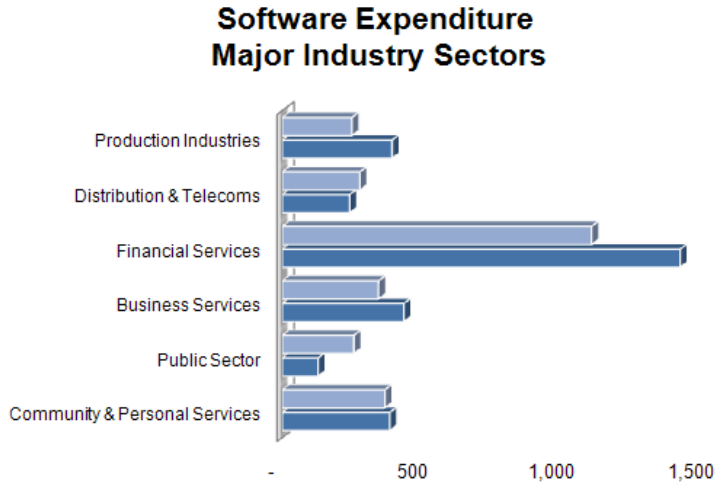
- Computer graphics prevalence
- 36,000 Linux computers used for Avatar

[images from google search]

Software revolution: Financial biz

- **SW industry masquerading as financial industry – Watts S. Humphrey**
  - **Cannot run banks without SW**
- **IT companies into financial industry**
  - **Capture new service of customer interaction**
  - **Take 1/3 of profits**
- **Korea, late in Fintech**

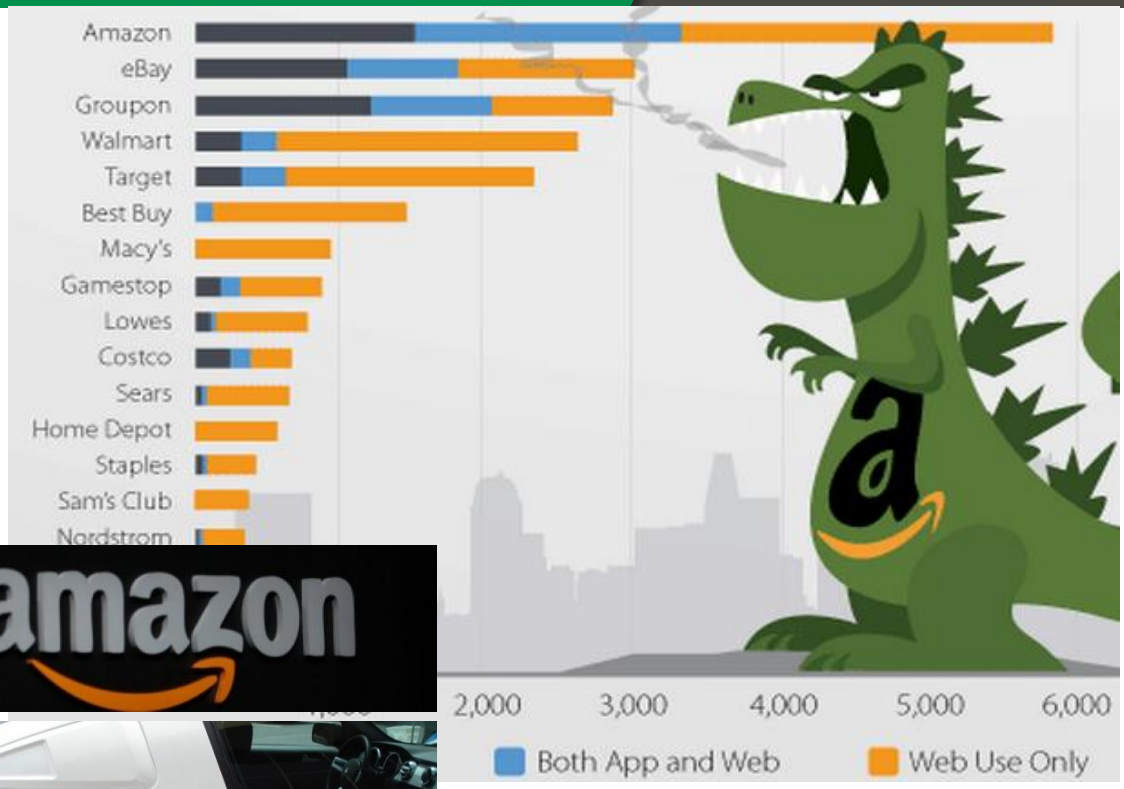
Financial market development 80th in 2014



[source : http://www.venturesquare.net/535012 , Harvard Business Review "Banks' New Competitors: Starbucks, Google and Alibaba]

Electronic commerce & distribution

SPRi Software Policy & Research Institute



글로벌공룡 아마존, 한국사업 확대 움직임

실무인력 확보 나서… 기업용 IT서비스 넘어 유통 진출할지 주목

이형근 기자 bass007@dt.co.kr | 입력: 2014-03-26 20:57

[2014년 03월 27일자 8면 기사]

알리바바, 한국 상륙하는 날 무슨일이…

매경닷컴 기사입력 2015.01.28 18:01| 최종수정 2015.01.28 20:06

Alibaba.com 阿里巴巴

Images from Google search

Shopping

Barcode scan
or voice to order

Predictive shipping

Order with QR code

ebay

Connected Glass. eBay

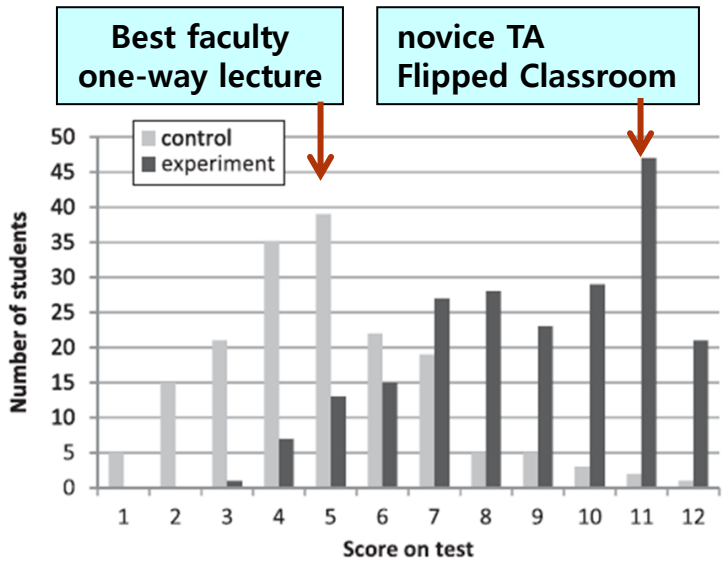
http://www.fool.com/investing/general/2013/12/20/ebays-popup-up-profit-plan.aspx

http://www.wealthinformatics.com/2012/02/01/do-you-think-this-is-possible/

source : google search , https://www.computerhartware.de/thread-vorausschauenden_versand_patentiert.html

Massive Open Online Course

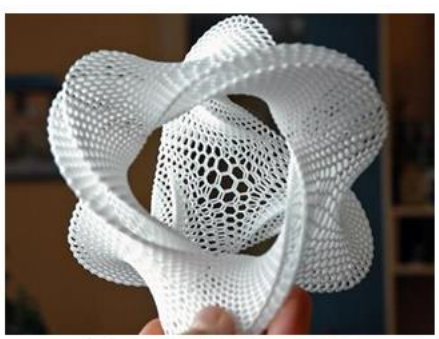
- College level lecture from about 50 providers including Coursera, edX, Udacity
  - Video lecture
  - group collaboration, assignments, exams
  - earn credit by machine grading and peer review
  - certificates and job match services
- Global, concurrent access
- Flipped learning
  - watch lectures online at home and work on projects in class
- K-MOOC launch
  - Starts off with college classes for lifelong education
  - Looks to flipped learning and/or more opportunities for learning
- *Higher education in 50 years will be provided by no more than 10 institutions worldwide.* – Sebastian Thrun, founder of Udacity



Effect of flipped learning

http://blogs.stern.nyu.edu/learnED/?p=227,

3D Printing + 3D Scanner



무한 상상의 場

the pricing of heads starts at US$5,875

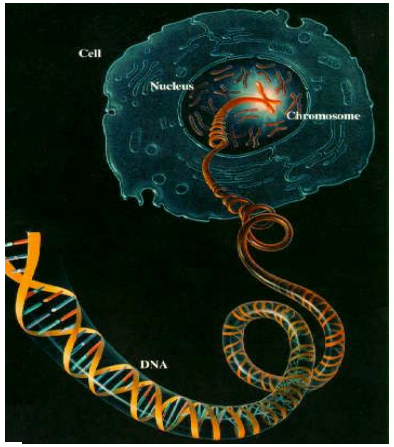
3D model sales → Order → Printing → Payment → Delivery

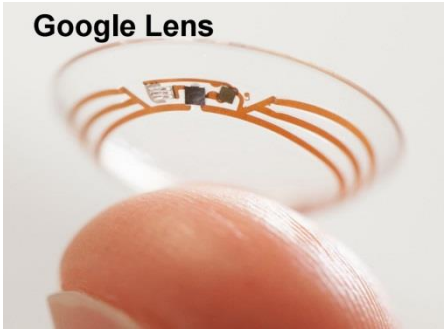
Innovation of manufacturing supply chain

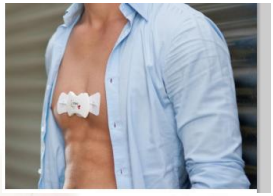
Healthcare + IT

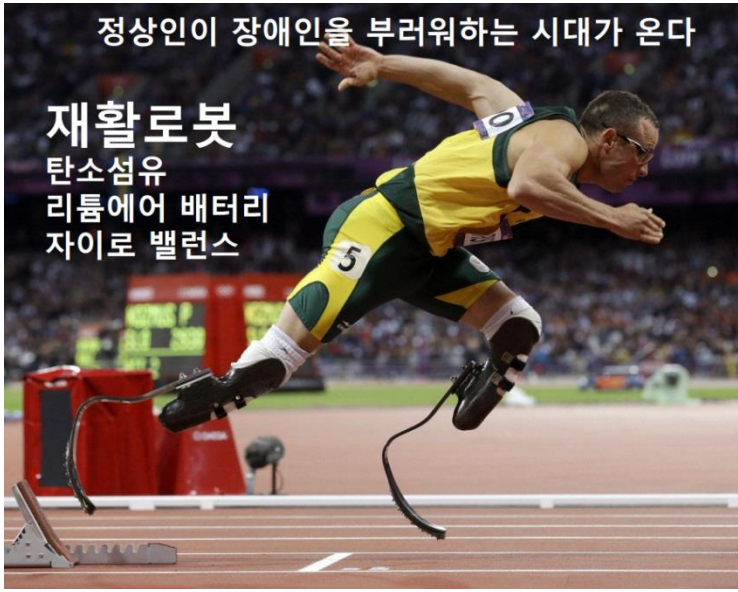
SPRi Software Policy & Research Institute

- **Personalized medicine based on DNA analysis**
  - **Patient's DNA sequence analysis and personalized medicine**
    - Use software algorithm to mix and match a lot of known genome sequences
  - **Personal genome analysis service market**
    - First it took 13 years and $4 billion
    - Now 23andMe : $99









http://www.kumc.edu/school-of-medicine/psychiatry-and-behavioral-sciences/research.html

News articles written by algorithm

- **Robot reported L.A. earthquake first**

  "A shallow magnitude 4.7 earthquake was reported Monday morning five miles from Westwood, California, according to the U.S. Geological Survey. The temblor occurred at 6:25 a.m. Pacific time at a depth of 5.0 miles. ..."

