The Politics of Innovation:

Why Some countries are better than others? (Ch 3 & 7)

STP510 Yunji Woo

0. Table of Contents

Opening Question

W

why some countries are better than others in innovation?

There are several factors that can contribute to a country's success in innovation. These include:

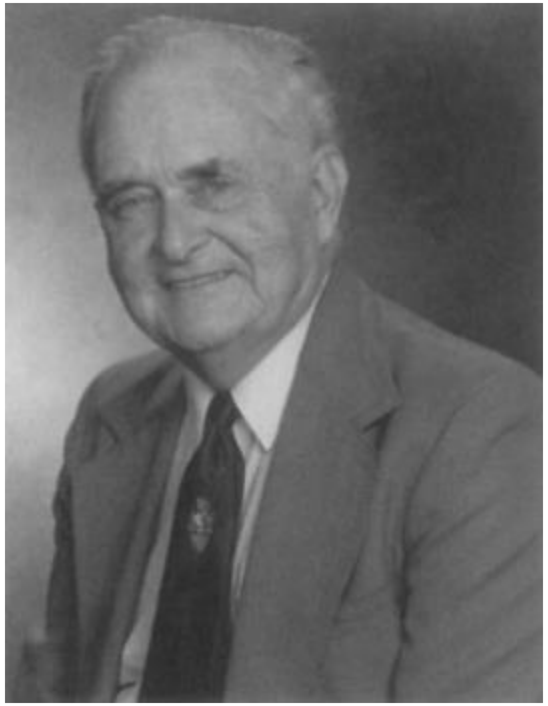
1. A supportive and conducive business environment that fosters entrepreneurship and encourages innovation.
2. Strong education and research institutions that provide access to high-quality education and cutting-edge research facilities.
3. Access to funding and other resources that can help companies and individuals pursue innovative projects.
4. A culture that values and rewards creativity and innovation.
5. Government policies and initiatives that support and promote innovation.
6. A diverse and highly skilled workforce that can provide the necessary expertise and knowledge to drive innovation.

Overall, a combination of these factors can help a country create an ecosystem that supports and promotes innovation, leading to success in this area.

Answered by ChatGPT
https://chat.openai.com/chat

1. Cardwell's Law

- Donald Cardwell (1970s)
  - British historian, set out to identify the main turning points in the history of western technology.
  - Surveyed over a years of developments in science and technology, cataloging what many consider to be the most important discoveries and inventions in human history.
  - Simple observation: ***Nationality should not matter***



Donald Cardwell (1919 – 1998)

"No nation has been very creative for more than an historically short period. Fortunately as each leader has flagged there has always been, up to now, a nation or nations to take over the torch." – Donald Cardwell (British historian)

1. Cardwell's Law

- **National disparities** in innovation
- How easy it has become to innovate
  - Globalization: Capital, equipment worldwide
  - Transportation: People can move with low cost
  - Communication: Scientific knowledge and technical information are easier to transmit internationally
- Then, why are some countries better than others at science and technology?
  - Why some countries succeed at S&T while others fail
  - Why national S&T success tends not to last long

  → **National leadership** in science and technology

2-0. Cardwell's Law in Action

- S&T had fairly low priorities throughout most of human history
  - The connection between science and technology was not broadly recognized before the late nineteenth century
- Modern economic thought: practically define new science and technology
  - Most societies realize that S&T can vastly improve their standards of living, economic competitiveness, and physical security
- Most government felt that they had little duty or ability to promote innovation
  - S&T progress is a random occurrence, a product of luck, not policy
  - National interests
  - After WWII, gov have come to believed they can, and should do something positive about national innovation rates.

2-0. What needs explaining?

- Technologically disparity countries
- Consumption than production
  - Many countries can afford to buy cutting-edge S&T, but they cannot create it
  - Factories that produce exports or often set up and run by foreigner.
  - National innovation rate, look at S&T creation instead of consumption
  - National patent data

