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How does public procurement create innovation in Korea?

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What kind of innovation system does Korea have?

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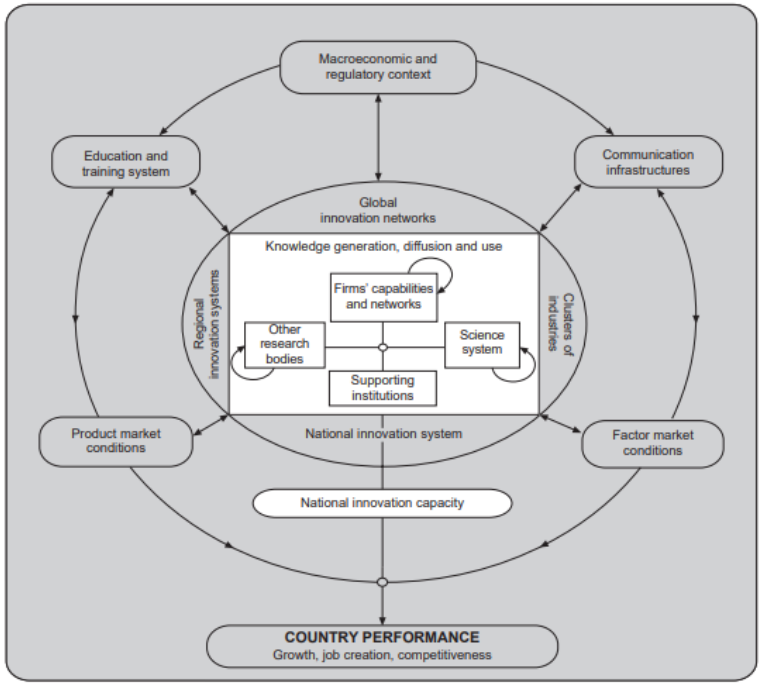
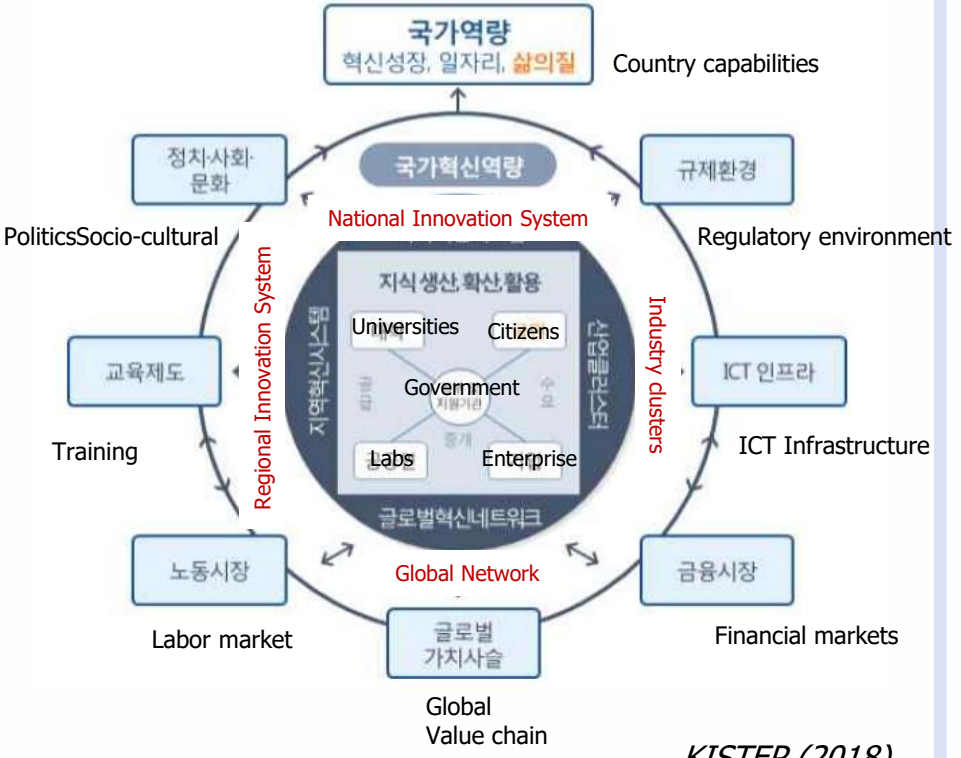
Korea has designed its own National Innovation System by referring to the OECD's standard National Innovation System model and is in the process of continuously improving the model.

OECD Standard National Innovation System



OECD (1999)

Korea's National Innovation System (NIS 2.0)



KISTEP (2018)

What kind of innovation system does Korea have?

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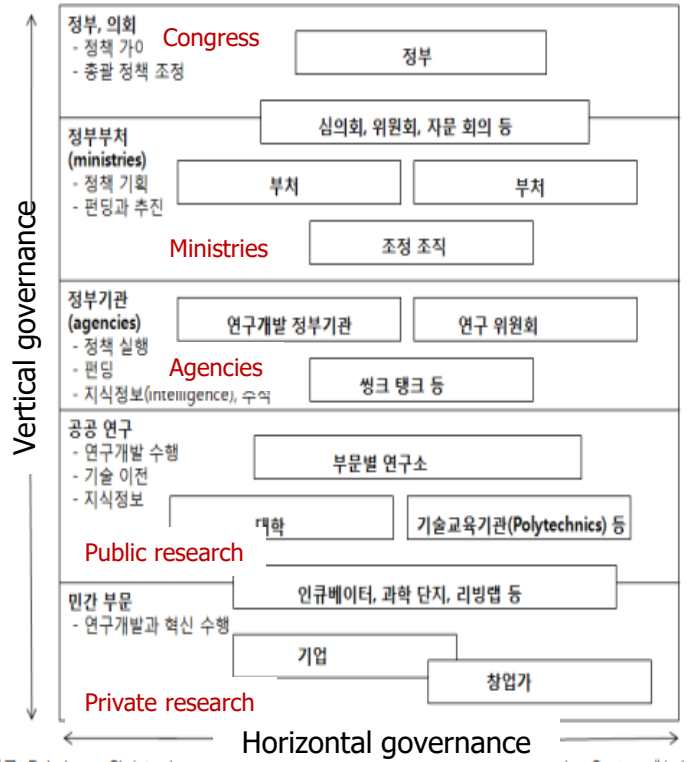
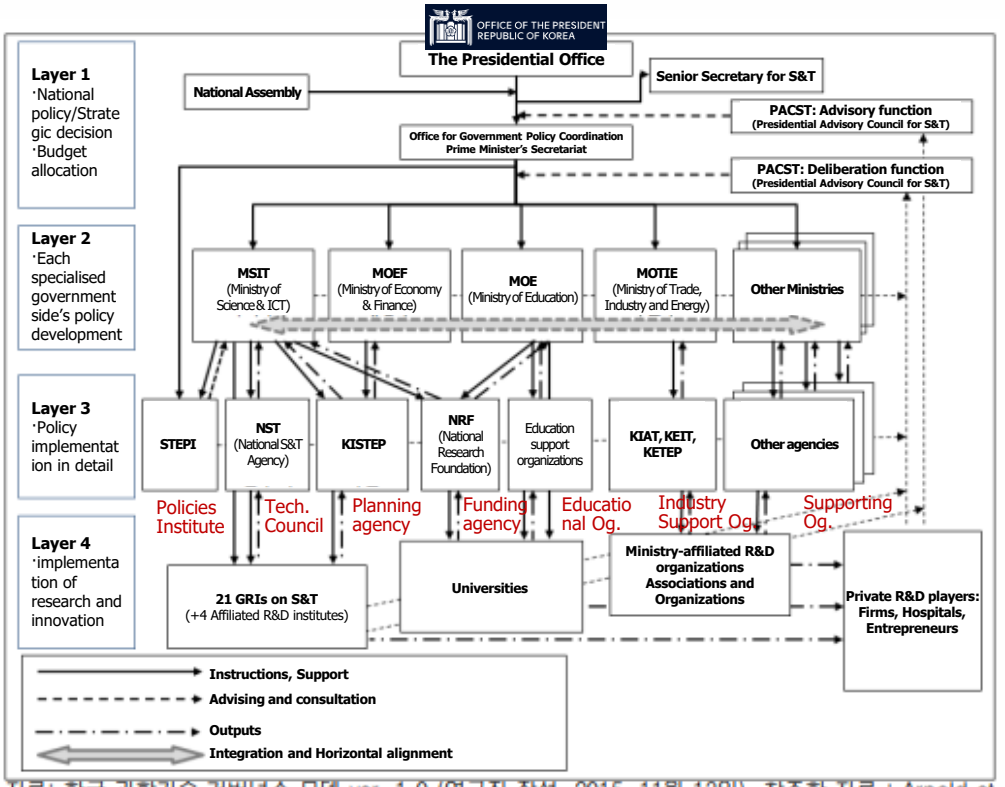
Korea's NIS is organized in the following layers, taking into account the vertical and horizontal governance, and the collaboration of the various actors.