- **Sports news articles sent in almost real-time**
  - **template based, parameter adjustment**
  - **expands to earnings report, restaurant evaluation**
  - **template is made by experienced reporter**

Illustration: Mark Allen Miller

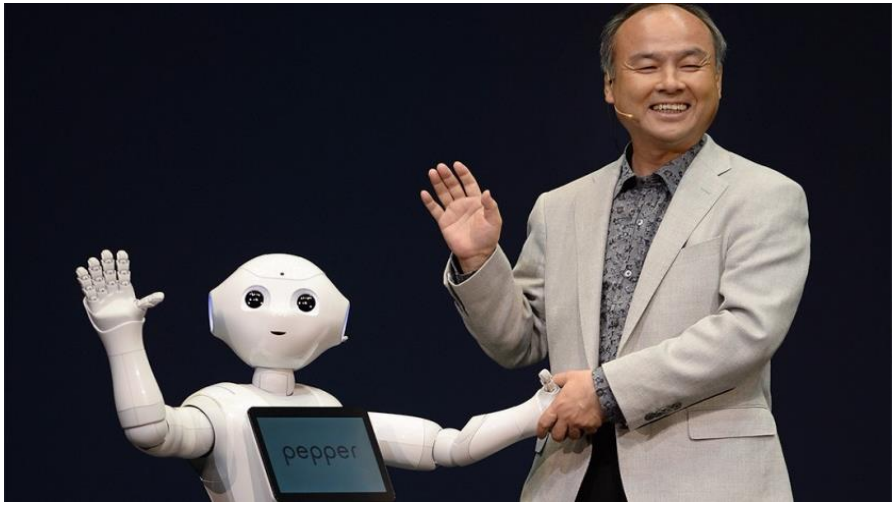
- **More than 90 percent of news would be written by computers in 15 years**
  - **K, Hammond, CTO, Narrative Science**

http://www.wired.com/2012/04/can-an-algorithm-write-a-better-news-story-than-a-human-reporter/, http://www.nytimes.com/interactive/2015/03/08/opinion/sunday/algorithm-human-quiz.html

Amazing Artificial Intelligence

Watson wins Jeopardy (2011)
http://en.wikipedia.org/wiki/Watson_(computer)

Unsupervised Deep Learning (2012)
http://static.googleusercontent.com/media/research.google.com/ko//archive/unsupervised_icml2012.pdf



Japanese AI To-Robo on Tokyo Univ. entrance exams

Torobo-kun scored 386 out of 900 points in the common exam for university hopefuls, which included sections on English, Japanese, mathematics, history and physics.
It(He?) has a probability of at least 80 percent of passing the exams of 80 percent of 581 private universities across Japan.**(2014.11.03)**

http://ajw.asahi.com/article/sci_tech/technology/AJ201411030042

Pepper : Emotional robot (2014.6) http://www.thewire.com/technology/2014/06/pepper-the-robot-knows-your-feelings-probably-wont-kill-you-in-your-sleep/372262/

Computational X

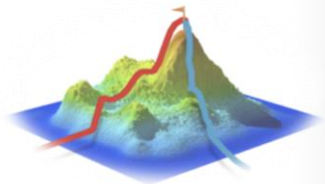
- Computational Biology
- Computational Chemistry
- Computational Physics
- Computational Mathematics
- Computational Geometry
- Computational Logic
- Computational Statistics
- Computational Engineering
- Computational Electronics
- Computational Mechanics
- Computational NeuroScience
- Computational Material Science
- Computational Toxicology
- Computational Cosmology
- Computational Cognitive Science
- Computational Sociology
- Computational Linguistics
- Computational Economics
- Computational Medicine
- Computational Journalism
- Computational Culture
- Computational Sustainability
- Computational Legal Studies
- Computational Intractability
- Computational Learning Systems
- Computational Metaphysics
- Computational Crystallography
- Computational Thinking
- Computational Creativity
- Computational Photography
- …

What SW can do

Data collection and processing

Automation

Optimization



Flexibility

Context awareness

Scientific decision making

Knowledge discovery

Easy-to-use machine

http://offers.hubspot.com/the-science-of-marketing-automation, http://www.freepik.com]

What brings software revolution?

Computing Power

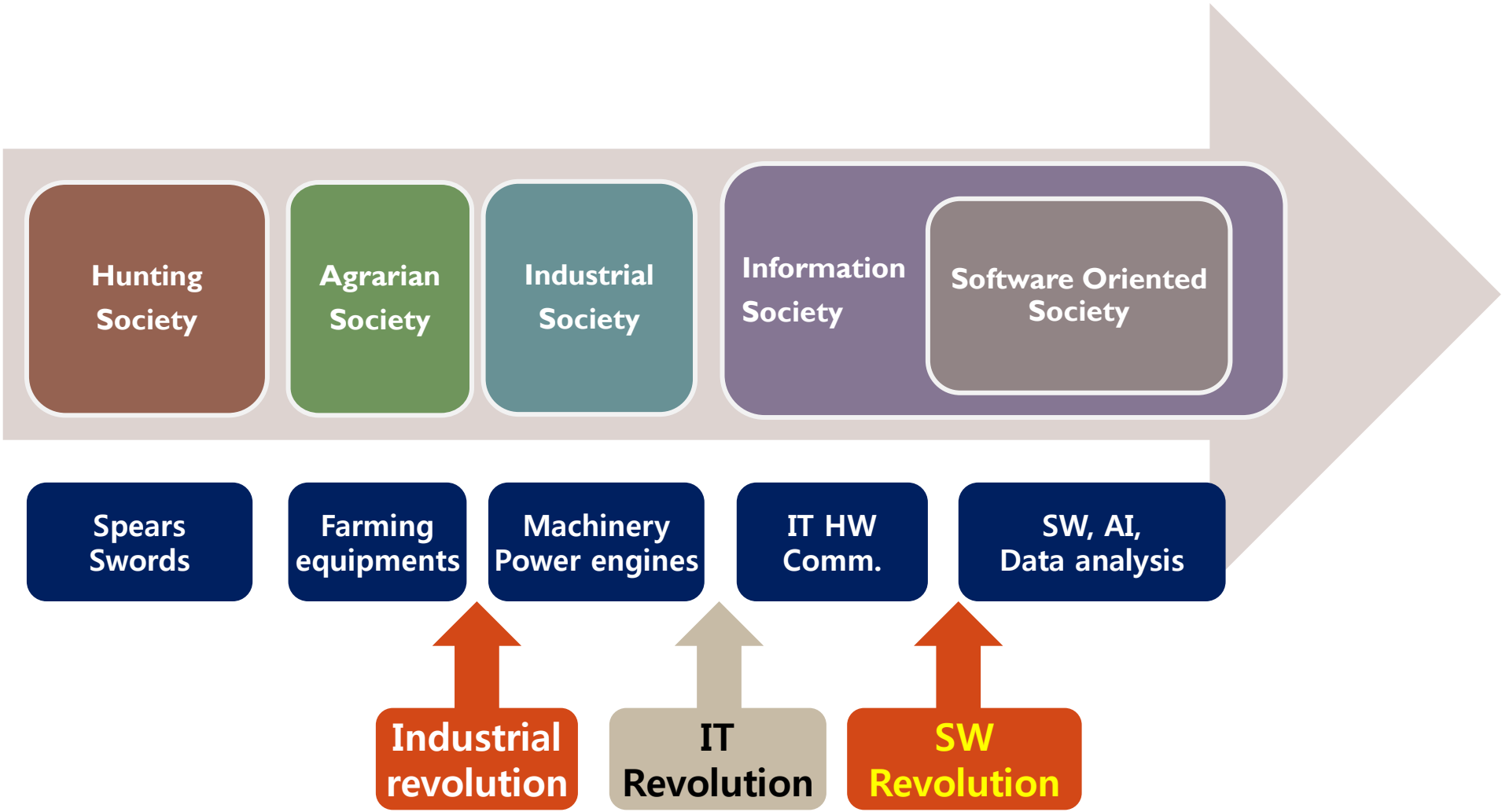
High-speed Network

SW Technology

The best General Purpose Technology of human history

General purpose technology: Technology that is driving force of social and economic changes by accelerating technical innovation and economic growth such as steam engine and electricity – The Second Machine Age, E. Brynjolfsson and A. McAfee

Advent of Software Oriented Society



Software Oriented Society

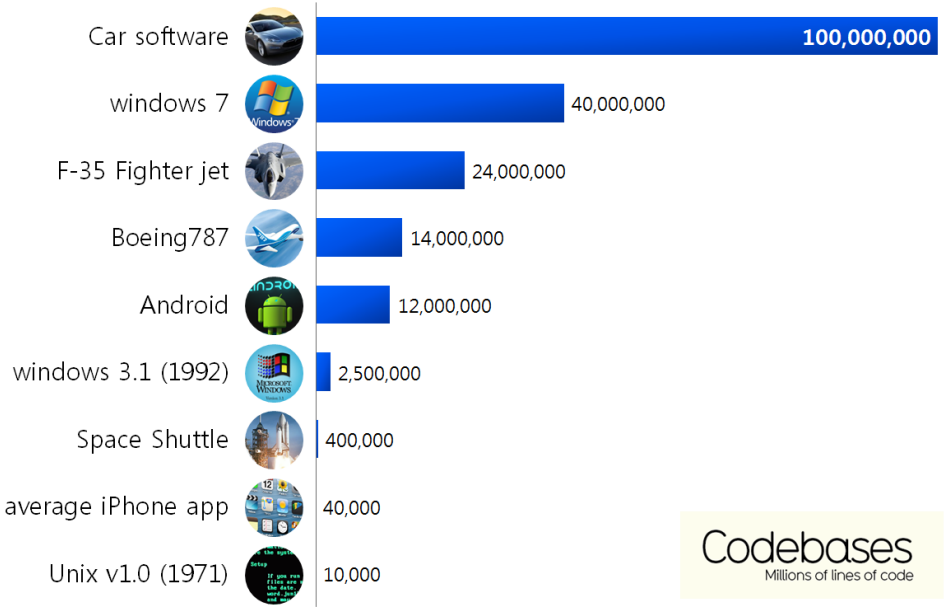
Quality of our life is improved by
extensive **use of SW**

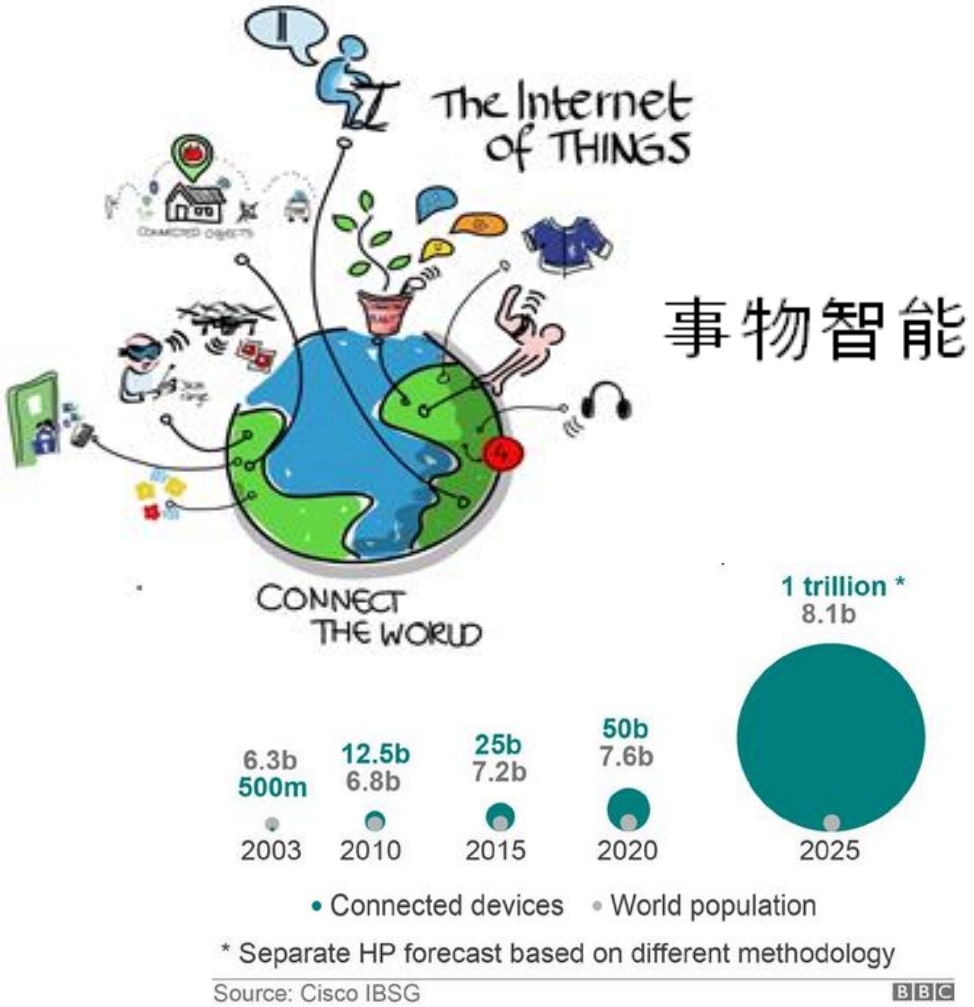
Software becomes
the major **tool for competitiveness**
of individuals, enterprises, and nations