2-1. Innovation Index

Index: Patent

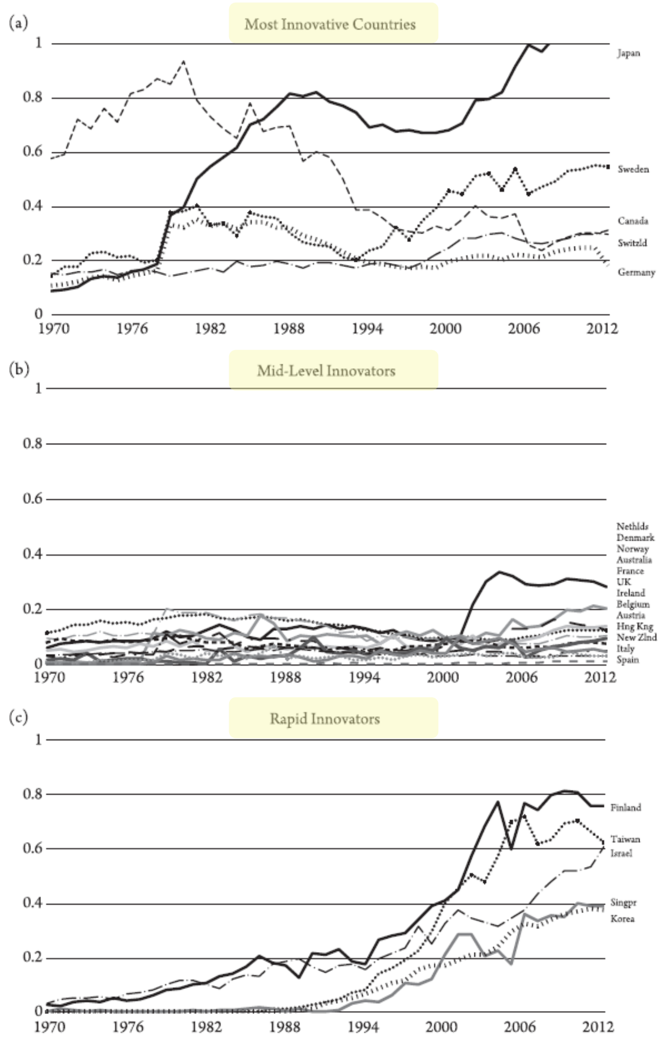


Figure 3.1a–c Total citations-weighted technology patents per capita (US = 1.00).

Normalized by US index (US = 1)

- National patent data
  - patent somehow reflect specific industries
- Patent data rate depends on industrial sector

Table 3.2 **Percentage of Total Patents, by Industry (1963–2006)**
Grey cells indicate overweight/underweight relative to the world average; Bold = overweight; Italic = underweight.

	World	*USA*	*JPN*	*SWE*	*SWZ*	*GER*	*CAN*	*KOR*	*TWN*	*FIN*	*ISR*	*CHN*
Chemical	18.9%	19.7%	16.9%	**26.5%**	19.5%	**26.7%**	16.7%	*9.7%*	*7.1%*	21.9%	15.1%	**26.9%**
IT-Telecom	13.5%	13.7%	**21.6%**	*4.0%*	*5.2%*	*6.0%*	12.9%	**31.3%**	14.2%	**25.6%**	**19.2%**	10.3%
Medical-Drugs	8.2%	9.1%	*4.3%*	9.5%	11.1%	7.0%	8.4%	*2.3%*	*1.9%*	5.9%	**21.0%**	**13.3%**
Electrical	18.4%	17.8%	**24.7%**	14.1%	15.2%	16.1%	*13.5%*	**37.6%**	**43.5%**	*13.0%*	16.7%	19.9%
Mechanical	20.9%	19.1%	21.5%	22.2%	23.9%	**27.3%**	22.5%	*11.1%*	*15.0%*	20.8%	*13.0%*	*14.5%*
Other	20.1%	20.6%	**11.1%**	23.7%	**25.1%**	16.8%	**25.9%**	*8.0%*	18.4%	*12.6%*	*15.1%*	*15.0%*

Source: National Bureau of Economic Research (2006).