OECD Standard National Innovation System



자료: Palmberg, Christopher and Tarmo Lemola(2012), "Governance of Innovation Systems" in World Bank. 2012. Agricultural Innovation Systems : An Investment Sourcebook, World Bank. Pp. 469-479.

National Innovation System in South Korea (NIS 2.0)

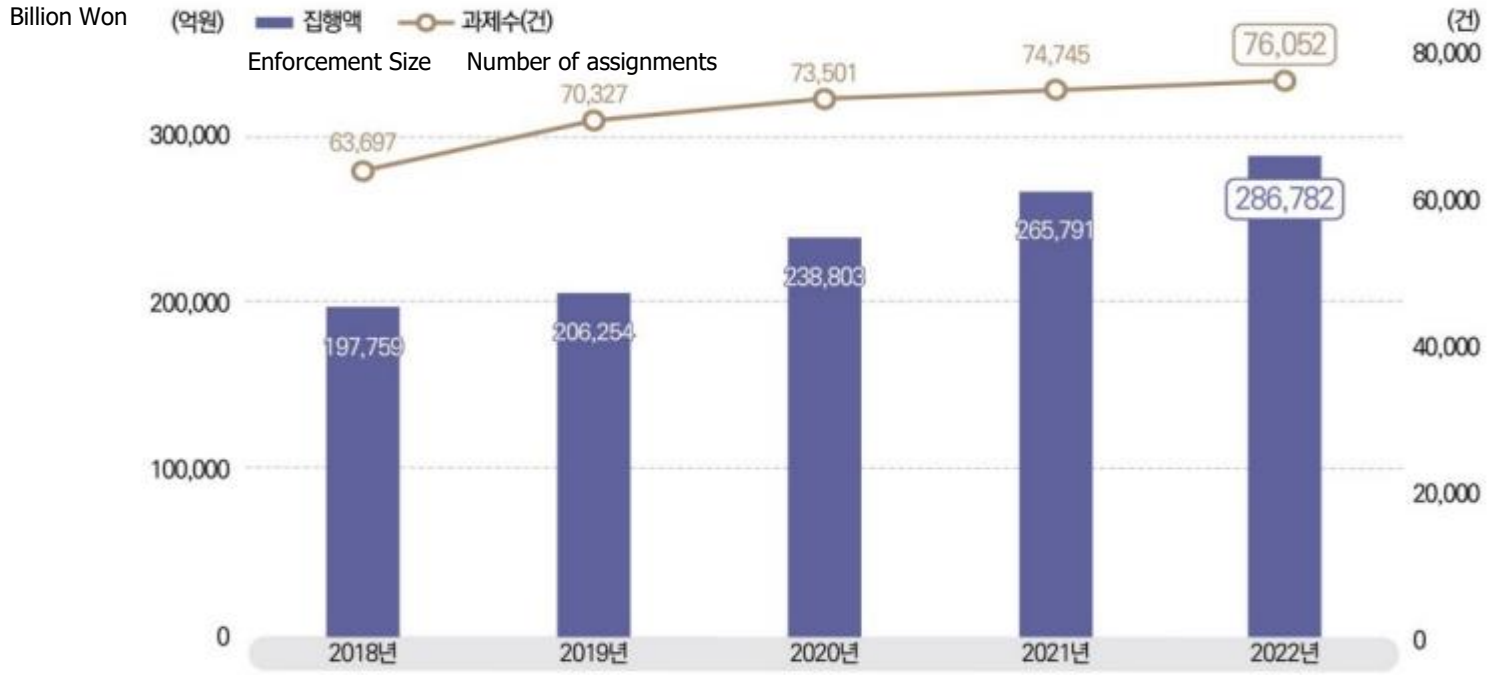


자료: 한국 과학기술 거버넌스 모델 ver. 1.0 (연구진 작성, 2015. 11월 13일), 참조한 자료 : Arnold et al.(2000), 홍형득(2007).

What kind of innovation system does Korea have?

As a result of this innovation system, Korea is one of the world's leading countries in terms of R&D investment, with a total investment of approximately KRW 29 trillion and an average of more than 70,000 R&D projects per year.

Trends in the amount of national R&D funding and number of projects



주) 2022년도 국가연구개발사업 조사분석 보고서, 과기정통부/한국과학기술기획평가원, 2023

KISTEP (2023)

What kind of innovation system does Korea have?

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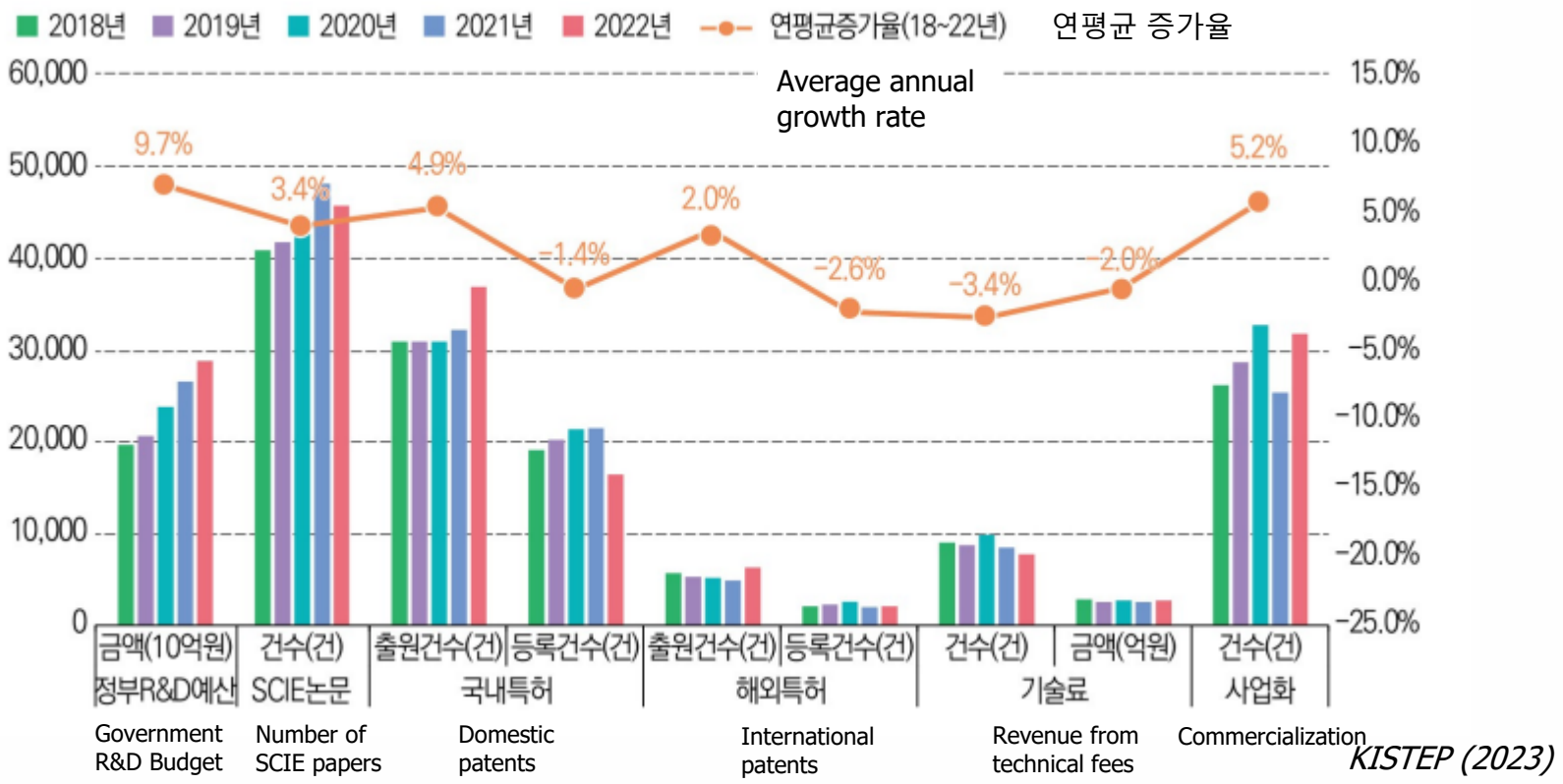
As a result of these R&D investments, Korea's R&D investment performance has shown a growing trend every year, especially in terms of papers, patents, and commercialization.