SW is Everywhere in SOS

- **Embedded, Mobile, Wearable, Internet of Things, …**

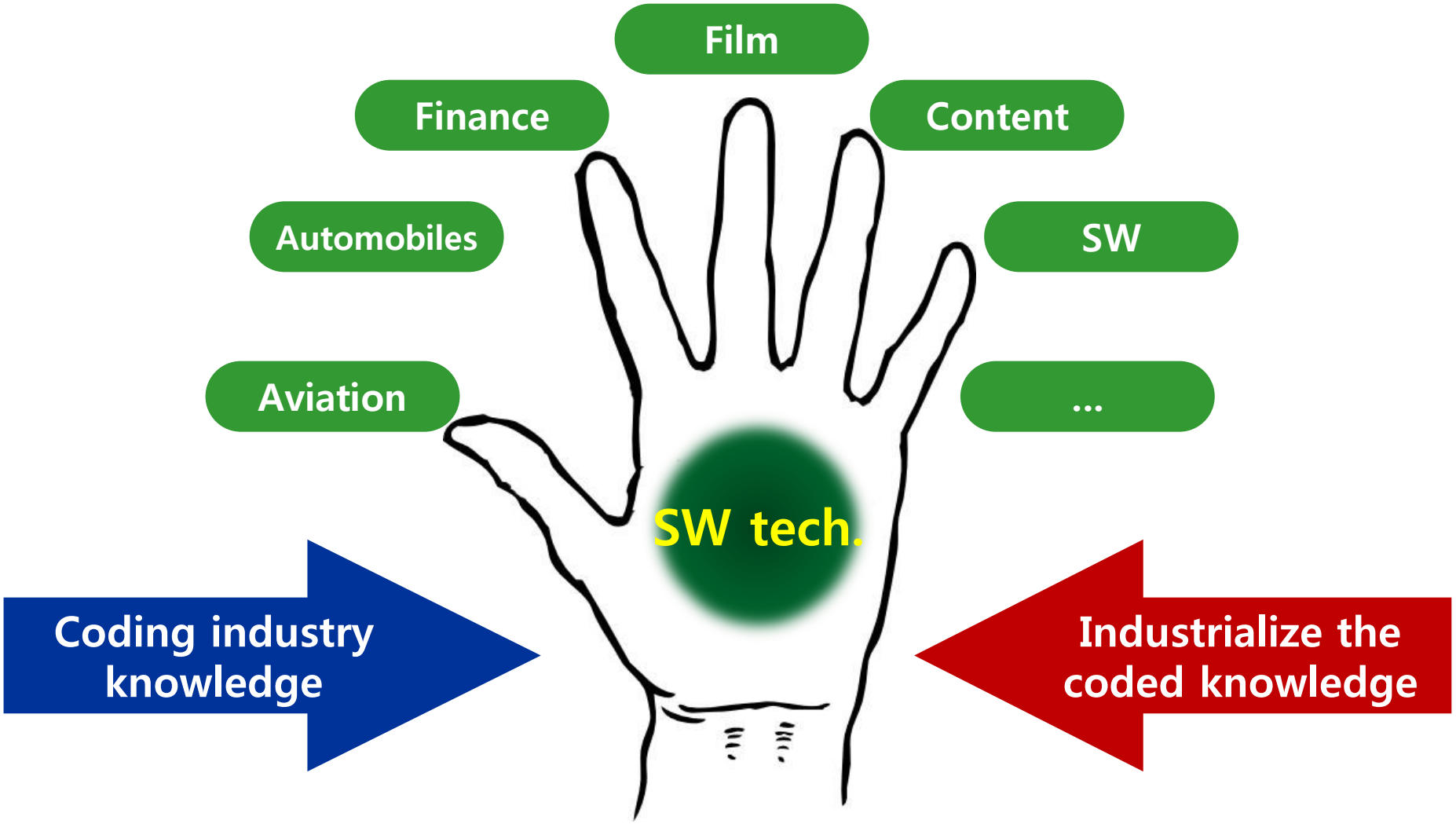
Number of Code Lines





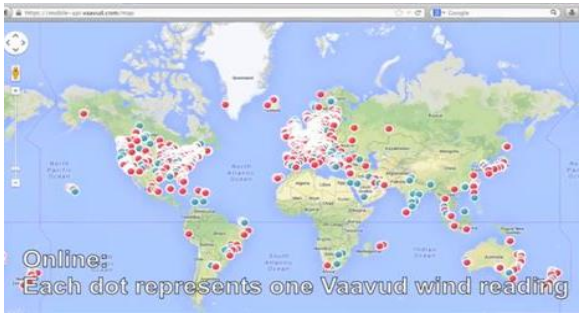
http://www.yakupad.info/?tag=cihazlar-arasi-etkilesim, http://www.informationisbeautiful.net/visualizations/million-lines-of-code/

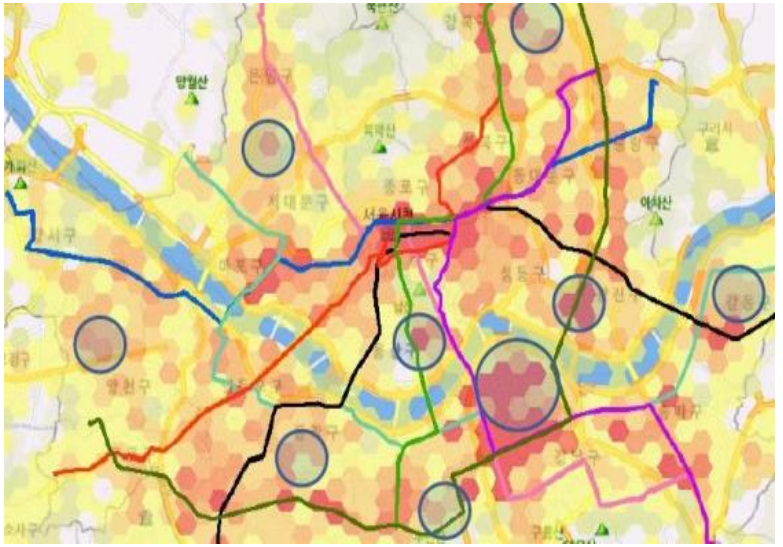
SW is the key enabler of every industry

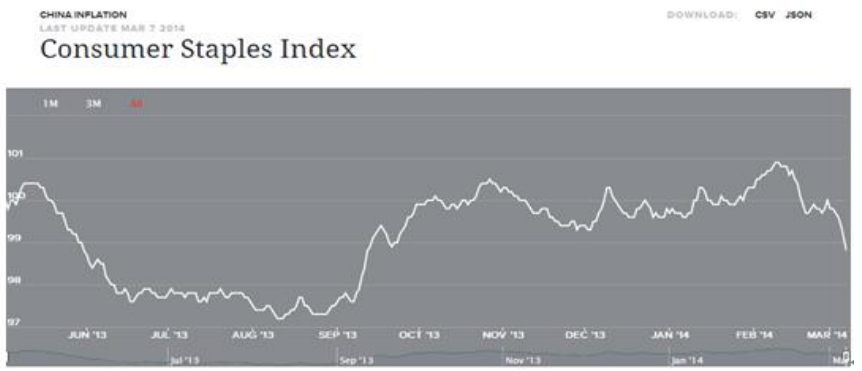


Data-driven decision making

- **Data deluge → Big Data**
- **Data-driven decision making is a common practice**

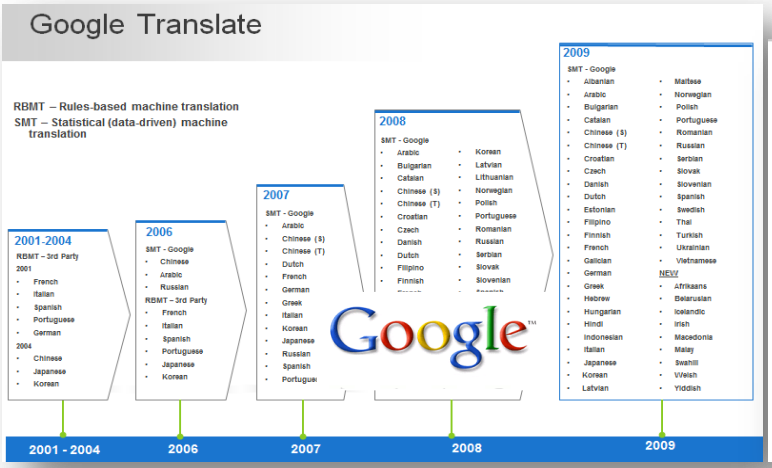






http://www.google.org/flutrends/

Artificial Intelligence in daily life

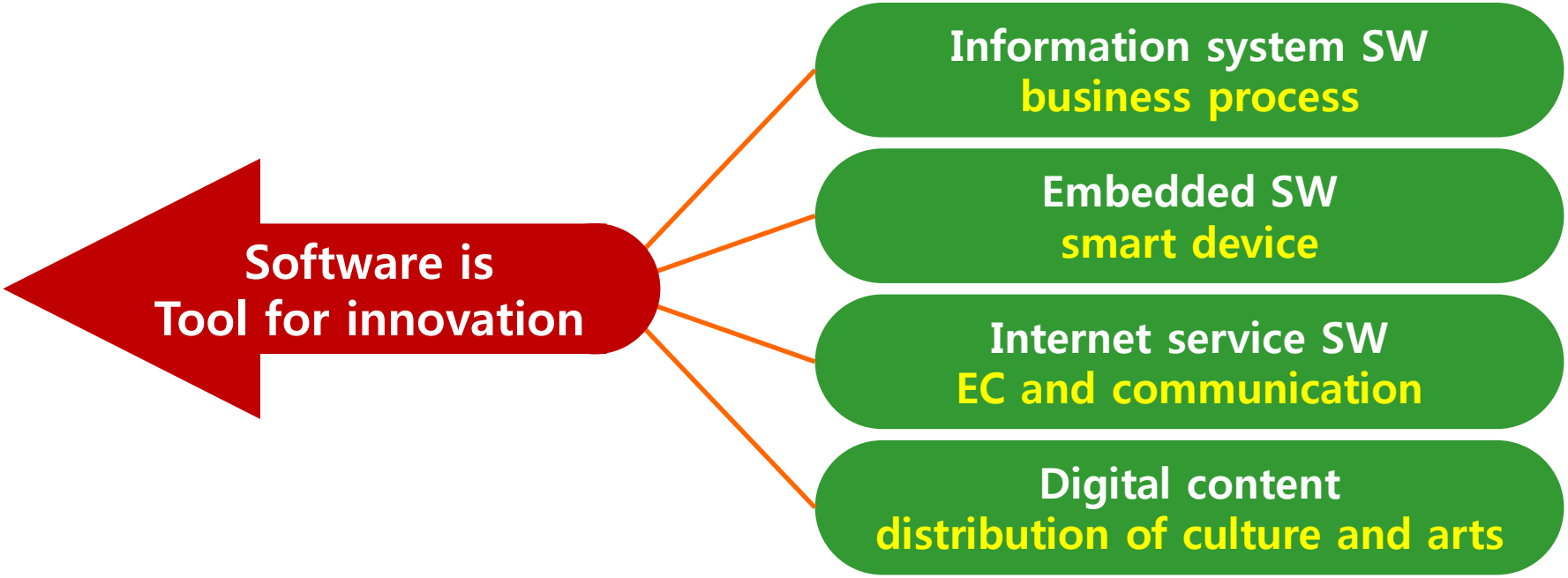


Any 2 Any language real-time Translation

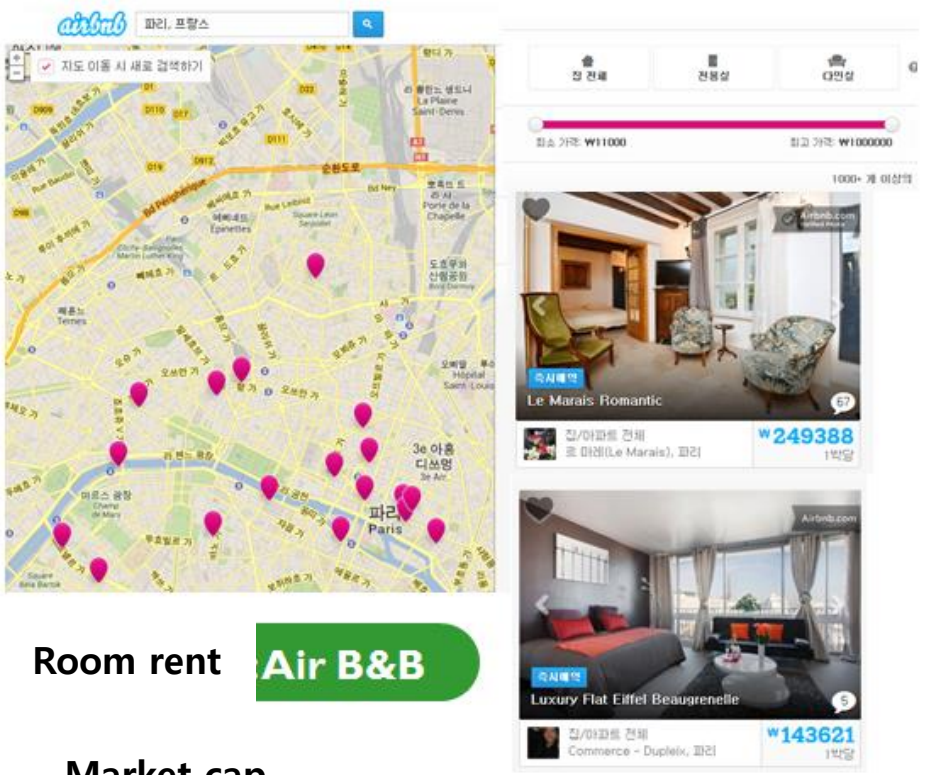
- Instant translation of any language
- Driverless cars, planes, ships, …
- Question & Answering System
- Accurate prediction from machine learning
- Recommendation System
- Discovery, accumulation, classification of knowledge

Innovation and Creation

- SW is a tool for innovation and creation
  - Ideas implemented by SW
  - Innovators equipped with SW capability
  - SW developers dream innovation