2-1. Innovation Index

Index: STEM research publication

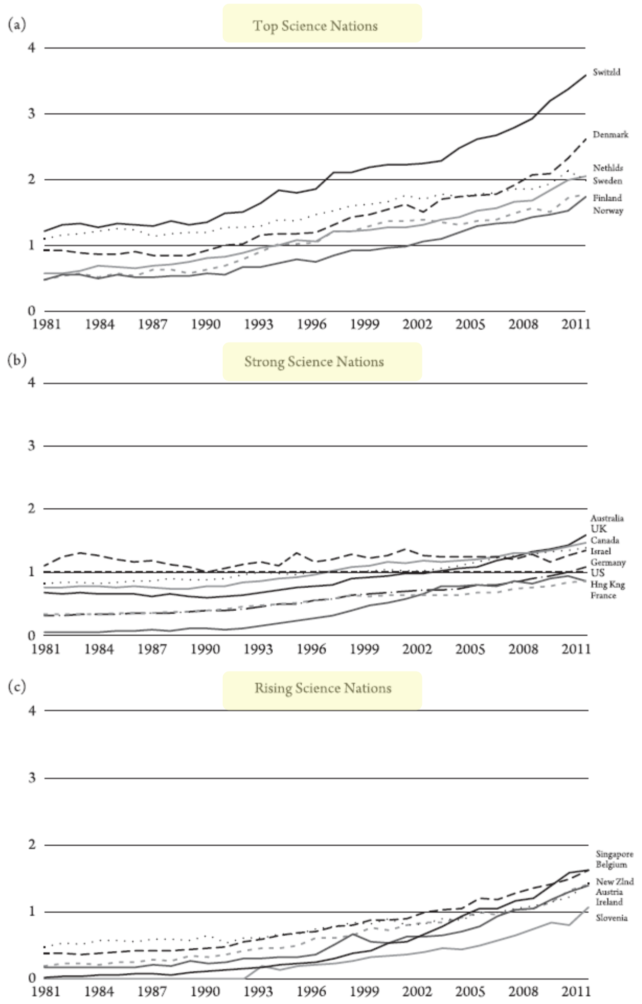
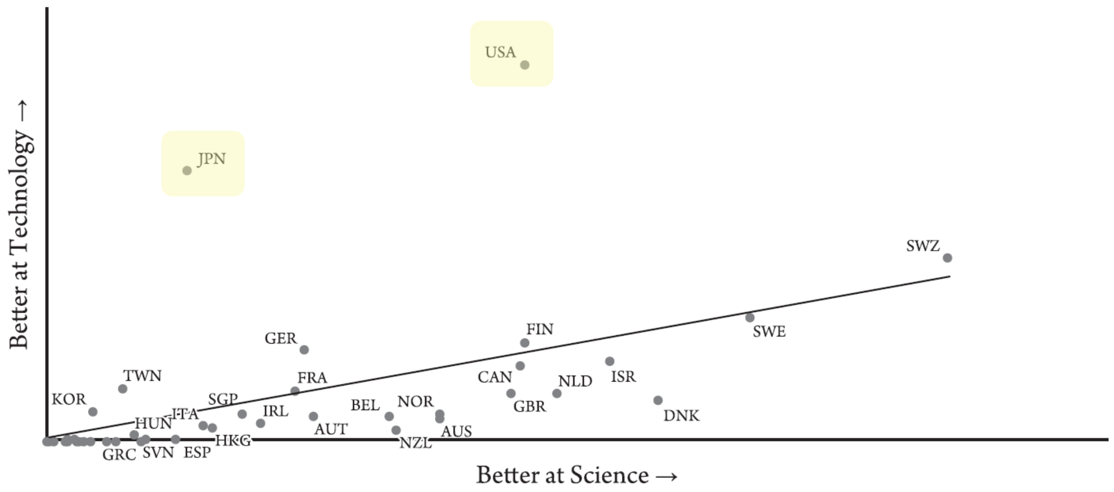


Figure 3.2a–d Total citations-weighted STEM research publications per capita (US = 1.00).

Normalized by US index (US = 1)

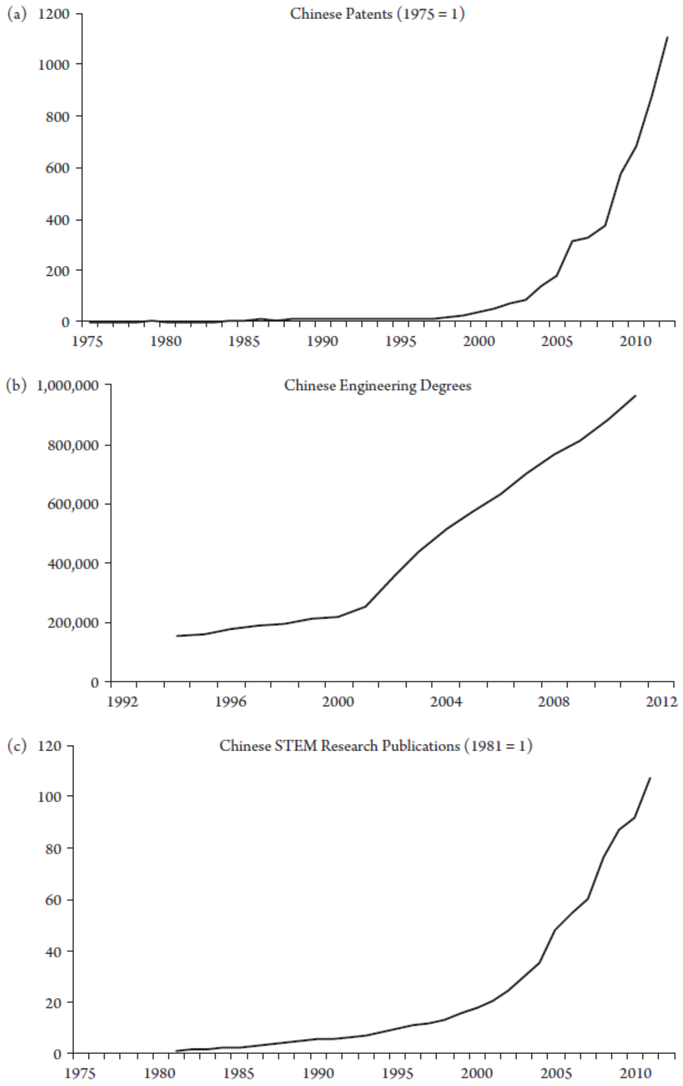
- Scientific knowledge is regularly used as an input to the innovation process.
  - STEM research publication rates
- Scientific progress and technological innovation overlap, but the former does not necessarily lead to latter.