Recent 5-year trend of national R&D project performance ('18~'22)



KISTEP (2023)

What kind of innovation system does Korea have?

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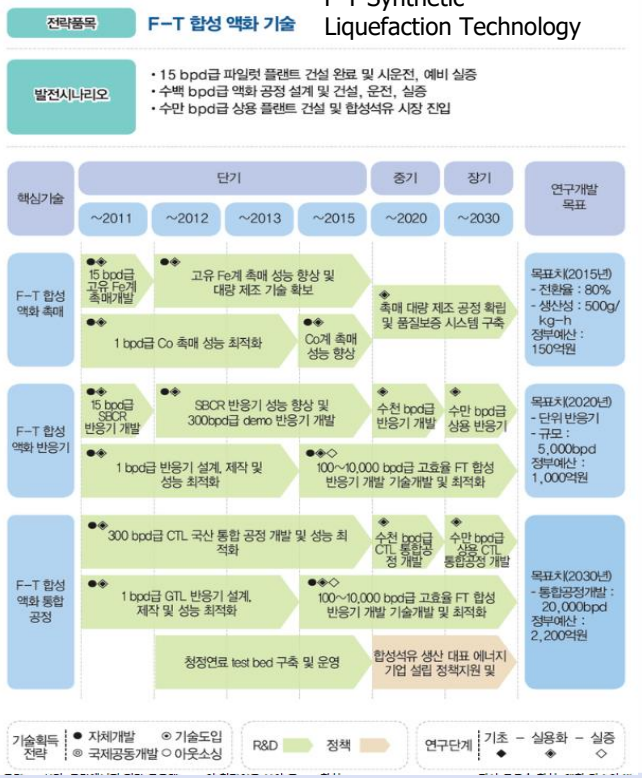
Korea's R&D investments are centered on the technologies selected by the government, which defines the core technology elements corresponding to the core strategic items for each technology group and establishes a roadmap to secure them through R&D.

(Ex.) Technology Roadmap for Clean Fuels

F-T Synthetic Liquefaction Technology Segmentation

F-T Synthetic Liquefaction Technology



What kind of innovation system does Korea have?

As such, Korea has used a strategy of catching up with advanced economies by investing in national R&D based on the national innovation system, which has been a major factor in achieving ultra-fast and ultra-high economic growth.

- All core technologies have a roadmap with a long-term plan in line with the strategic goals set by the country.
- All core technologies have quantitative targets for each stage relative to the most advanced developed country technology.
- The government invests in the R&D of these technologies and provides the developed technologies to relevant companies for free to promote commercialization.
- In this process, universities and government labs serve as major producers of innovation.

How will we innovate beyond the technology of the developed countries that we have chased?

Demand-based innovation

South Korea as a First Mover

Strengthening the demand-based innovation system and alignment with public procurement policies

South Korea as a First Mover

While Korea's input-oriented national innovation strategy has been an effective way to drive rapid and large-scale growth, it has also faced systemic problems that have accumulated as a result of the continuation of the current policy.

- The current R&D system is based on a 'supply-oriented' characteristic as it follows a proactive innovation path of 'R&D' → 'industrial development' → 'export support'.
- Continued questioning of the effectiveness of strategies aimed at creating industrial outcomes through R&D subsidy investments
- Basic and original research is not reflected in national and corporate demand due to bottom-up R&D planning, and applied development research is operated in a top-down manner, which acts as an entry barrier to reflecting market demand.
- Focus on business contribution and quantitative performance creation limits utilization and diffusion of substantial R&D performance

  ** Insufficient quality of patents created (5% level of excellent patent rate)*

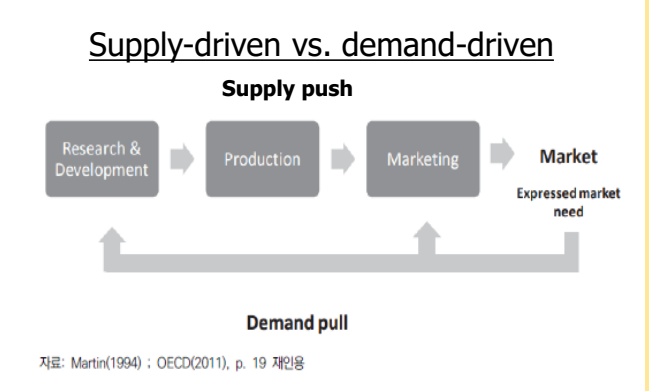
South Korea as a First Mover

In addition, as Korea's economy grows in size and technological capabilities, coupled with rapid global market changes and the increasing demand for technologies that meet market needs, it is no longer possible to rely on catch-up innovation policies alone.

- There are many problems in bringing new technologies and convergence products to the market due to technical regulations, including the certification system.
- More fundamentally, there is a lack of strategic policy direction for the utilization and diffusion of R&D results and a focus on input-oriented R&D policy measures.

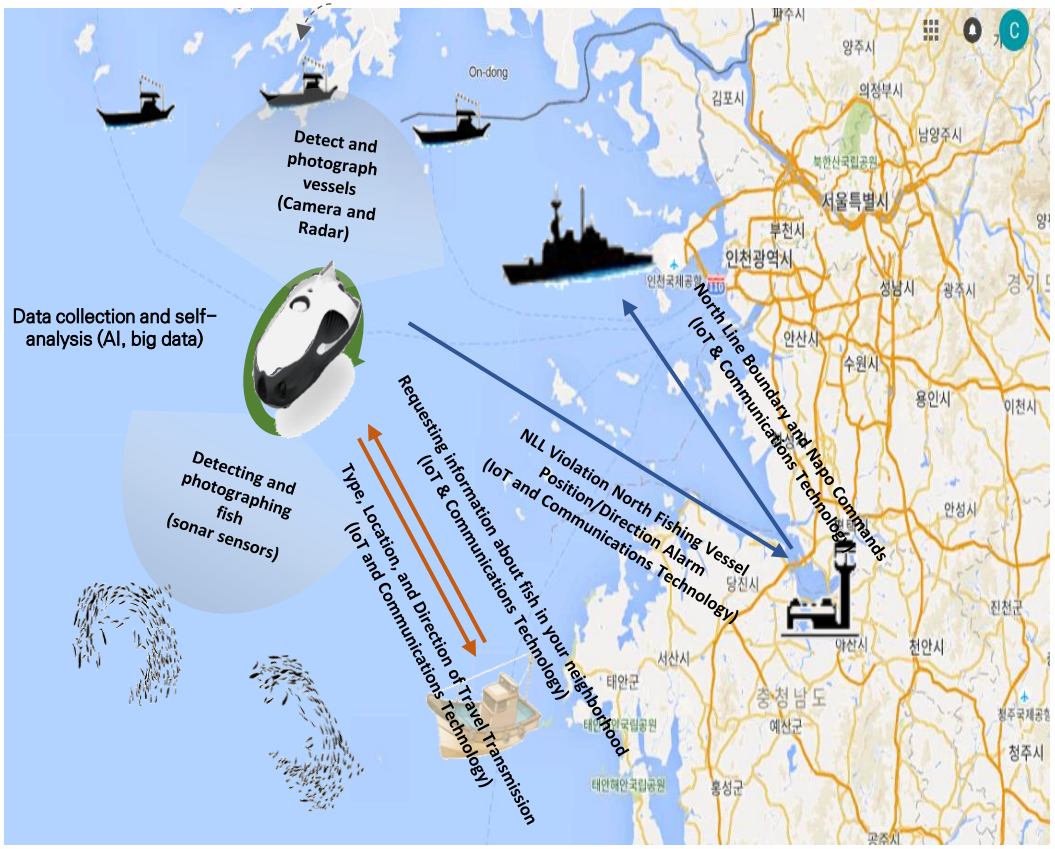
Emerging need for Demand Based Innovation policies utilizing 'public markets' as a new source of innovation