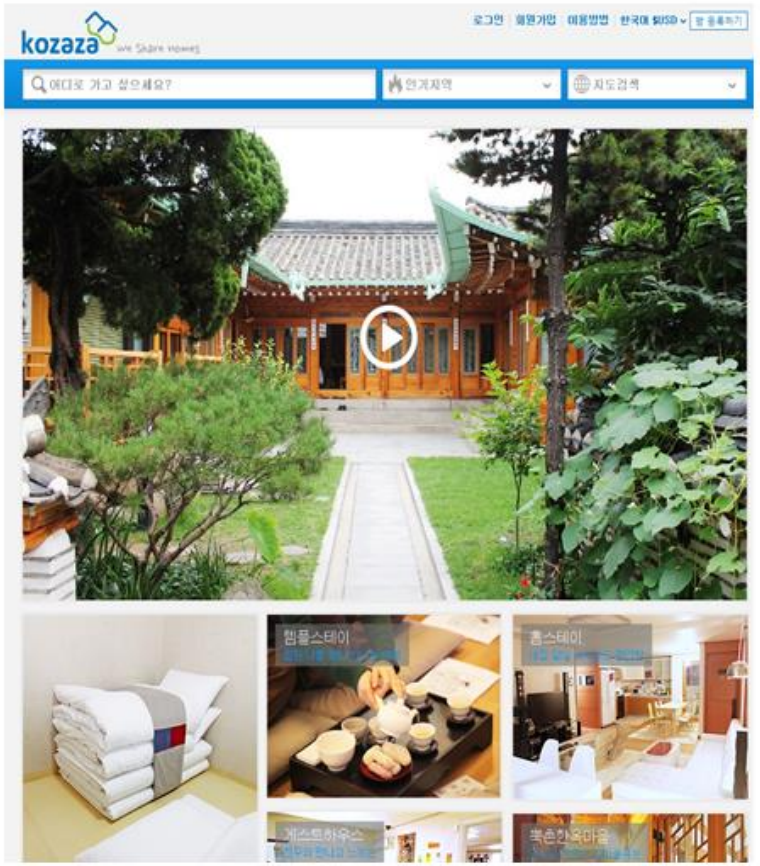
Small ideas make big businesses



Room rent

Air B&B

Market cap
Air B&B $10B
Hyatt $8.3



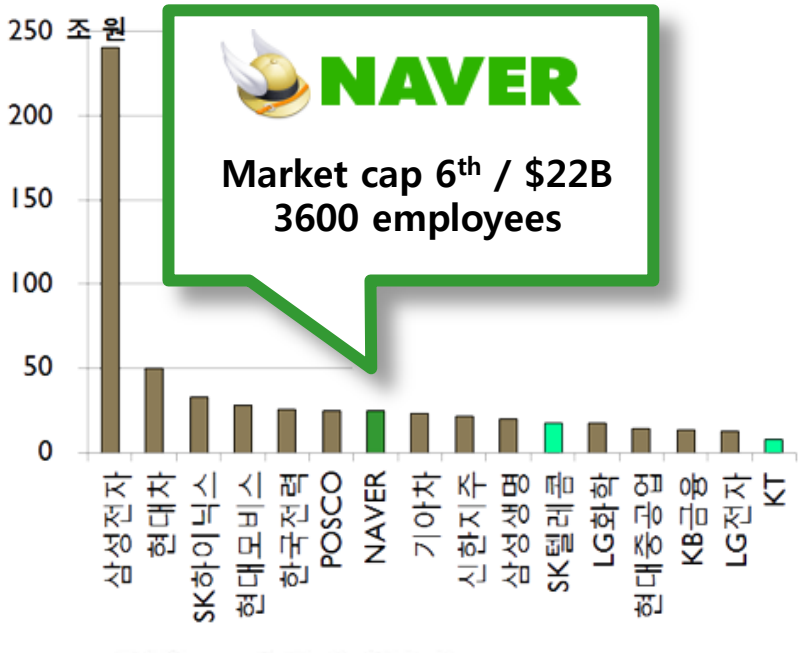
한국형 Air B&B 코자자

Korean Air B&B Kozaza

[이미지 출처 : http://www.nethosting.com/buzz/blog/airbnb-case-study/ , http://www.kozaza.com/]

Zero marginal cost society – Jeremy Rifkin

SW startups grow fast



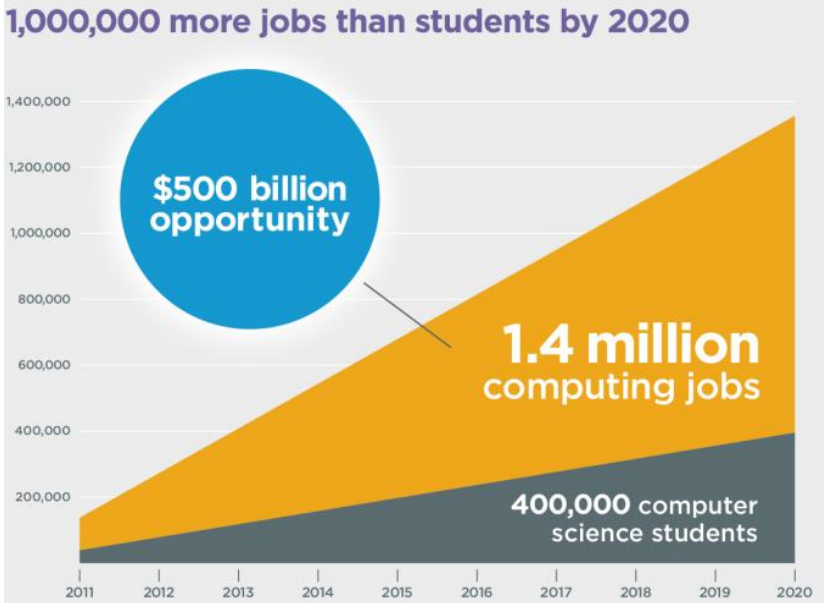
Global IT corporate market cap($, Billion)

Sep. 19th, 2014

SW yields more than economic value

Many decent SW jobs

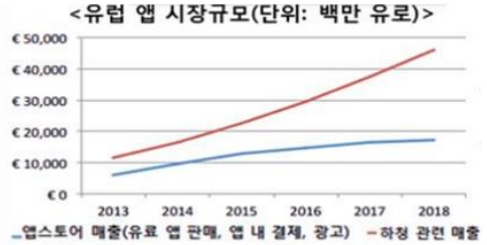
SW professionals in US (2018)



Computer science **is a top paying college degree** and Computer programming **jobs are growing at 2X the national average.**

90% jobs require digital tech. in EU

Employees in app industry from 1.8 mil (2013) to 4.8 mil (2018) in EU



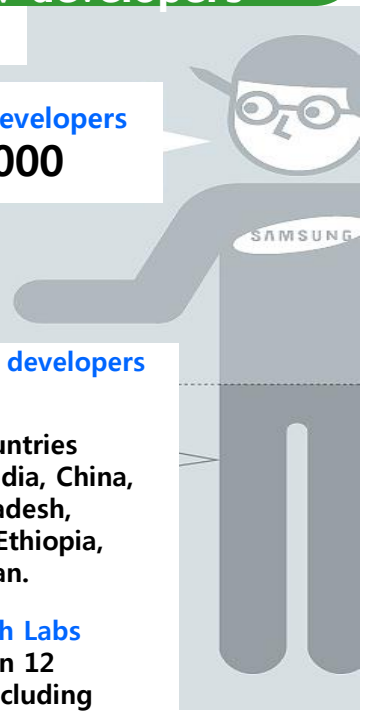
- 유럽 앱 시장규모는 2013년 기준 175억 유로로, 2018년경 260% 성장한 630억 유로(약 91조원)를 기록할 전망
  - ✓2013년 기준 유료 앱 판매, 앱 내 결제, 광고 등을 포함한 순수 앱스토어 매출만 61억 유로를 기록한 가운데, 2018년까지 187억 유로로 성장 전망

- 유럽 내 앱 산업 종사자는 2013년 기준 180만 명으로, 2018년까지 480만 명으로 확대될 전망
  - ✓앱 개발자는 2013년 100만 명에서 2018년 280만 명으로 증가할 전망
  - ✓마케팅, 지원 업무 등 기타 앱 산업 관련 종사자 규모 또한 2013년 80만 명에서 2018년 200만

Samsung electronics SW developers

2013/04

Total SW developers
36,000



Foreign SW developers
16,000
from 61 countries including India, China, USA, Bangladesh, Cambodia, Ethiopia, Turkmenistan.

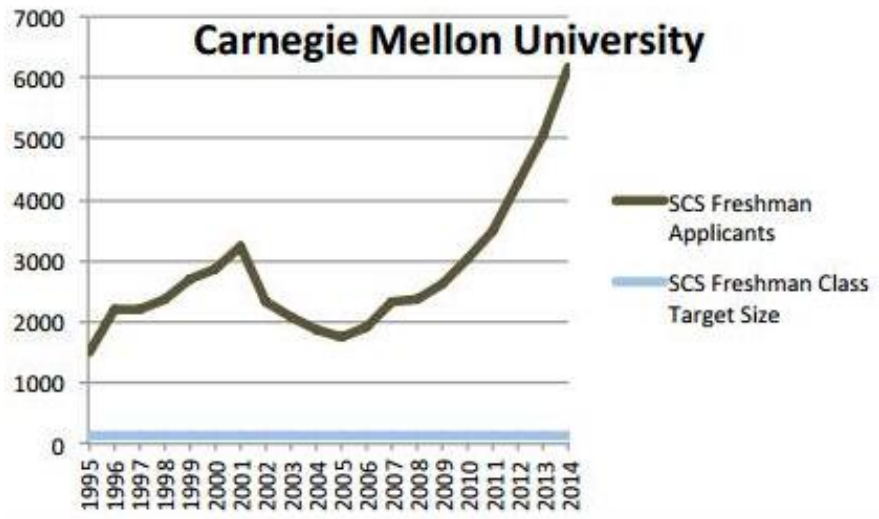
SW Research Labs
28 centers in 12 countries including India, Poland, China.

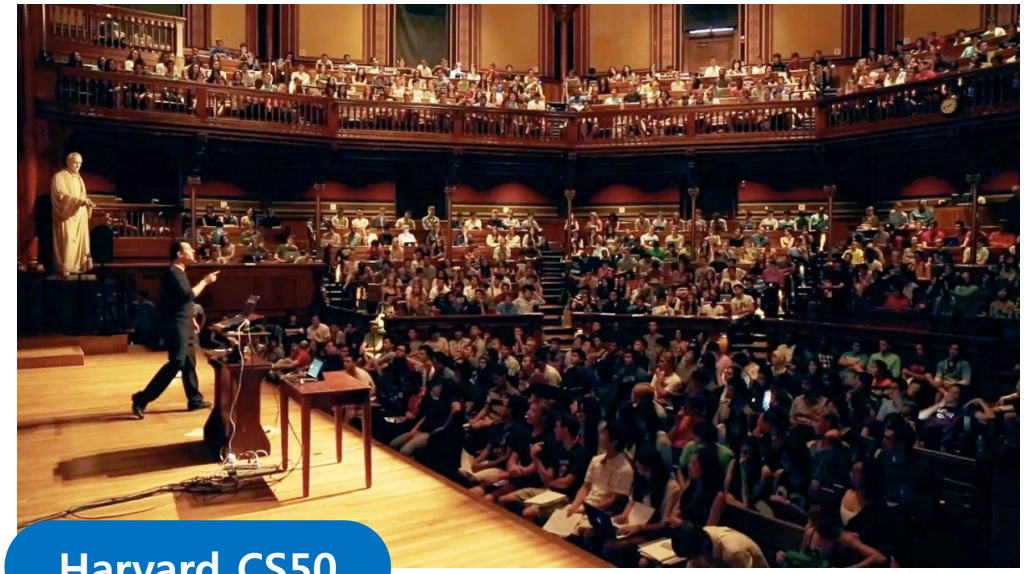
Best Jobs 2014

Software Developer
★★★★★ (8.4 out of 10)

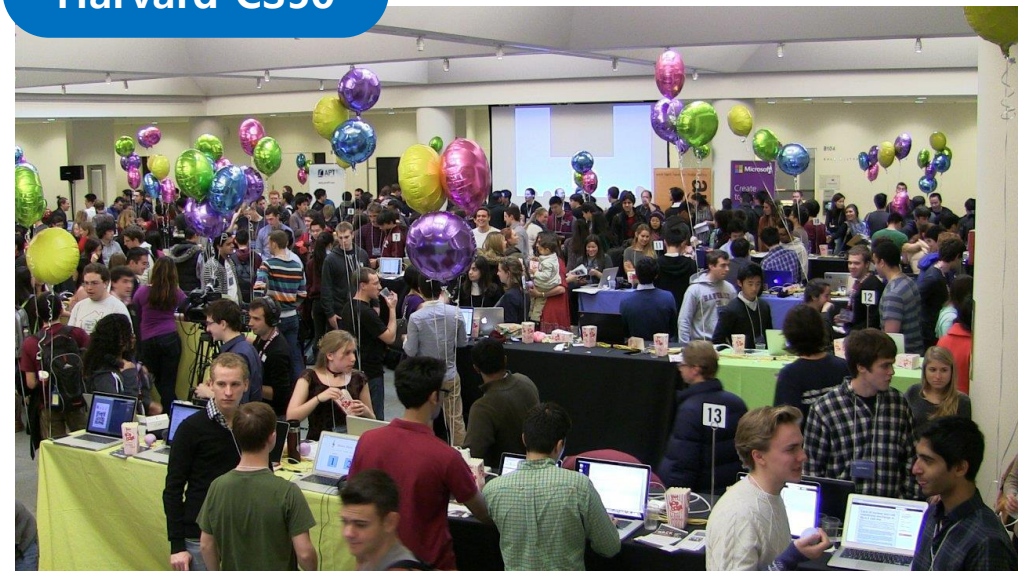
Computer Systems Analyst
★★★★★ (8.2 out of 10)

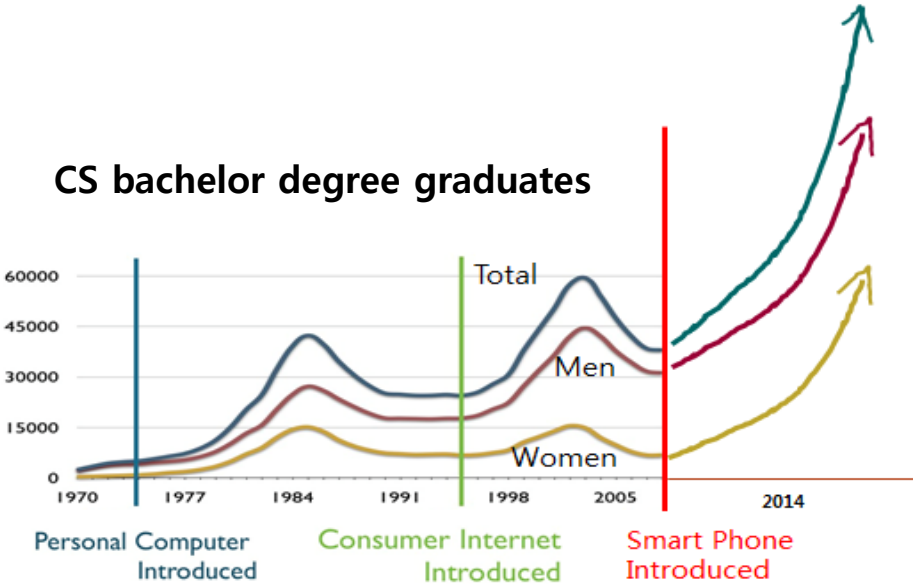
Computer science boom





Harvard CS50

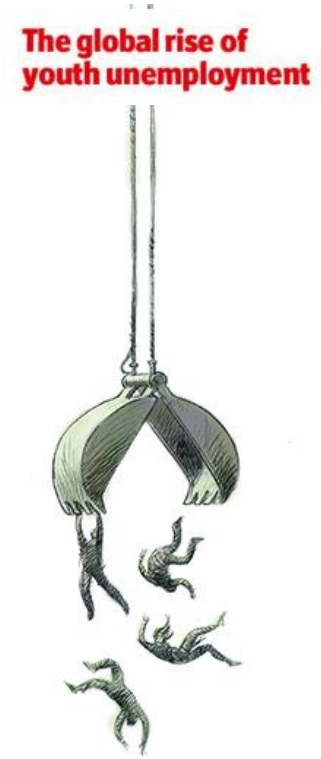




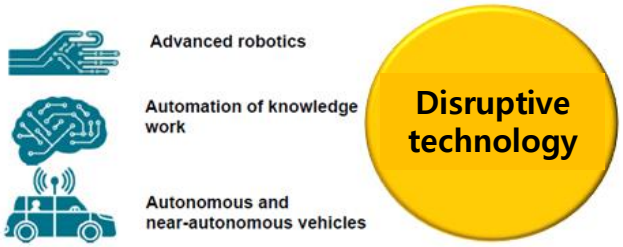
https://news.cs.washington.edu/ , http://techstart.logdown.com/ , http://www.geekwire.com/2014/analysis-examining-computer-science-education-explosion/