Tech(patents per capita) vs Science(STEM research publications per capita) for 1981-2011

2-2. Case of China

Index: Patent, Researchers, STEM Paper



- China has dramatically improved S&T capabilities, but it still remains a minor player relative to the world's most innovative nations.
- Patent
  - Concentrated on sectors that accept lower standards, less expensive and faster
- Papers
  - China generally lacks the ability to do big science or organize large scale research projects
  - STEM workers have far less funding and equipment.
  - Middle Kingdom - outside of Beijing or Shanghai.

2-2. Case of China

Index: Patent, Engineers, STEM Paper

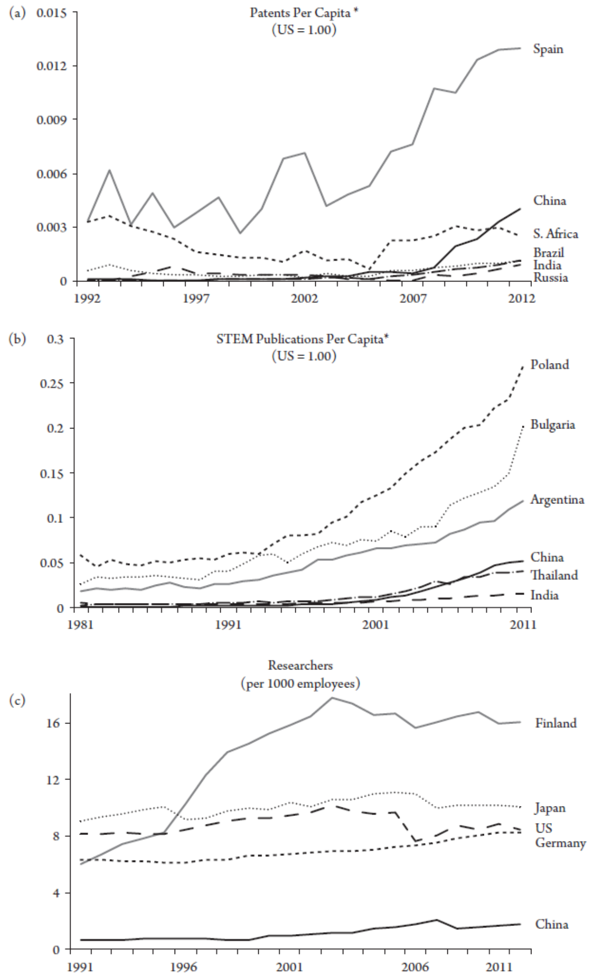


Figure 3.5a–d Or is China an S&T mouse that roars?.
Sources: NBER Patent Database; US Patent and Trademark Office; Thomson-ISI; China Statistical Yearbook. National Bureau of Statistics of China; World Bank; OECD Main Science & Technology Indicators; US International Trade Commission.
*Weighted by forward citations

Is China the most innovative country?

- Do not invent breakthrough technologies themselves. create workshops for manufacturing other countries innovations.
  - low cost knock offs of foreign products
  - Short term, low-risk improvements to production or distribution processes, or incremental improvements to foreign products
- Fantastic economic growth, but no cutting-edge S&T.
  - Similar arguments can be presented for - Russia, India, Brazil, South Africa
  - Occasionally win attention from the media as "Next miracle economy" but actually produce little in S&T

2-3. Methodology to observe the variation

- Other indexes
  - TEP(Total factor productivity)
  - Exports of tech
  - INSEAD index
  - WEF(World Economic Forum) index
  - Florida index
- Limitations: Private firms often do not publish their scientific research. The scientific output would not show up in the data that tracks research published in peer-reviewed scientific journals.
  - Corporate science is kept in house, as trade secrets, distributed internally or sold on private markets.
  - Military and defense contractors would also tend to remain unpublished.

2-4. What needs explaining?

- Cardwell's law
  - How and why of national innovation rates differ?
- Roles of Government
  - If a nation wants to improve its S&T performance, then its government must act to solve both **market failure** and **network failures**.
  - Institutions, policies, and networks explain how nations innovate, but not why.
  - Governments **fix markets** and **create networks**
- Why do some governments create and support markets and networks for S&T better than others?

  e.g) Stronger intellectual property rights, R&D spending, the establishment of universities, advancement of education, strategic trade initiatives to foster national S&T competitiveness

2-5. Explanation of National Innovation Rates

- Explanation of Cardwell's Law
  - The rate and direction of scientific progress and technological change are the products of random changce
  - "Easter egg" or "heroic model" of innovation
- But, National innovation rates are not dominated by random chance, at least not on the time scale shown.
  - If innovation was mostly a random phenomenon, then we would expect to see very different sets of rankings each year.
  - Only a few countries have experience d drastic changes in their S&T performance over the past seventy years.