Identify products and services that meet market needs based on 'demand' to complement the existing R&D-intensive policies.



South Korea as a First Mover

This shift has led to increased interest in the idea of conducting R&D around "market demand," and the following examples show how the concept works



Step 1. Incubating the underlying technology

"Is drone technology on the rise?"

Step 2. R&D (Feature Implementation)

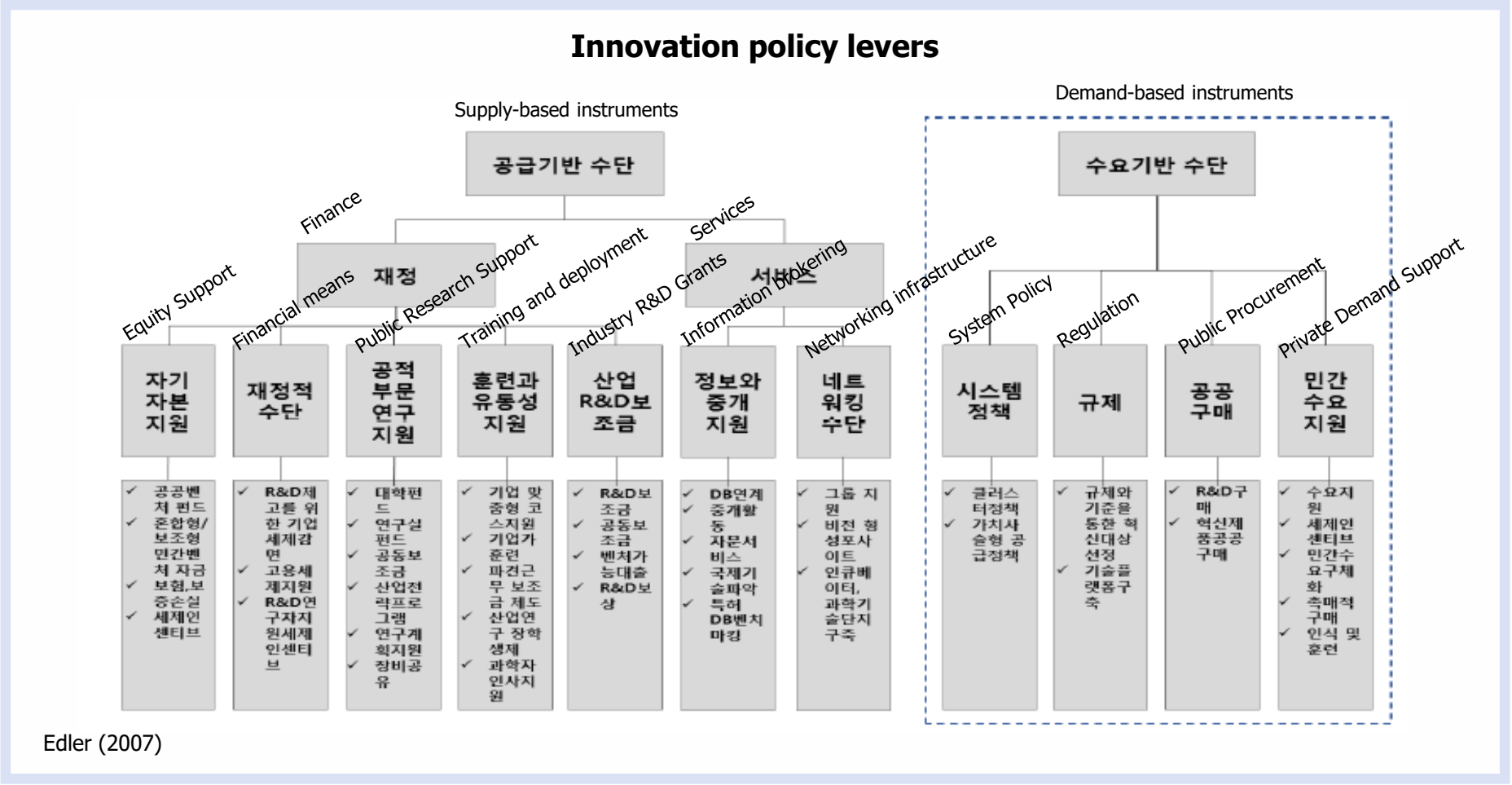
"What are the key technologies for drone development for drone development?"

Step 3. Serviceify

"What are the new services that utilize drones that don't exist before?"

South Korea as a First Mover

These demand-driven policy instruments can be in the form of policies, regulations, public procurement, and incentives to support private demand that align the system with demand.



Edler (2007)

South Korea as a First Mover

In particular, public procurement is a policy area which the government can do strong control, and it is also characterized by high effectiveness in compensating for the inefficiency of existing input-oriented policies which the government injects large amounts of budget through market provision.

Types and characteristics of public procurement

유형	설명 및 주요 특징
정기적 공공조달 (Regular public procurement)	공공기관이 업무를 수행함에 있어 정기적인 수요가 발생하는 제품 및 서비스를 구매하는 방식 ex) 사무용품, 통신서비스, 자동차 등
혁신 친화적 정기적 공공조달 (Innovation-friendly regular procurement)	정기적 공공 구매 시 혁신에 대한 요소를 고려하여 혁신 제품 및 서비스의 구매를 배척하지 않는 구매 방식 - (방법) 기능적 조달(functional procurement) 방식을 취함
혁신 공공조달 (Public procurement of innovation)	직접 공공구매(direct public procurement of innovation) - 정부가 직접 구매자이자 최종 사용자로, 점진적 & 급진적 혁신 가능
	촉매적 공공구매(catalytic public procurement of innovation) - 직접 공공구매 보다 조정자로서의 정부역할 중요 - 수요로 쉽게 전환되지 않는 필요성 명확화 및 사회적 욕구 충족 or 사회문제 해결하는 프로세스 구현에 사용됨
상업화 전 조달 (pre-commercial procurement)	정부가 직접 필요로 하는 제품 및 서비스에 대한 R&D를 지원하고, R&D결과물을 조달하는 구매 방식 - 문제해결중심의 R&D에 초점을 맞추며, 프로토타입 개발 or 테스트까지 지원 포함 - 제품 및 서비스에 대한 구매를 포함하고 있지 않음(상업화 미포함)

자료: Edquist(2015) 참고하여 저자 작성

- How public entities buy products and services that are in regular demand to fulfill their mission.
- A purchasing approach that does not preclude the purchase of innovative products and services by considering factors for innovation in regular public purchases.
- How governments meet consumer needs (such as solving social problems) by acting directly as buyers of innovative products or as coordinators of private demand.
- A procurement approach that supports R&D and procures the results for products and services that the government directly needs.

South Korea as a First Mover

These public procurement policies can be utilized in the public sector in various forms, and depending on the level and type of innovation, different types of procurement can be deployed in different forms.