Shadows of
Software Oriented Society

Changes in jobs



Mental labor replaced by machine



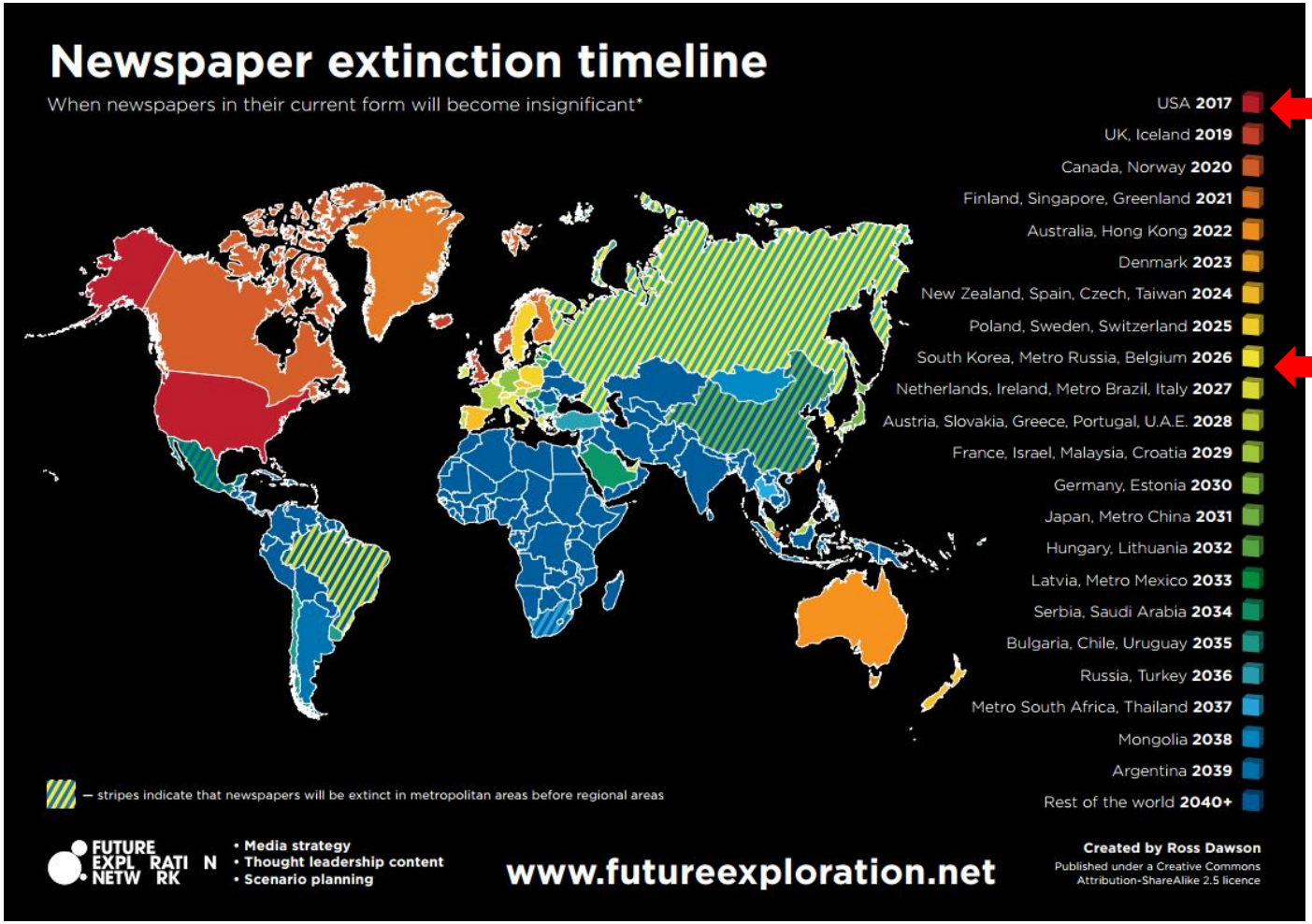
Collapse of middle class

47% of US occupations may disappear in 10-20 years

THE FUTURE OF EMPLOYMENT: HOW SUSCEPTIBLE ARE JOBS TO COMPUTERISATION?
Carl Benedikt Frey & Michael A. Osborne, September 17, 2013

http://radar.oreilly.com/2012/11/unemployment-education-stem-investment-polic.html

End of newspaper



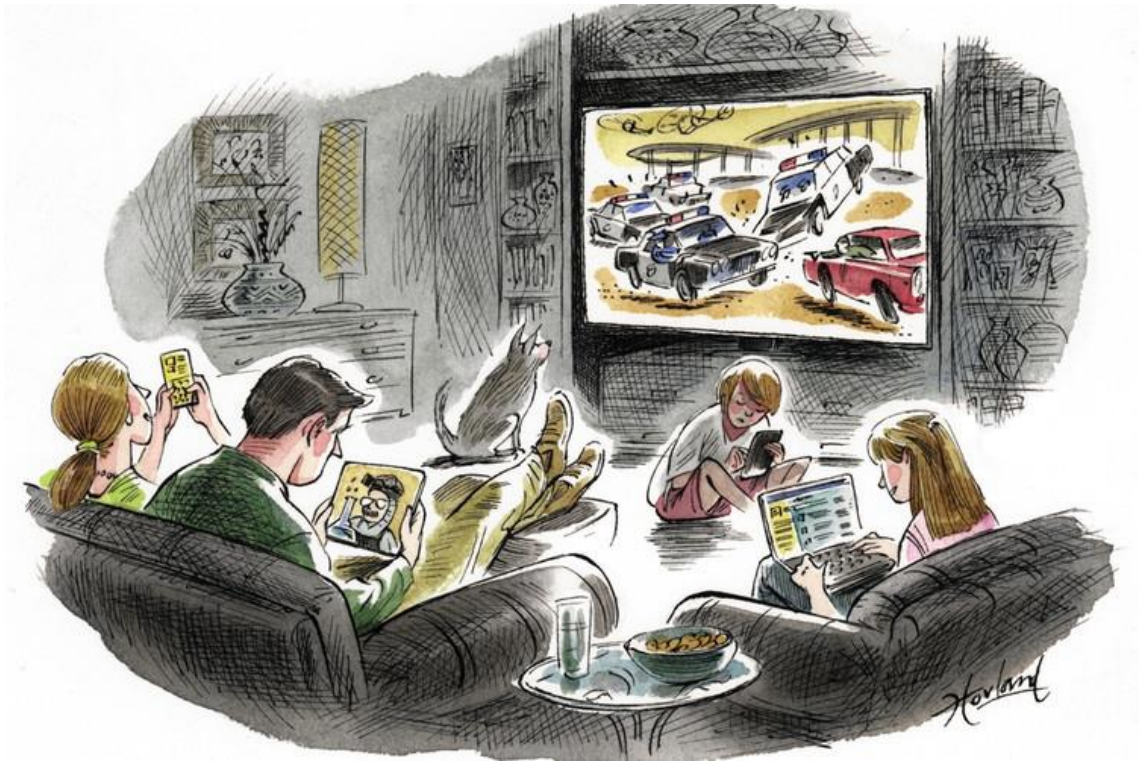
USA 2017

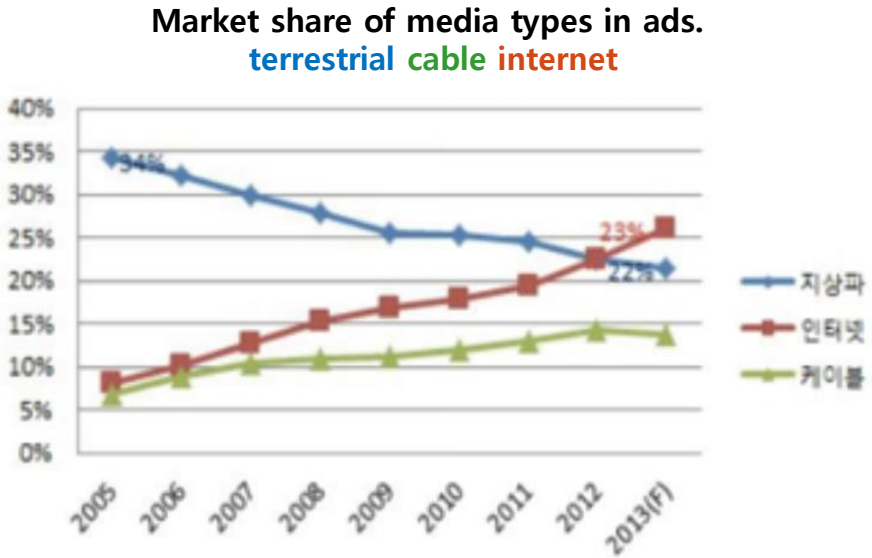
Korea 2026

http://futureexploration.net/Newspaper_Extinction_Timeline.pdf

Stop The Presses: 'Sunset' For Print In Five Years, FT Sees,
Robert Andrews May. 25, 2010
https://gigaom.com/2010/05/25/419-stop-the-presses-sunset-for-print-in-five-years-ft-sees

Who's watching TV?





- **Average age of Sweden's National TV News is 66**

http://www.wsj.com/articles/SB10001424052702303442004579123423303797850, http://www.baekdal.com/analysis/market-of-information

Global competition

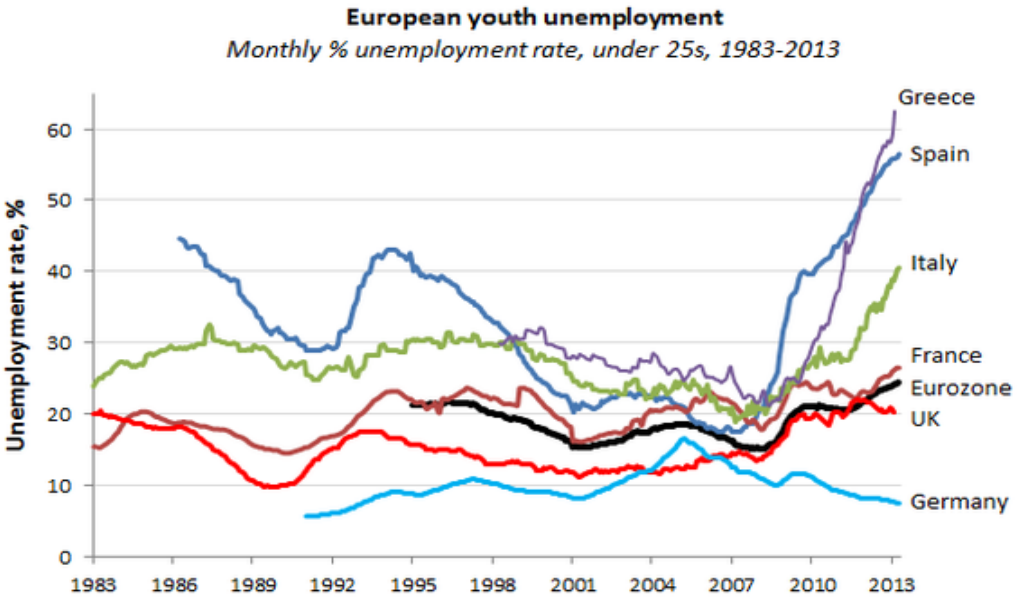
One market

Flat world

https://www.riamatch.com/Article/Book_Reviews/The_World_is_Flat

Shadow of Software Oriented Society

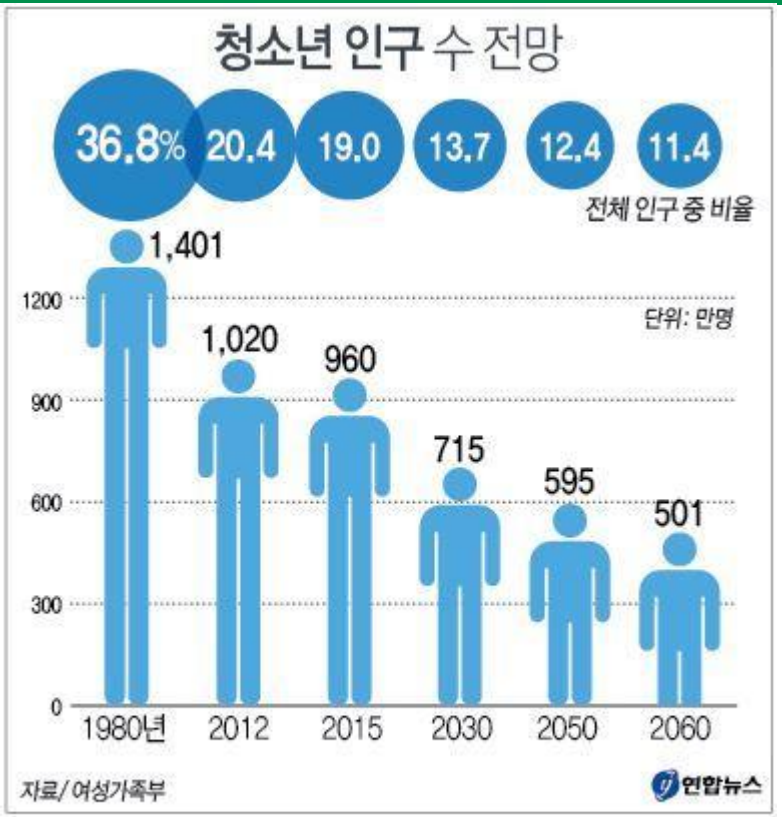
- **Polarization causes Intensifying conflicts**
  - **Few high-income(1%) vs. most low-income(99%)**
  - **Collapse of individuals, enterprises and nations if not prepared**