2-5. Explanation of National Innovation Rates

1. Country's population or economy will determine its national innovation rate
   - Larger populations can provide more STEM workers and entrepreneurs, and more innovation.
   - Larger economies have more resources to dedicate toward S&T, exploit for profits and world market share.
   - **But**, China, India, Indonesia, Russia, Pakistan, Mexico should be among the world's best innovators.
2. Military spending determines national innovation rates
   - Defense-related innovation consistently spills over into the civilian economy
   - **But**, S&T progress has flowed in reverse, from civilian to military from some countries in during Cold War period
   - Neither military spending nor weapons production correlates well with national innovation rates

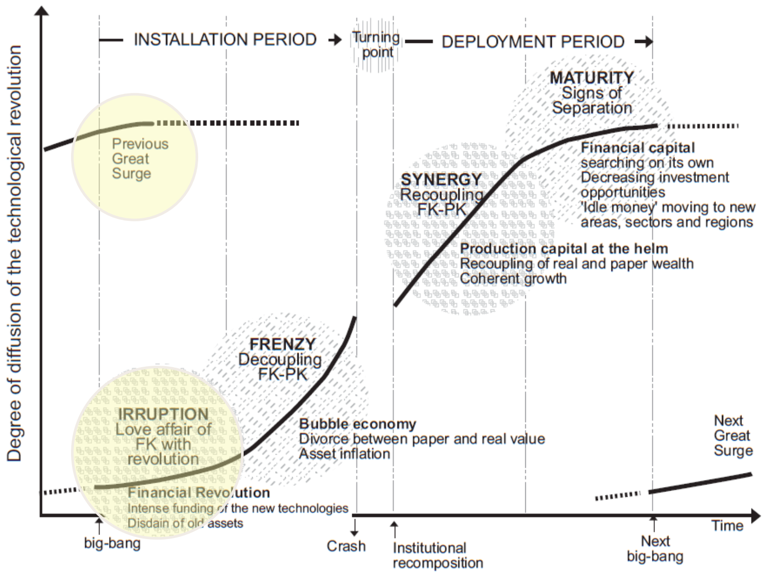
2-5. Explanation of National Innovation Rates

3. First-mover advantages on some countries while others locking in competition.
   - Education system with STEM workforce, S&T based industries make easier to maintain tech frontier.
   - **But**, contradicted by late innovators (e.g. Japan, Taiwan…)
4. Late industrialization explains national innovation rates
   - Late-comers have strong incentives to leap ahead to tech frontier.
   - Strong interventionist government to allocate resources for catch-up (free-riding concept)
   - **But**, how could USA persist as a lead innovator?
5. National culture matters
   - Risks, rewards, opportunities that guide economic activity, level of trust in a society …
   - Sometimes society resists to innovate

Ch7. Technological Losers and Political Resistance to Innovation

3-1. Political Resistance

- “Creative destruction” – Joseph Schumpeter’s insights into innovation
  - The killing off of the old by the new
  - Innovation may benefit society, but it has its victims, and these victims fight back
- Political resistance to new S&T throws a wrench into traditional theories of national innovation rates, and can wreck the policies and institutions designed to promote innovation
- Primary obstacles to technological progress are the market and network failures
- Technological losers
  - Fight back against Technology, Industry, jobs, and investors



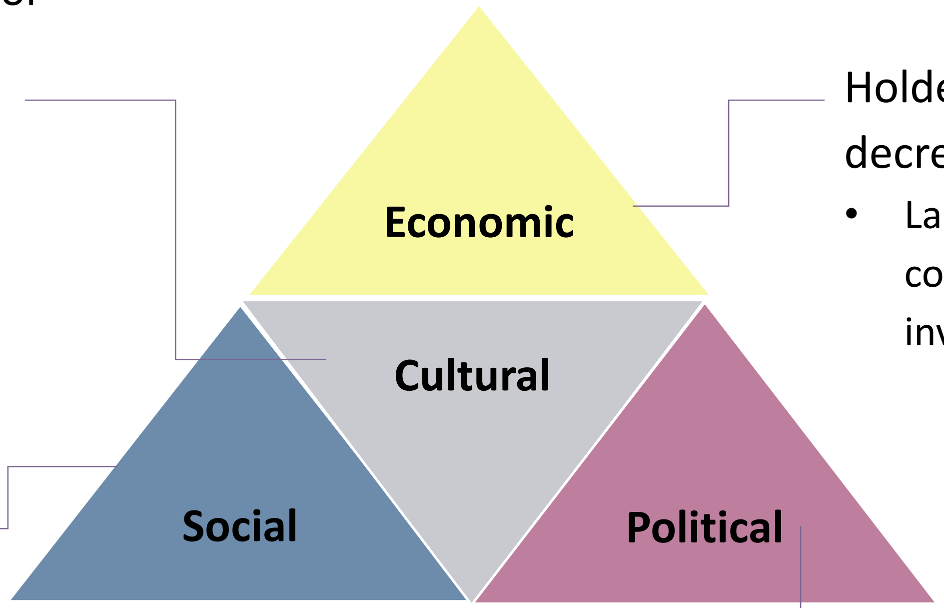
3-2. Losers created by New S&T

S&T progress that conflicts with ethical or normative values

- Religious or other cultural groups

Holders of assets whose value is decreased by new S&T

- Labor, Land owners, environmentalists, consumers, producers of status quo S&T, inventors in status quo S&T