Public sector impact of procurement on innovation

조달유형	공공부문의 역할	조달 또는 보상의 주요동기	잠재 혁신 유형	공급 측면에서의 혁신 관련 위험	조달대상/지역 (geography)
효율적 조달 (Efficient procurement)	효율을 추구하는 다수 사용자	비용 대비 가치 (Best value for money)	점진적 혁신	공공시장에 지나친 의존성, 노후화 위험	중앙 집중된 규격(표준) (Centralized specifications)
적응조달 (Adapted procurement)	틈새 사용자	최적의 솔루션 (the best adapted solution)	틈새시장	시장 불확실성	지역적 규격, 지역 조달
기술적 조달 (Technological procurement)	복잡한 대형 고객	최상의 솔루션 (the best available solution)	아키텍처	투자를 정당화하기에 불충분한 수요	중앙 집중된 규격, 국가 조달
실험적 조달 (Experimental procurement)	실험적 (선도) 사용자	가장 혁신적인 솔루션 (the most innovative solution)	급진적 혁신	시장 불확실성, 사용자-생산자 소통의 어려움, 인센티브 부족(예. IP 보호)	지역 규격, 국가조달

자료: Uyarra and Flanagan(2010) ; OECD(2011), p. 38 재인용

- Value for money and moderate expectation of incremental innovations
- Procurement aims to find the best solution, so you can expect innovations that meet market needs rather than cutting-edge technology
- Pursue great innovation technologically by finding the best solution, but may be limited in terms of finding the right demand and economics
- Pursue the most radical innovations and expect the biggest results, but cannot fully address the many threats of experimental procurement

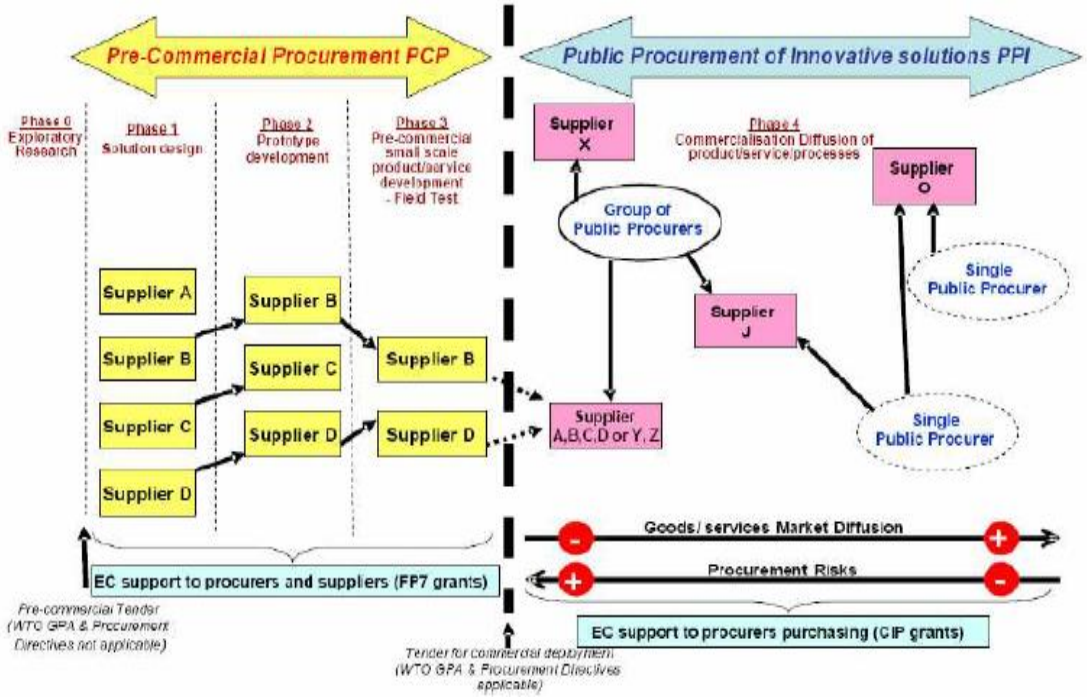
South Korea as a First Mover

Procurement policies aimed at these innovation outcomes were first adopted by the most innovative countries in Europe, and theory and practice have been shaped by key EU member states and their academics.

- Demand-driven R&D policies that utilize the purchasing power of public procurement markets are becoming more popular in Europe's leading innovation countries.
- Establishment of a theoretical framework and related systems for Public Procurement for Innovation (PPI) centered on the EU
- Edler (2007) presents public procurement as a representative instrument of the demand perspective of innovation policy. In addition, there are various studies (Dalpe, 1994, Edquist, 2012) that claim that public procurement has the effect of inducing technological innovation.
- In Europe, the PPI Guidelines issued by the European Commission (EC) provide the basis for implementing PPI schemes in member states.
- As a result, countries such as Germany (FMI), Finland (BF), and Sweden (VINNOVA) have established and are operating PPI systems tailored to their specific needs.

South Korea as a First Mover

In the EU, the EC has categorized these innovative procurement methods into two main types: PCP, which is procurement in conjunction with R&D, and PPI, which is procurement of innovative products.



자료: Rigby, J., et al.(2012), Feasibility Study on Future EU Support to Public Procurement of Innovative Solutions: Obtaining Evidence for a Full Scheme. European Commission DG Enterprise & Industry.

PCP(Pre-Commercial Procurement)

A system that targets products and services that are in need of public procurement but are not currently developed, and links technology development to procurement.

Public Procurement for Innovation (PPI)

Developing and expanding markets for innovative products and services through public procurement

**Purchase process of public organizations for developed products and services that do not require R&D support.*

South Korea as a First Mover

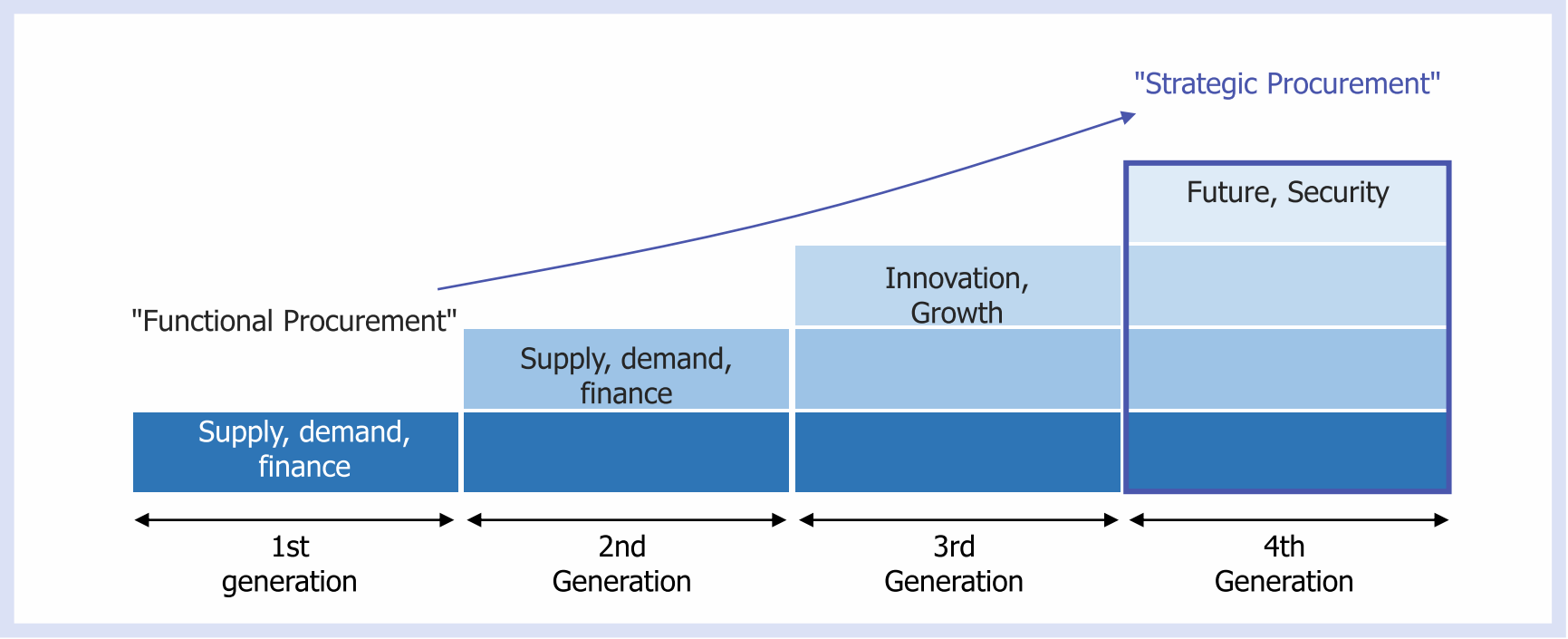
Innovative procurement policies are effective in Korea because the country continues to invest at a world-leading level in R&D, and because it is a country with a centralized procurement system, it can be very effective in terms of scale and control.