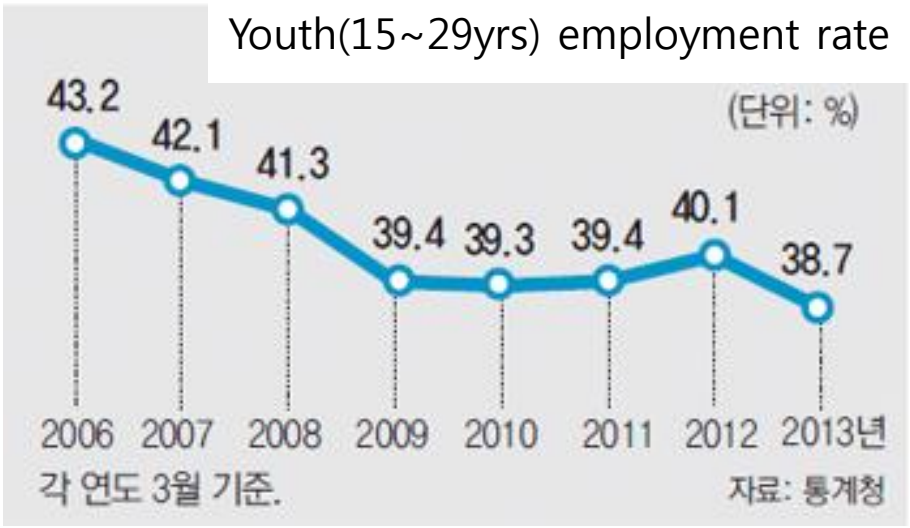
http://www.pbs.org/newshour/slideshow/multimedia-occupyglobal/

http://www.theatlantic.com/business/archive/2013/05/europes-record-youth-unemployment-the-scariest-graph-in-the-world-just-got-scarier/276423/

Korea's Youth employment below 40%



Outlook of teenager population



http://www.mjknews.com/news/articleView.html?idxno=58695

Jan. 2015

Record-breaking youth unemployment rate

- Enduring youth unemployment entails
  - Individual and domestic troubles
  - Undermining nation-wide productivity and growth
  - Aggravating low birthrate and aging
  - Social burden and national crisis

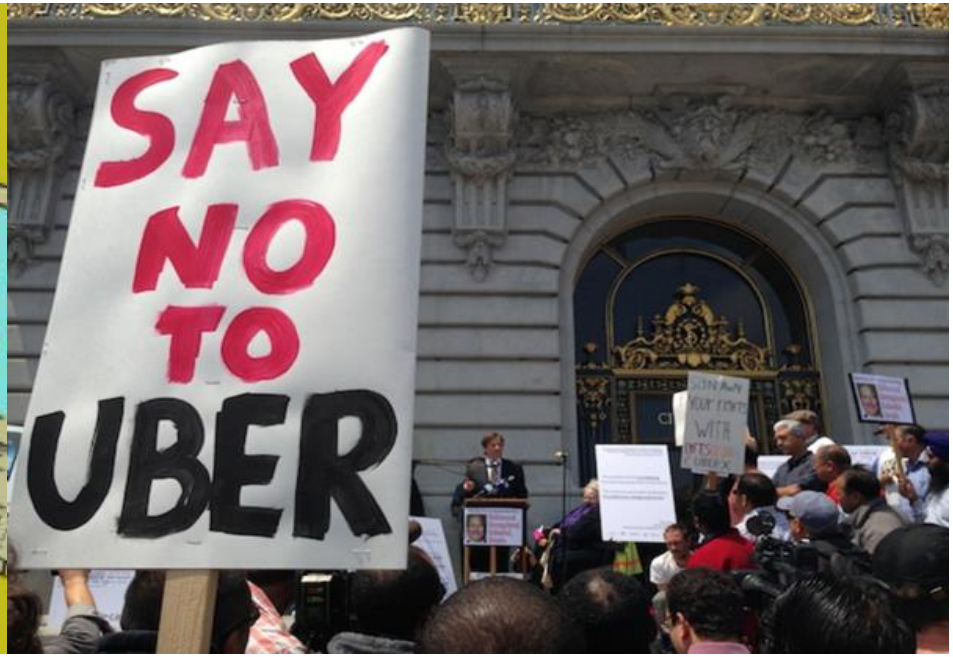
http://www.yonhapnews.co.kr/society/2013/01/05/0701000000AKR20130105038700005.HTML

Are we already in the shadow of the Software Oriented Society?

image source: http://www.lagoinha.com/ibl-vida-crista/arrependimento-a-manchete-do-evangelho/

Is this a wave we can avoid?

http://bananapost.wordpress.com/netiqueta/



http://www.justsayno.com/suggested/say-no-to-uber/

Hostility of Neo-Luddite

Can regulation stop it?

SPRi Software Policy & Research Institute

-

Dental technicians protest 3D printing of prosthetic teeth

http://www.bloter.net/archives/191131

Red Flag Act to limit automobiles, 1890s in UK

http://robohub.org/lloyds-insurance-report-overcoming-obstacles-for-driverless-cars/

How should we prepare for Software Oriented Society?

소프트웨어 중심사회의 Think Tank
SPRi
소프트웨어정책연구소

Government Initiatives

Opening SPRi
2014.03.31

A Meeting for National Strategy setting up
2014.07.23

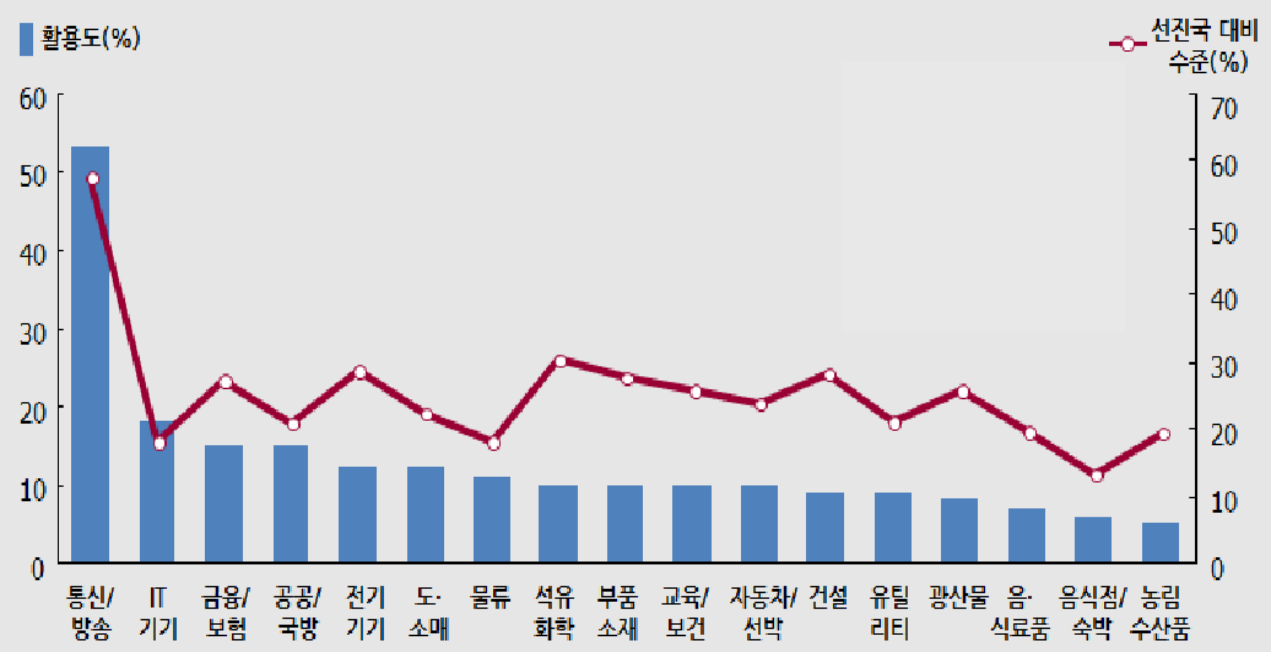
The first step to realize SW Oriented Society !!

http://spri.kr/ , https://www.sw.or.kr/news/n_pss_view.jsp?articleNo=22299

Korea's SW utilization

- is only 1/3 of developed countries
- Korea's GDP will be improved by 16 bil. US$ when SW was utilized as advanced countries

Ratio of SW Utilization(%) - blue bar



Comparison with the largest(%) - red line

Index to measure relative ratio of SW utilization in comparison with the largest utilizing industry in the developed countries for 100-million-won products

Samsung Economic Research Institute Report "한국 소프트웨어산업의 경쟁력 제고 방안", 2011.3

High Quality SW Production Capability

SPRi Software Policy & Research Institute

- Quality design and development
- SW industry by SW enterprises with professional skills

Unintended Acceleration and Other Embedded Software Bugs

Tuesday, March 1st, 2011 by Michael Barr

Last month, NHTSA and the NASA Engineering and Safety Center (NESC) published reports of their joint investigation into the causes of unintended acceleration in Toyota vehicles. NASA's multi-disciplinary NESC technical team was asked, by Congress, to assist NHTSA by performing a review of Toyota's electronic throttle control and the associated embedded software. In carefully worded concluding statement, NASA stated that it "found no electronic flaws in Toyota vehicles capable of producing the large throttle openings required to create dangerous high-speed unintended acceleration incidents." (The official reports and a number of supporting files are available for download at http://www.nhtsa.gov/UA.)

http://embeddedgurus.com/barr-code/2011/03/unintended-acceleration-and-other-embedded-software-bugs/

SW Safety National Control Tower

SPRi Software Policy & Research Institute

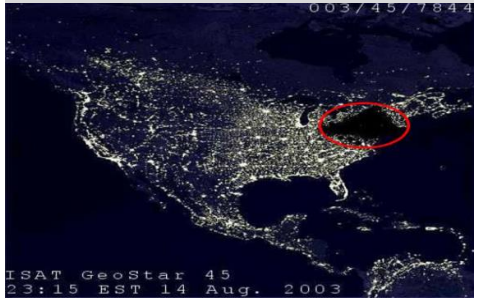
- Scope and Scale of Damage enlarged due to SW defects
- Product's SW safety certification required

Arian 5 explosion ['96]

an unmanned Ariane 5 rocket launched by the European Space Agency exploded just forty seconds after its lift-off. $500 mil damage.

SW error in conversion of 64bit integer to 16 bit

US East Coast Blackout ['03]



Shutdown more than 10 airports and 22 nuclear power plants for 3 days. 6Bil economic loss.

SW error in control and monitoring system blocked automatic power generation and transmission

Toyota SUA ['14]

Sudden Unintended Acceleration of Toyota '09. 5-year-long trial left suspicion about the manufacturer's faults on the causes of SUAs.

Barr report reproduced ECU SW error could cause SUA

Subway accident ['14]

Subway collision in Seoul. 250 people injured.