Innovation will alter their ability to access or negatively affect the costs, risks, or benefit of an existing technology

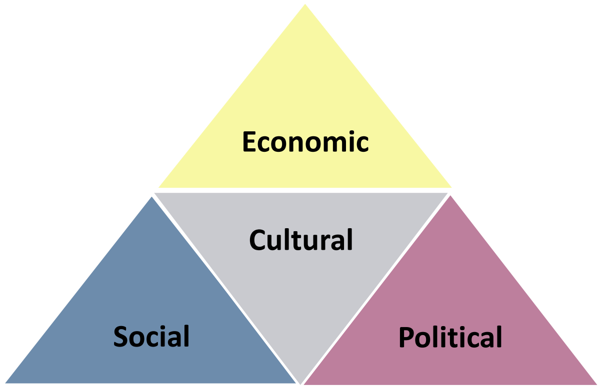
- Minorities

Political power or legitimacy is threatened by S&T progress

- Elected officials, political parties, bureaucrats, military, interest groups

3-3. Case of Electricity

- Thomas Edison(1880)
  - Market his new electric power stations
  - Resistance appeared across economic and political spectrum
- Technological Losers
  - Gas industry: 70yr old Monopoly on lightening in most cities and sought to retain it
  - Municipal government: power was threatened by the ever increasing size and scope of the local electricity monopolies
  - Consumers: Feared exploitation by monopoly pricing and service
  - Citizens: Cross-section of people who felt that electrical fires and electrocution posed a serious threat to their lives and property.



3-3. Case of Electricity

- The Chorus of Losers
- General-purpose technology
  - Regulations slowed technological change throughout the economy.
- Incremental innovations
  - Face less opposition than radical
  - New technology need not to be a revolutionary

Table 7.1 **Appearance and Diffusion of Various Electric Power Technologies**

	First Central Power Station	*Incandescent Lighting, 1887 (US=100)*	*First Electric Tram*	*Miles of Electric Trams, 1900*	*First AC Power**	*Generating Capacity, 1912–1915 (kWh)*
United States	1882	100	1887	20,000	1893	5,165,000 (1912)
Germany	1884	37.5	1890	1,800	1891	2,075,000 (1913)
Great Britain	1882	25	1896	572	1899	1,135,000 (1914)
France	1883	8	1895	292	1895	1,800,000 (1913)

*Modern, 3-phase electric power.

Sources: Hughes (1983); Levy-LeBoyer and Morsel (1994a, 1994b); Millard (1981); Todd (1984).

3-4. The Chorus of Losers

- Distributive aspects of innovation
  - Revolutionary S&T can be fought so successfully for so long, while some incremental innovations are able to proceed more rapidly.
  - Revolutionary: entire industries, workers, economic vitality of the regions
  - Incremental: only a single firm's product line, decrease its profit.
- Political elites are pressured by much larger interest groups seeking protection
  - General taxes, regulations, the removal of government support for new tech, protection and procurement for status quo tech
  - → Political representative's constituency

3-4. The Chorus of Losers

- The higher the cost of discarding an existing tech, the more resistant and less supportive to innovations

Immobile Assets	Mobile Assets
More Resistant	**More Supportive**
Tightly linked to Technology (e.g. Nuclear engineers)	Highly liquid(stocks and bonds)
Firms of status quo technology	Unaffected by technological change (accounting skills, physics degree)
	Uncommitted(cash, college entrants)

cf) Developer: Highly innovative culture, technology rapidly changes

백앤드 개발자 면접 문제 은행

@Version 1.0

이 저장소에는 백앤드 개발자 면접에 나왔던 문제들이 있습니다. 여기에 있는 모든 문제들은 푸는 것(꽤 많은 시간이 걸릴 것입니다)보다는 여기서 몇 가지 질문을 골라 자신의 실력을 평가해보는 것이 좋을 것입니다.

한국어 번역

- @DevSusu

목차

Reference: https://github.com/tvandame/back-end-developer-interview-questions/blob/master/Translations/Korean/README_KR.md

4-0. Military resistance to Innovation

- Resistance to technology that might replace them can be quite intense in military
  - Changes to long-established strategic doctrines, battlefield tactics, or bureaucratic organizations
- Military advancement
  - Altering or reducing the dangers of combat, new technology can affect the prestige of particular assignments.
- Civilians can also slow military innovations.
  - Budget allocation, myriad organizational and political forces, provocative anti-war
  - e.g) ship construction, munitions acquisition, Tomahawk cruise missiles
- Tomahawk cruise missiles
  - Delayed 30 yrs

Tomahawk cruise missile, launches from ships and submarines, Manufactured by Ratheon

4-1. Case of Naval Missile

- Oppose from Aircraft community within Navy(1960s)
  - Pilots claimed manned aircraft fulfilled missions more efficiently
  - Harpoon antiship missile, possessed limited range (1977)