- It is expected to have a high ripple effect when applied to Korea, which has an advanced R&D system and a centralized public procurement system.
- As the country is promoting high R&D investment of 4% of GDP, it is expected to achieve substantial policy effects if R&D suitable for creating and fostering new industries is linked to the public procurement market.
  - *Public procurement is a large market, with more than $200 trillion traded annually.*
  - *Efficient public sector purchasing can foster new, high-value-added industries and serve as a stepping stone for SME growth*
- In particular, the purchasing power of the public procurement market, which is more than 10% of GDP (about 196 trillion won, as of '22), and the market control power due to the centralized public procurement system serve as an excellent foundation for improving the effectiveness of the policy implementation process.
  - *Contributing to sales support through various support policies, such as increasing the amount of public sector purchases of SME products.*
  - *In particular, the Public Procurement Service procured 77.3% (17.4 trillion won) of its total purchases (22.5 trillion won) from SMEs (as of 2014).*

South Korea as a First Mover

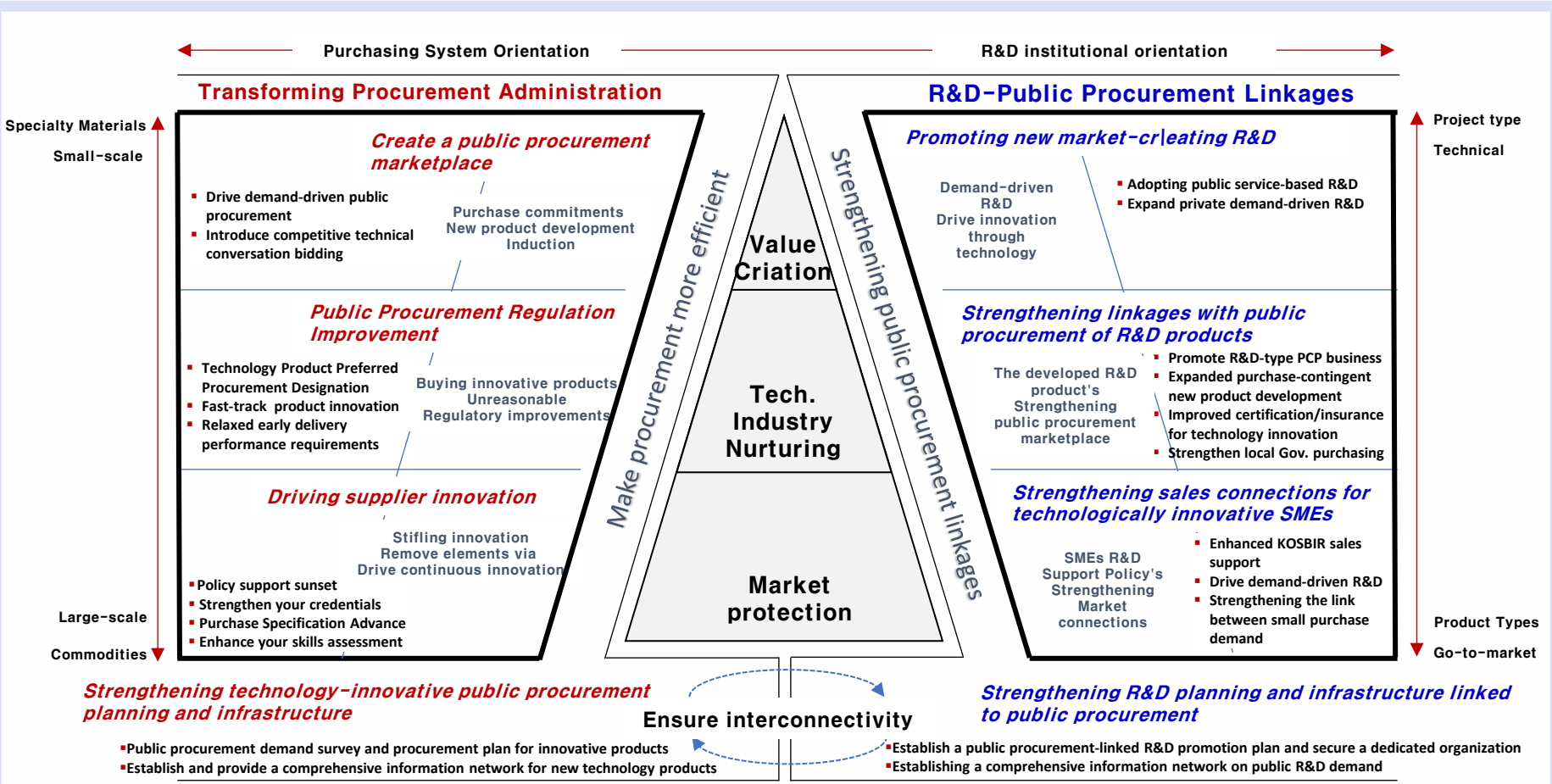
These procurement policies were originally promoted as part of fiscal policy, but are increasingly being utilized as a policy tool to drive innovation, national security, and food security.

- Since the implementation of the Innovative Procurement Policy since 2019, public procurement policy has been transformed from a function centered on supplying the government's needs, adjusting prices, and protecting the weak to a policy that contributes to national growth.



South Korea as a First Mover

In this context, it can be said that South Korea's procurement policy is expanding its utilization strategy from a policy that protects the market to a policy that fosters technology and industry, and finally to a policy that increases new national value.



Source: Finalization (2016), Strategy for Establishing and Promoting the K-PPI System, STEPI