Frequent malfunction of traffic warning signals had operators ignore them. Root cause of the malfunction is presumed a SW bug.

http://dailyman40.com/the-daily-retro-pic-the-2003-east-coast-blackout/

Fostering Digital Talents

High quality SW engineers

- SW industry
- R&D and tools
- Startups
- CS education

Domain knowledge + SW utilization capability

- Convergence in every industry
- Professional level coding ability
- Use of tools

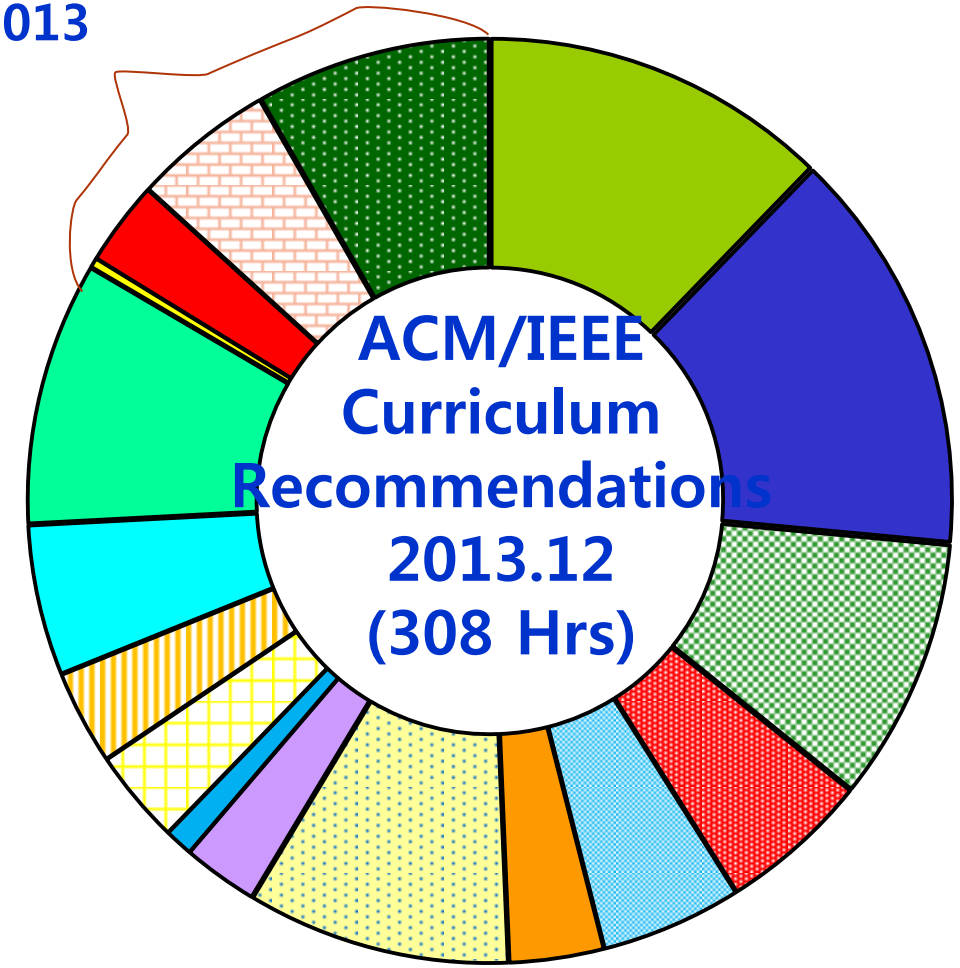
Liberal arts in SOS

- Digital literacy
- Understand SW value
- Basic coding skills
- Basic skills to use tools

More high quality SW engineers

SPRi Software Policy & Research Institute

New courses in 2013



- Discrete Structure
- SW Dev. Fundamentals
- Algorithm & Complexity
- Architecture & Organization
- Operating Systems
- Networking & Communication
- Programming Languages
- Human-Computer Interaction
- Grophics & Visualization
- Intelligent Systems
- Information Management
- Social Issues & Professional Practice
- SW Engineering
- Computational Science
- Information Assurance & Security
- Parallel & Distributed Computing
- System Fundamentals
- Platform-based Development

Computer Science Body of Knowledge

http://www.acm.org/education/CS2013-final-report.pdf

Teaching Kids Computer Programming

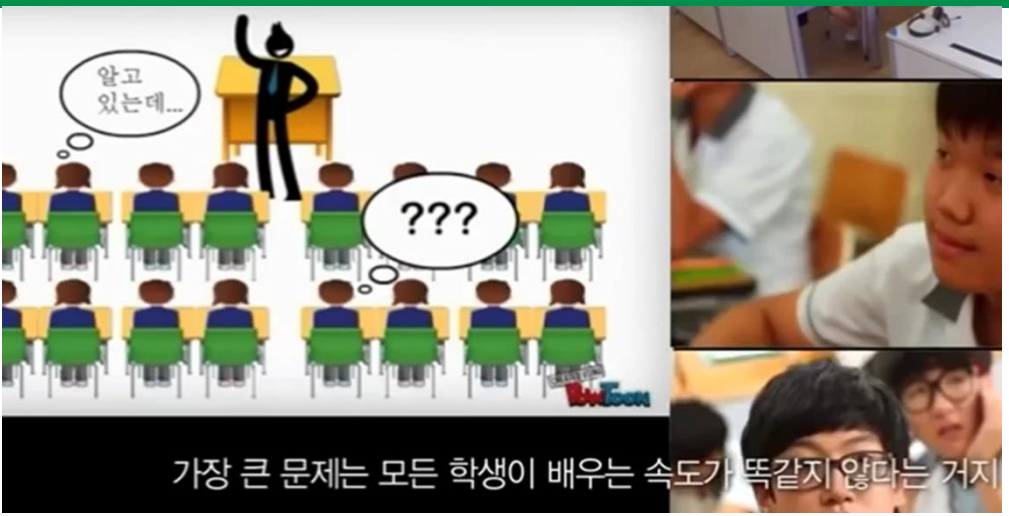
SPRi Software Policy & Research Institute

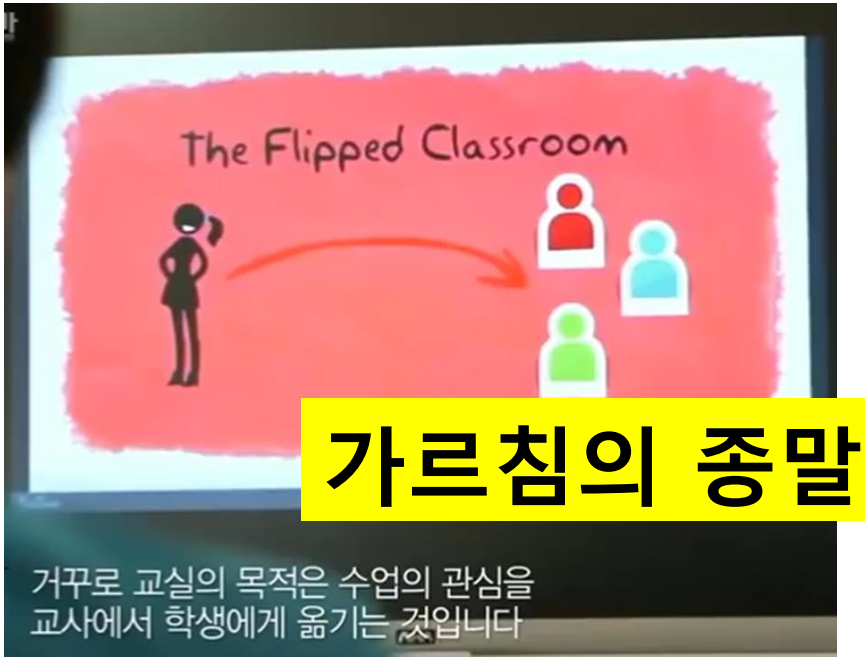
Program or be programmed – Douglas Rushkoff

http://leifh.blogspot.kr/2013/05/digital-dmmekraft.html

Is our education on the right track?

Flipped Class





가르침의 종말 !!

SW-friendly Culture

Open

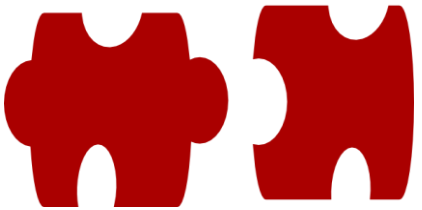
Share

Participation

Collaboration

SW-friendly Culture

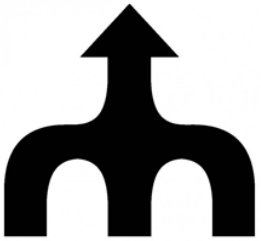
Crowd Sourcing



Reuse

Innovation, not Instant perfection

Idea respect



Mashup

SW-friendly Law and Regulation

Education

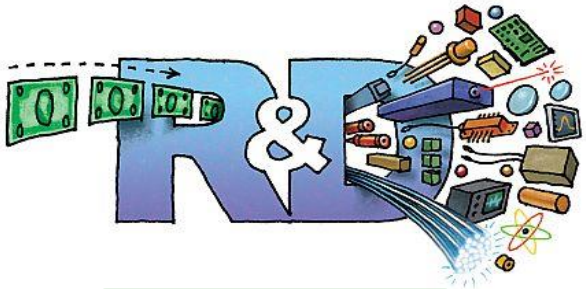
Performance Appraisal

Intellectual Property Law

SW-friendly Law and Regulation

Regulations

National Procurement



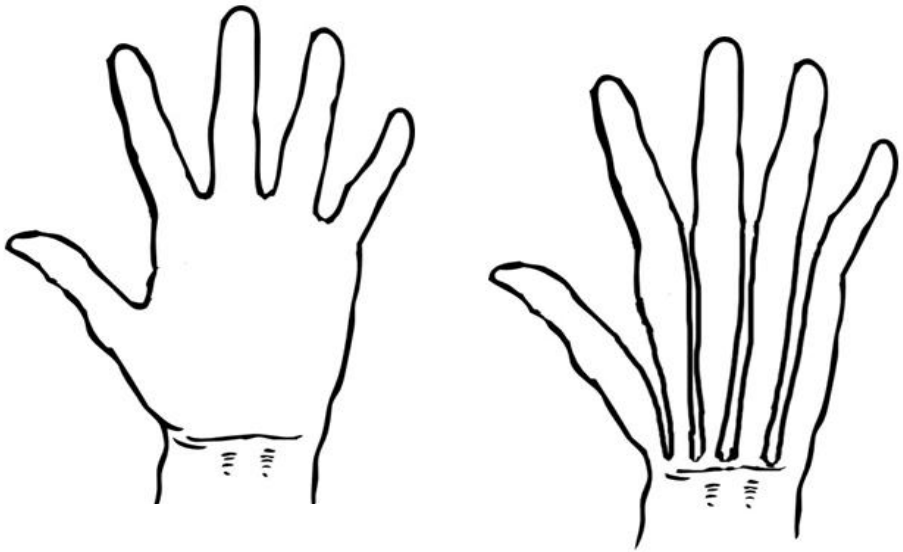
R&D System

SW Friendly Corporate Culture

SPRi Software Policy & Research Institute

Creativity comes from Surplus

Share, Reuse, Collaboration



Apple

Google

http://mesaseola2013.blogspot.kr/2013/09/google.html

Preparing for SW Oriented Society

Alice & the Red Queen.
Image source: http://www.lealandeve.com

Red Queen Syndrome: "It takes all the running you can do, to keep in the same place."

http://www.wtoutiao.com/a/260423.html

Directions of National SW R&D

SPRi
Software Policy & Research Institute

Activities for SW promotion

- Incumbent administration acknowledged the importance of SW for the growth of the nation at the outset
- Some of the actions so far (‘13~)
  - Single control tower for R&D administration
    - Ministry of Science, ICT and Future Planning
  - National S&T Roadmap for R&D investment
  - SPRI legislation and opening
  - Declaration of Software Oriented Society
  - Stepwise R&D investment for SW startups, SME’s

National Science and Technology Roadmap

- Works as main criteria of R&D investment for the next 10 years
- 30 technologies in 5 categories from 120 national strategic technologies
  - ICT convergence, New industry, Environment, Aging, Safety and SW infrastructure
  - Identify SW as infrastructure and lay out independent strategy for common SW technologies
    - System SW(security, OS, DBMS, Embedded)
    - Intelligent SW(AI, Image recognition, Voice recognition/translation
    - Internet service SW(Big data, Cloud computing, IoT)
  - All categories also include SW components specific to their domains

Software Policy & Research Institute

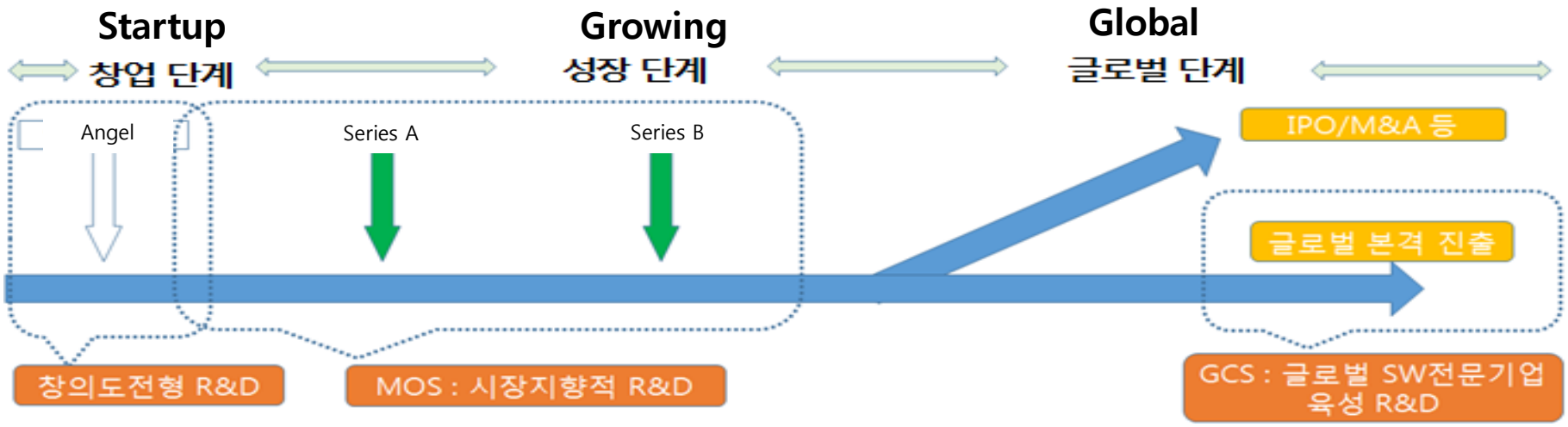
- Legislated in 2013 and opened in 2014/03
- R&D for national software policy
- Laws and regulations
- Revision of SW Statistics to catch up with technology progress
- Layout new innovative national projects

Declaration of SW Oriented Society

- A Meeting for National Strategy setting up to implement SOS
  - 2014.07.23
- Symbolic implication to government officials and institutions as well as industries

Stepwise R&D investment

- **Expand R&D investment for SW startups and SME's**
  - **Creative challenging R&D - Seeding**
  - **MOS(Market Oriented SW) - Watering**
  - **GCS(Global Creative SW) - Harvesting**
- **Foster startups by firsthand researchers**



K-ICT Software global leadership strategy, Press Release, Ministry of Science, ICT and Future Planning, 2015.04.10.