ATM-85 Harpoon antiship missile on A-4 Skyhawk

Harpoon antiship missile, launched from ship

P-3 Orion Patrol Aircraft armed Harpoon missiles

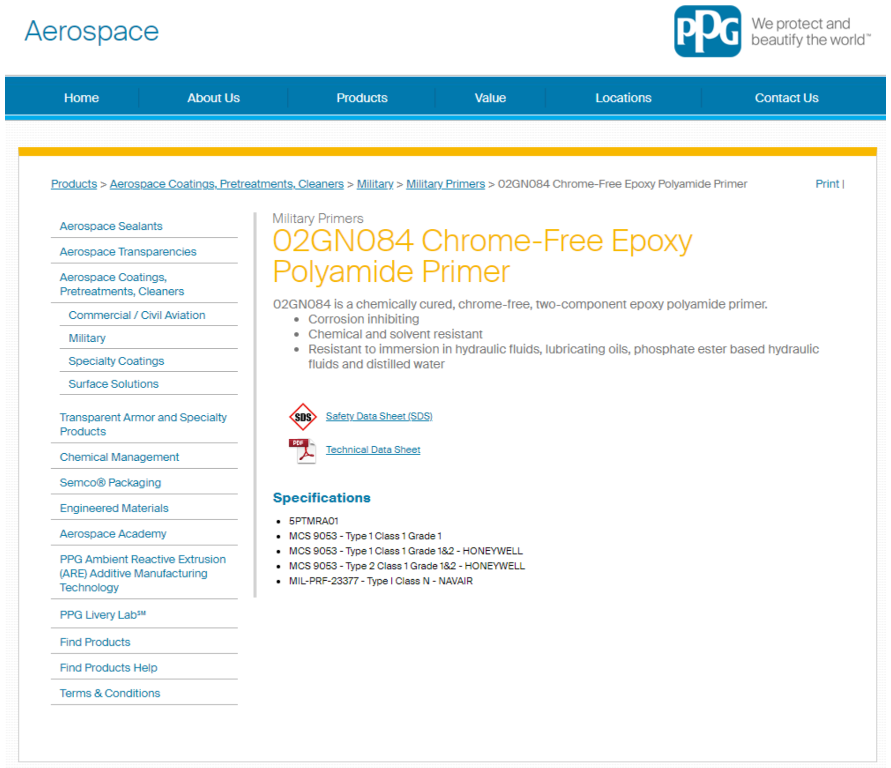
- Tomahawk cruise missile
  - Naval commanders continued to resist the weapon's installation (1983)
  - Lack of control on new over-the-horizon missile, not able to recalled nor targeted by sight