Innovative Procurement

Adoption of innovation-focused public procurement policies

Designing and implementing innovation-oriented public procurement policies

Adoption of inno-focused public procurement policies

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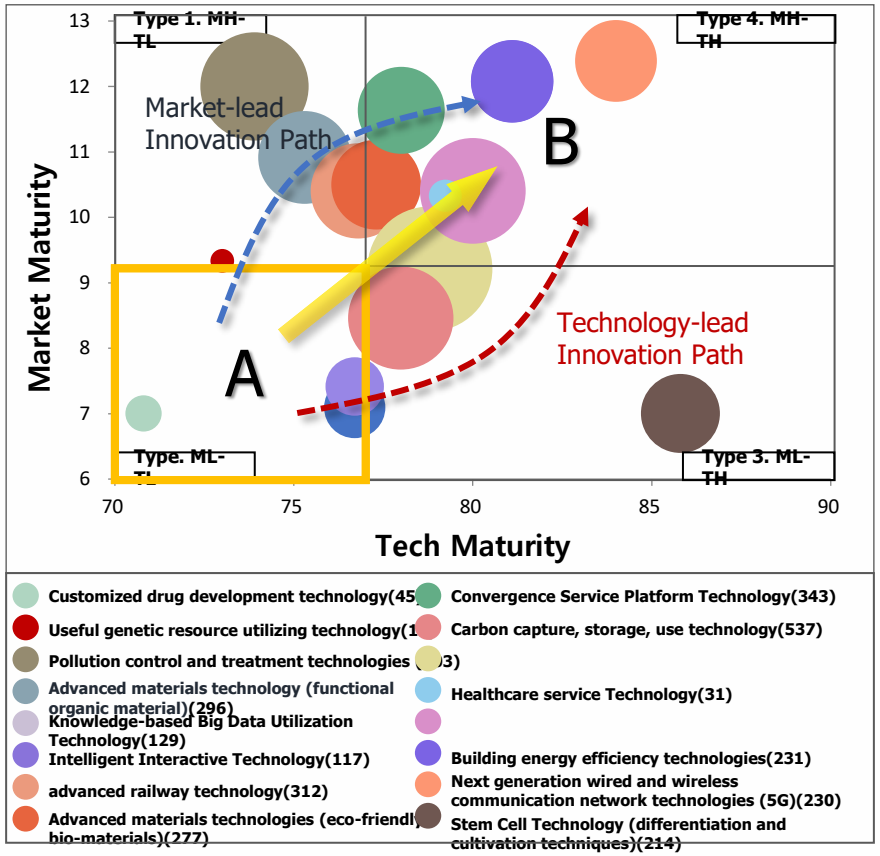
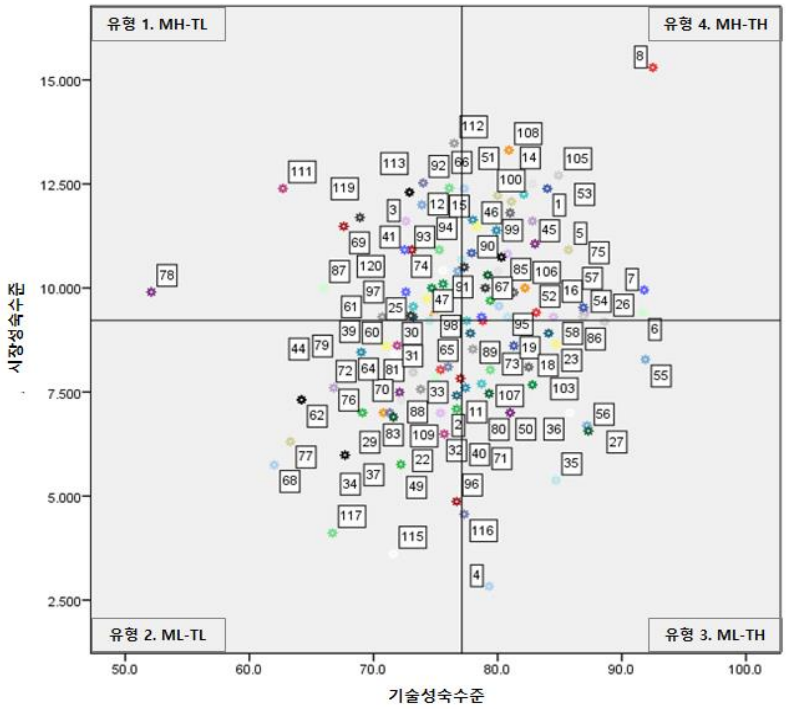
To identify the areas where public financing is needed in innovation policy, we observed the flow of national R&D investment performance and found that each R&D project has a specific path related to technology maturity and market maturity.



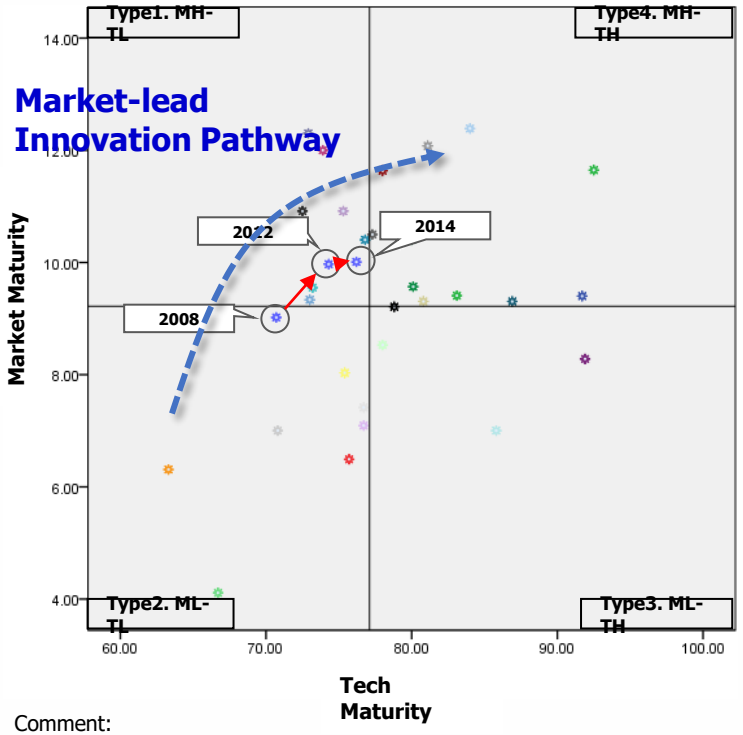


1) Technological maturity level: The level of domestic technology compared to the highest technology countries (as of 2012), distributed from 1 to 100
2) Market maturity level: Logarithm of domestic market size (as of 2012), Y=log(X), distributed from 0 to 16
3) If there is no domestic market size in 2012, the market size of the closest year was used, and 3 technologies that did not have market data were excluded from the analysis, and a total of 117 technologies were classified.
4) Classification criteria: X axis - 77.11 (average of technology level), Y axis - 9.22 (average of domestic market size, about KRW 1 trillion)

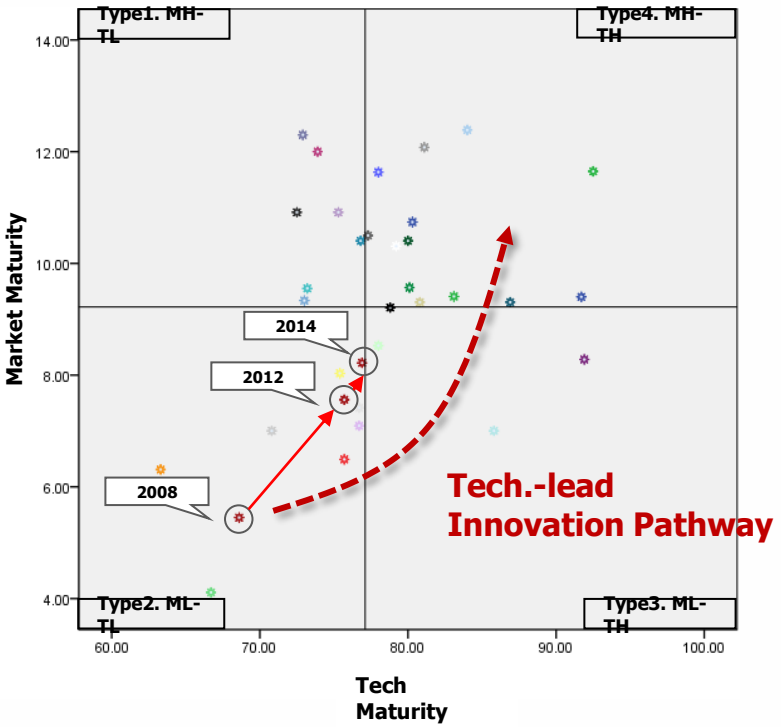
Adoption of inno-focused public procurement policies

The evolution through these paths signifies that there is a new direction for South Korea's strategy, which is not to create markets through technology investment, which has been its primary strategy, but to acquire technology as market demand matures.

service robot technology



Disease diagnostic biochip technology



Comment:

1) Standard of Classification : X axis - 77.11(Technical level Average of 117 Technologies, Y axis - 9.22(Market size average of 117 Technologies. about 1trillion)
2) This study was conducted to collect additional data for time series analysis, the collected data is as follows.
   Technology level and domestic Market size of '32. Disease diagnostic biochip technology' and '48. service robot technology' in 2008, 2012 and 2014.
3) The market size of 48. service robot technology includes all of the construction, disaster treatment, industrial robots markets.