More fundamental issues

- Effectiveness of pulling-in approach
- Big enterprise vs startups

Recent government R&D policy

- **Emphasis on commercialization of R&D results**
  - Start-ups
  - Small and medium enterprises
  - Universities and government-funded research facilities
  - Academy-research-industry cooperation

- **Model**
  - **R&D investment ▶ Outputs ▶ Technology transfer/commercialization to industry ▶ Business/industry growth**

2015, 2014, 2013 National R&D budget allocation, MSIP

SW R&D Budget 2015 (partial)

- New industry
  - SW R&D (‘14) $248M (₩274B) → (‘15) $269M (₩297.4B) (△ 8.5%)
  - IoT/3D Printing R&D (‘14) $28M (₩30.8B) → (‘15) $41M (₩45.3B) (△ 47.1%)
- Content and Convergence services
  - Content R&D (‘14) $85M (₩94.3B) → (‘15) $94M (₩104.6) (△ 10.9%)
  - Service R&D (‘14) $106M (₩116.9B) → (‘15) $118M (₩130.8) (△ 11.9%)
- Startup, venture, SME, Mid-sized company
  - Startup and venture R&D : (‘14) $162M (₩179.8B) → (‘15) $190M (₩210.5B) (△ 17.1%)
  - SME and Mid-sized enterprise R&D : (‘14) $1.107B (₩1.23Trillion) → (‘15) $1.190B (₩1.32T) (△ 7.4%)
- Promotion of R&D Commercialization
  - Promotion : (‘14) $496M (₩549.6B) → (‘15) $556M (₩615.1B) (△ 11.9%)

Promotion of commercialization

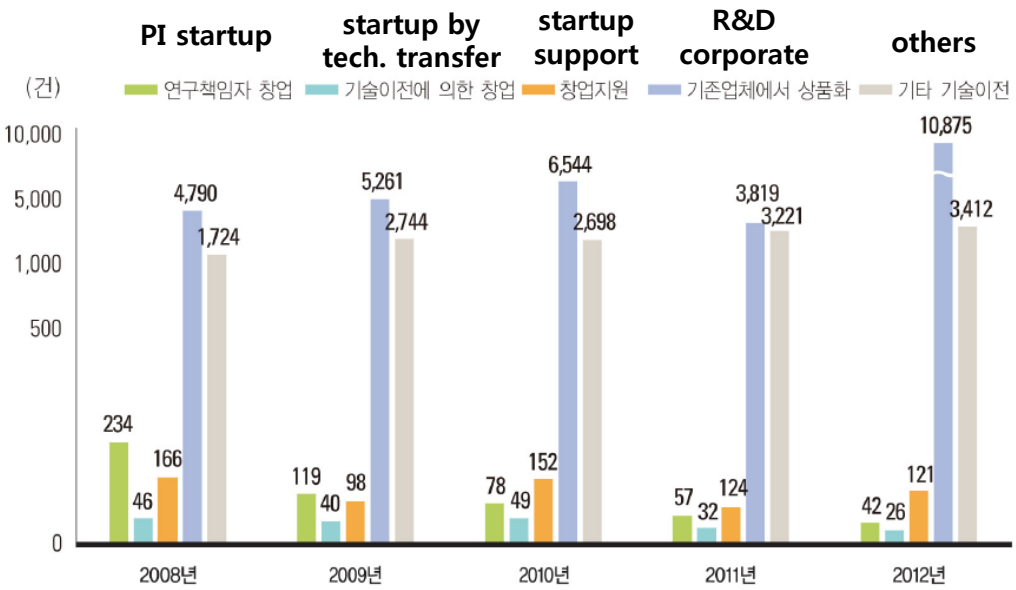
- **Enforce industry competitiveness and market creation**
  - **Prospective Output Discovery ▶ Tech. transfer, commercialization ▶ Enterprise growth and new market development**

- **Revitalize innovative technology startups using public technology and data**

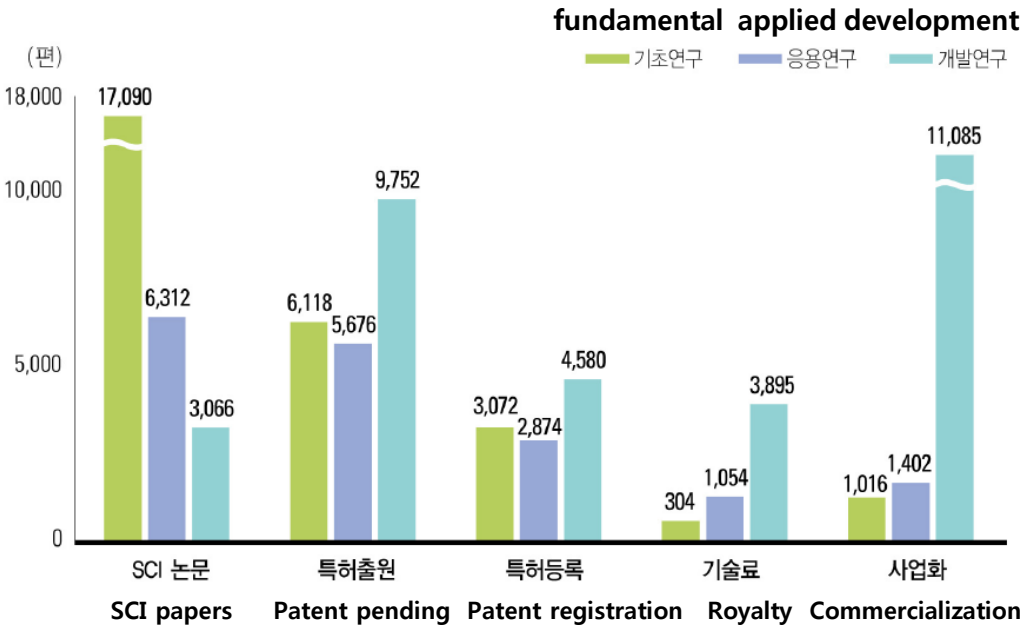
- **Ramp up technology transfer from public research institutions and universities to SME's and mid-sized enterprises**

- **Support for Demand-driven projects**

Performance Analysis 2012

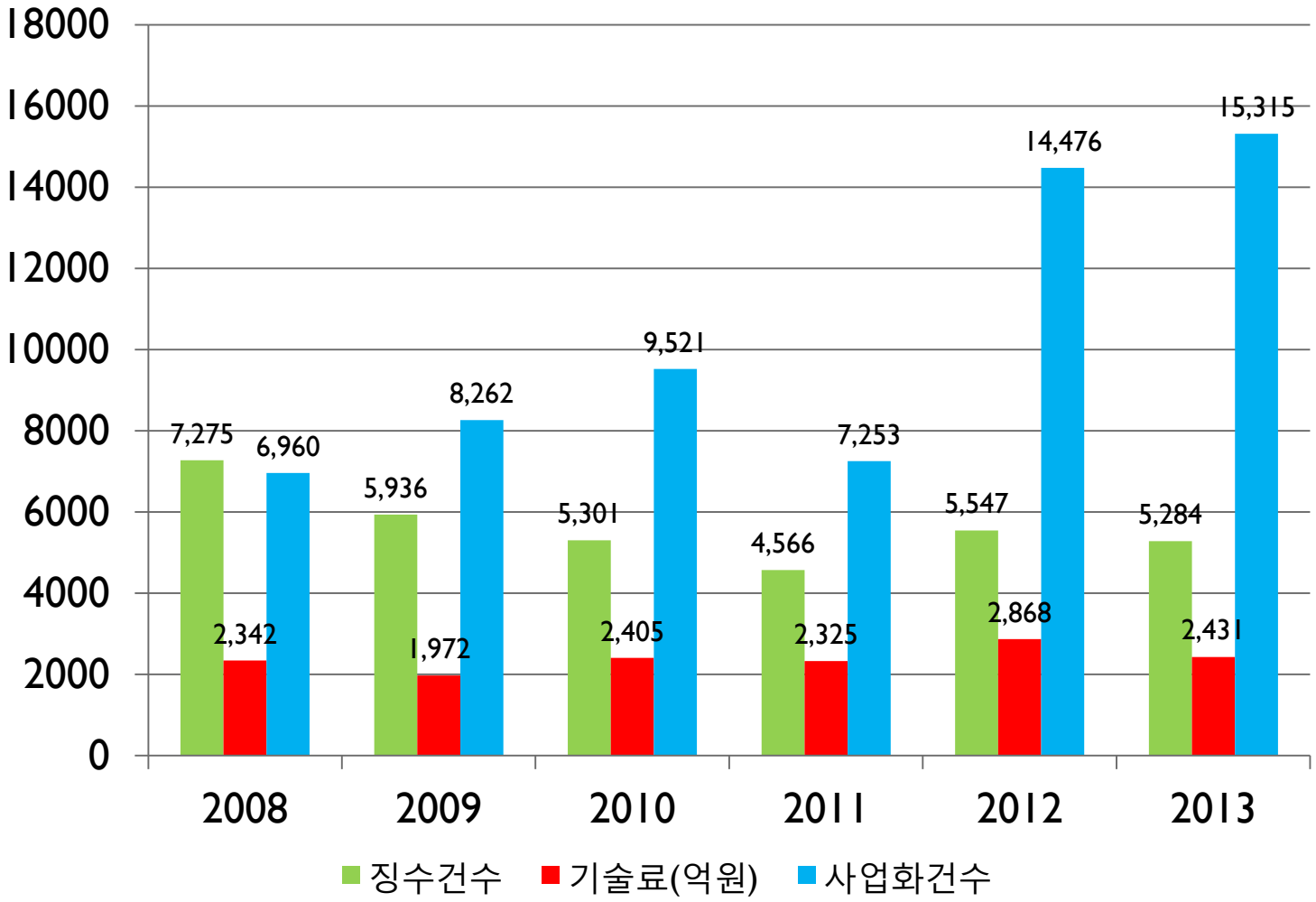


Annual Commercialization Cases



'12 R&D performance

Commercialization: cases vs. royalty



'12 R&D budget: $14B
Budget-Royalty ratio ≒ 1.8%

'13 R&D budget: $15.27B
Budget-Royalty ratio : ≒ 1.4%

'14 R&D budget: $16.1B
B-R ratio???

Royalty cases
Royalty amount
Commercialization cases

Miniscule rate of commercialization

- Success rate of technical challenge in research over 90%
- Rate of commercialization is 20% average, 4.4% with universities and gov. funded research institutes
  - UK 70.7%, US 69.3%, Japan 54.1% - National Assembly Budget Office, 2013

- Gov. funded research institutes hold more than 190K technologies, but over 154K of R&D deliverables are sleeping in their cabinets – National Science and Technology Council, 2012

Problem in phased approach

- R&D ▶ Discovery from outcomes ▶ Technology transfer to industry ▶ Growth of companies
- Work poorly for software industry
  - R&D by universities and research institutes, then productizing by other companies through technology transfer
  - Fast changing technology
  - Assets lie in developers, not in software that will be obsolete soon
  - Software is ever-changing and gradually refined
  - Less incentives to launch startups and supporting SME's
- Need for adjustment to enforce continuity and commitment in software R&D policy

Distinction of Modern Software

- **Core components are developers**
  - Dependency on developers – creative idea of small group of excellent talents
  - Difficult to transfer technology
- **Gradual improvement**
  - Quick and persistent
- **Short technology cycle**
  - Value of deliverables drops rapidly in 2-3 years
- **Large effect on other industries**
  - Diversity
  - Impact on other industries
    - Ratio of added value 49.0% 2.2 times of manufacturing, 1.3 times of industry average – KIAT 2013)
- **Low initial investment, almost zero marginal cost**
  - Big if you made it – network effect, lock-in effect
- **Relentless pursuit of success**
  - Support more through infrastructure, less on specific projects
- **Open source software ecosystem**

Recommended Directions

- More investment on firsthand startup
  - All projects relevant to SW including convergence, security, big data, etc.
- Commercialization
  - Developers joining/launching startups
  - Initial version is for proof of concept in terms of technology/business
  - Incremental revisions towards competitive products/services
  - Support system to bridge the gap between R&D and business

- Open, Share
  - Open outcomes of gov. funded research projects
  - Use and contribute to open source
  - Including data and documents
  - Official credit for opening and sharing
    - Usage, opinion, revision activities

Open and sharing

- **Utilization of R&D results by opening and sharing software and data**
  - **Regulations to support researchers**
  - **Cut down costs of developing similar features repetitively**
  - **Assure the quality of software and data by peer-review**
  - **Expedite the application of research results**
- **Papers, patents, copyrights to protect researchers' rights**

Status of Law and regulation reform

SPRi Software Policy & Research Institute

- **Research data**
  - **Science and Technology Big data open and sharing plan ('13~'17)**
- **Software**
  - **Revision of ICT R&D regulations on Jan, 2014**
    - **Projects may be carried out in open software methodology with the approval of the Minister**
    - **Existing outcomes may be released in open software if the commercialization is slow**
- **Recommendation for more revisions**
  - **Positive regulations to negative**
    - **Default is open SW methodology**
    - **Require approval for non open SW projects**

Summary of recommendations

- Encourage firsthand startup and ramp up open source software development
- Commercialization
  - Motivate researchers and developers to kick off startups
  - Expand support for startups
- Open and Share
  - Open and share software, data and documents from the government's R&D projects
  - Acknowledge researchers' effort of revision and the accumulated contribution of the software

소프트웨어 중심사회의 Think Tank