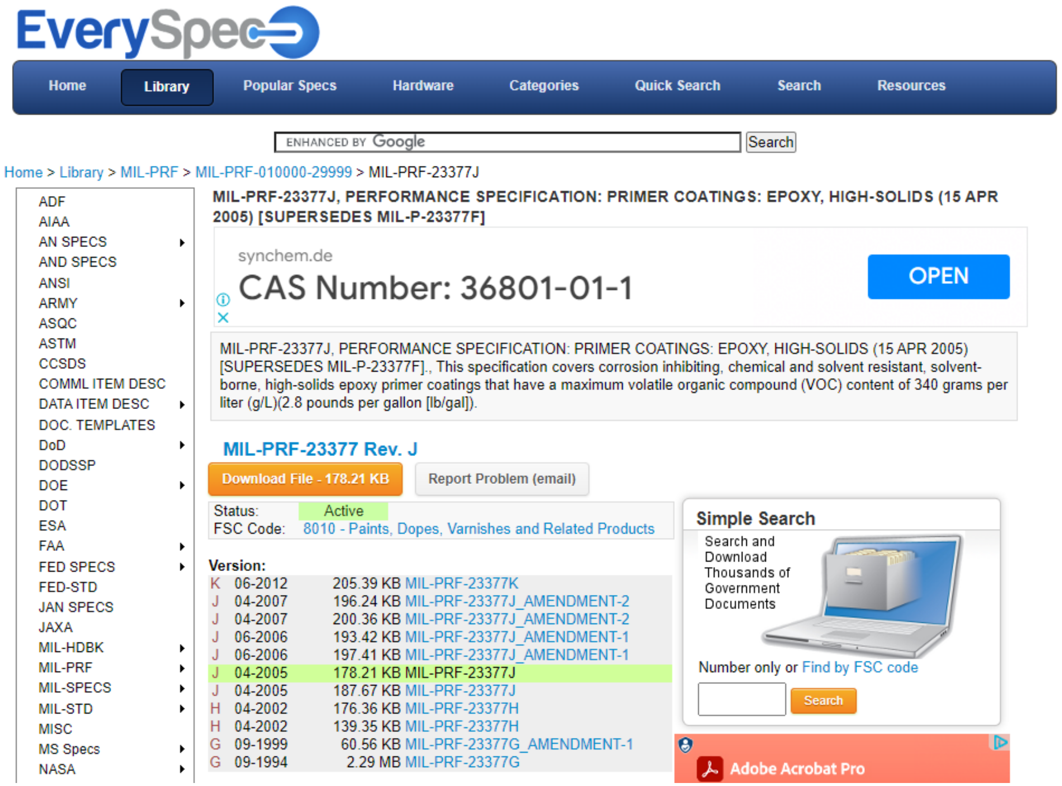
→ Request of Trustworthy

4-2. Military standardization & qualification

- Trustworthiness of standardization & qualification

MIL-STD-XXXX





4-3. Meanwhile, in Korea

핵심기술사업 개요

사업설명

미래 핵심전력 무기체계의 국내개발 또는 생산에 필요한 고도 첨단기술로서 선진 외국에서 旣 개발되어도 기술이전을 회피하거나 국가안보차원에서 반드시 확보가 요구되는 기술을 개발하는 사업

주요사업 현황

핵심기술사업은 사업형태 및 기술수준에 따라 기초연구, 응용연구/시험개발, 무기체계 패키지형 핵심기술, 국제공동연구로 분류

구분		사업목적	규모	과제당 총 예산	사업 기간	연구 단계
기초연구	개별기초	신개념 무기체계 개발에 활용 가능한 미래 원천기술 확보를 위해 대학 등에서 연구하는 사업	1개 과제	1.5~3억	3년 내외	기초 연구
	특화 연구실	미래 핵심기술 분야에 필요한 기초연구분야 5개 내외의 과제로 구성하여 연구실 단위로 집단 연구 하는 사업	3~5개 과제	30~50억	3년, 6년	
	특화 연구센터	핵심기술 확보를 위한 기반을 구축하고, 우수인력의 국방 연구개발 참여 유도를 위해 특정 기술의 중점적 연구를 지원하는 사업	15~20 개 과제	120~180 억 내외	6년, 9년	
핵심 기술 개발	응용연구/시험개발	무기체계 전력화 시기에 부합하도록 체계개발에 요구되는 핵심기술을 사전에 개발하기 위해 단위 과제별로 개발하는 사업	1개 과제	50~200억 내외	3~5년	응용연구/시험개발
	무기체계 패키지형	핵심기술의 무기체계 연계성 향상 및 산·학·연 국가 R&D 역량을 적극 활용하기 위해 무기체계 연구개발 이전에 필요한 핵심기술들을 묶음 (패키지)으로 개발하는 사업	3~5개 과제	300~500 억 내외	3~5년	응용연구/시험개발
	국제공동 연구개발	국내의 연구개발주체와 국외의 연구개발주체가 공동의 연구개발목표를 위하여 개발비를 공동으로 부담하여 수행하는 사업	1개 과제	50억 내외	3~5년	응용연구/시험개발

국방기술진흥연구소, krit.re.kr

전력지원체계 연구개발 사업

사업개요

*** 전력지원체계란?**
유도무기, 항공기, 함정 등 전투력을 발휘하는 무기체계 외의 장비·부품·시설·소프트웨어, 그 밖의 물품 등의 제반요소로, 근무지원 물자·장비, 피복·장구류, 방탄류, 일반차량 등이 포함됨
※ 전력지원체계 세부분류는 국방부 훈령 '국방전력발전 업무훈령' 별표 5를 통해 확인 가능

전력지원체계 획득은 국방전력발전업무훈령에 규정되어 있으며, 연구개발 사업은 아래의 절차에 따라 추진

국방기술진흥연구소 전력지원체계연구센터는 「국방과학기술혁신 촉진법」, 「민·군 기술협력사업 촉진법」 에 기반한 연구개발 사업의 관리와 기타 연구개발 사업에 대한 시험평가 등에 관한 기술지원을 수행

사업구분

- 정부가 연구개발비를 부담하는 **정부투자 연구개발**
- 업체가 연구개발비를 부담하는 **업체투자 연구개발**
- 국방부와 산·학·연이 연구구개발비를 공동으로 부담하는 **정부·업체공동투자 연구개발**
- 국방부와 타 정부부처가 공동으로 비용을 분담하는 **정부공동협력사업**
- 민·군기술협력 출연금으로 개발하는 **민·군기술협력사업**
- **「국방과학기술혁신촉진법」**에 따른 전력지원체계연구개발

관련규정

- 국방과학기술혁신 촉진법
- 민·군기술협력사업 촉진법
- 국방부 훈령 「국방전력발전업무훈령」 제3장
- 국방부 지침 「전력지원체계 연구개발 업무지침」

Government as a innovation initiative is ongoing project on military systems

5. Conclusion

- S&T progress creates winners and losers, and the losers can resort to politics to obstruct innovations that threaten their interests.

> "Every innovation is born into an uncongenial society, has few friends and many enemies, and only the hardiest and luckiest survive" – Cyril Smith, historian

- Government is rarely a neutral observer in these upheavals but rather is pursued by both sides in the hope of gaining policy advantages in their mortal conflict
- Political opposition to the "*creative destruction*" aspects of innovation helps to explain why some countries are better at S&T than others.
  - Political opposition lowers the incentives to innovate