Adoption of inno-focused public procurement policies

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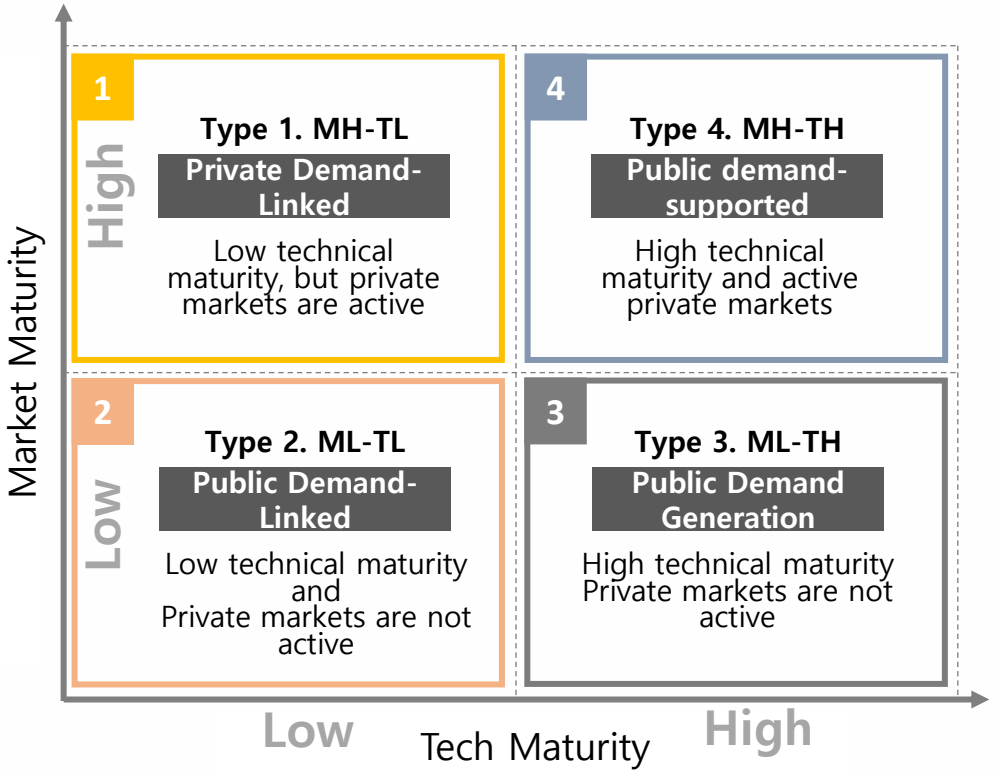
By considering these innovation pathways and linking them to public procurement policies, various optimal forms of public procurement policies can be predicted.



Type	Attributes
1 Type 1. MH-TL Private Demand-Linked	✓ Enabling the private market and making it easier to commercialize ✓ Potential for market disruption due to strong public procurement ties Requires government to act as an intermediary
2 Type 2. ML-TL Public Demand-Linked	✓ Private markets are not active, making it difficult to commercialize deliverables ✓ Burdened by commercialization costs (demonstration, etc.) due to lack of market Requires active public market connectivity
3 Type 3. ML-TH Public Demand Generation	✓ Productized applications due to high technical maturity ↑. ✓ Disabling the private marketplace makes early sales challenging Need to capture demand through public demand discovery
4 Type 4. MH-TH Public demand-supported	✓ Highly technical and private market ready ✓ Linking technology development outcomes to commercialization outcomes Need indirect public market access support

Adoption of inno-focused public procurement policies

In the case of Korea, various systems aimed at innovation have evolved in conjunction with these theoretical discussions, and in 2019, the 'Innovation-Oriented Public Procurement Policy' was established and implemented as a comprehensive policy.

Initialization

- Mid-term, **'New product development project with purchase condition'** is the most similar concept
- Public Procurement **Service** allows innovative products to enter the public market through the **'Excellent Product Designation System'**

Turning points

- Reflected in the plan to improve government procurement at the level of **'procurement administration innovation'** centered on the Public Procurement Service (2 items on the agenda of the Council of Economic Ministers in February 2015 and others)
- Ministry of Science and **ICT/Public** Procurement **Service**, **'Public Demand-Linked** Unmanned **Mobile Vehicle Technology Development Support Project'** ('16~)
- Public Procurement Service, **'New Operation of** Venture **Country to Expand Procurement of Technology Innovation Products'** ('17~)

Initial Diffusion

- 'Concept application centered on R&D new business'
- MOTIE, **'R&D, Demonstration, and Public Purchase Linkage Project to Foster New Industries'** ('18~)
- Public Procurement Service, **'Technology Innovation Product Testbed Support Project** to Respond to the 4th Industrial Revolution' ('18~)
- Ministry of Science and ICT, **'National Life Research Demonstration Support Project'** ('18~)
- MSIT, **'Demonstration support for research equipment and promotion of public procurement linkage'** ('18~)

Full adoption

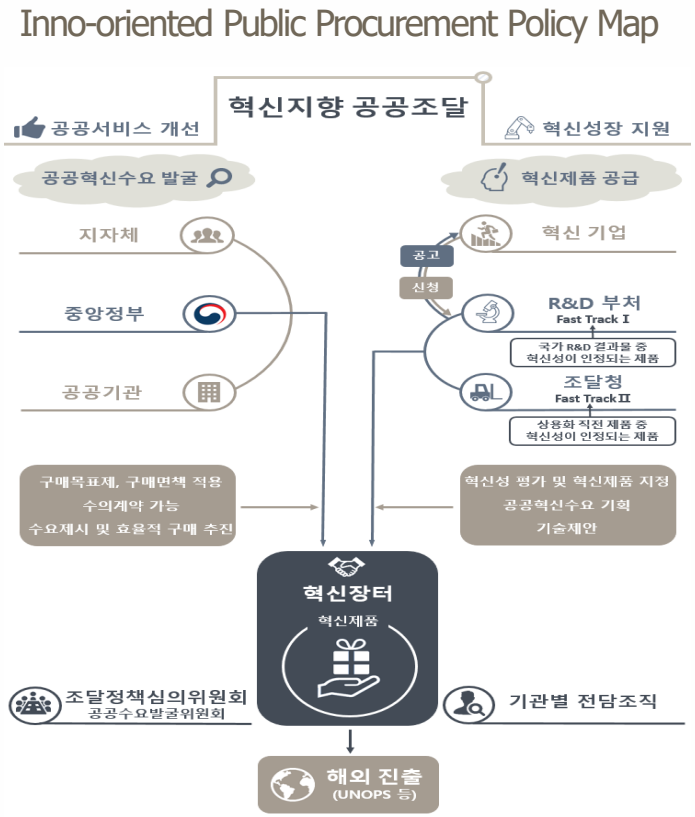
- 'Promoting in terms of comprehensive strategy'
- BH passes **'Innovation-oriented public procurement plan'** at the Cabinet meeting ('19.7.)
- Ministry of Trade and Industry implements **'Innovative Product Purchase Target Ratio System'** ('20~)
- Ministry of Trade, Industry, etc. implemented **the 'Excellent R&D Innovation Product Designation System'** ('20~)
- MOLIT, revision of **the 'Procurement Business Act'** ('20), Procurement Policy Review Council, etc.
- Public Procurement Service **increases budget for 'Technology Innovation Product Testbed Support Project'** ('21~)
- MSIT, **'Demonstration and commercialization support project for innovative products linked to public procurement'** new ('21~)
- MOTIE **re-plans 'R&D, demonstration, and public procurement linkage project to foster new industries'** ('21~)

Adoption of inno-focused public procurement policies

The value of innovation procurement policy is to improve public services, and in the process, it aims to promote the growth of companies that supply innovative products.

- It can be described as a system of discovering public demand for innovation, exploring and matching solutions called 'innovative products' with the aim of implementing 'demand-based innovation'.

- Ultimately, a comprehensive plan has been set up to support new products discovered through these innovation activities to expand beyond the domestic market, and the Ministry of Foreign Affairs and Trade and the Public Procurement Service have recently proposed a plan to support the overseas expansion of innovative products.

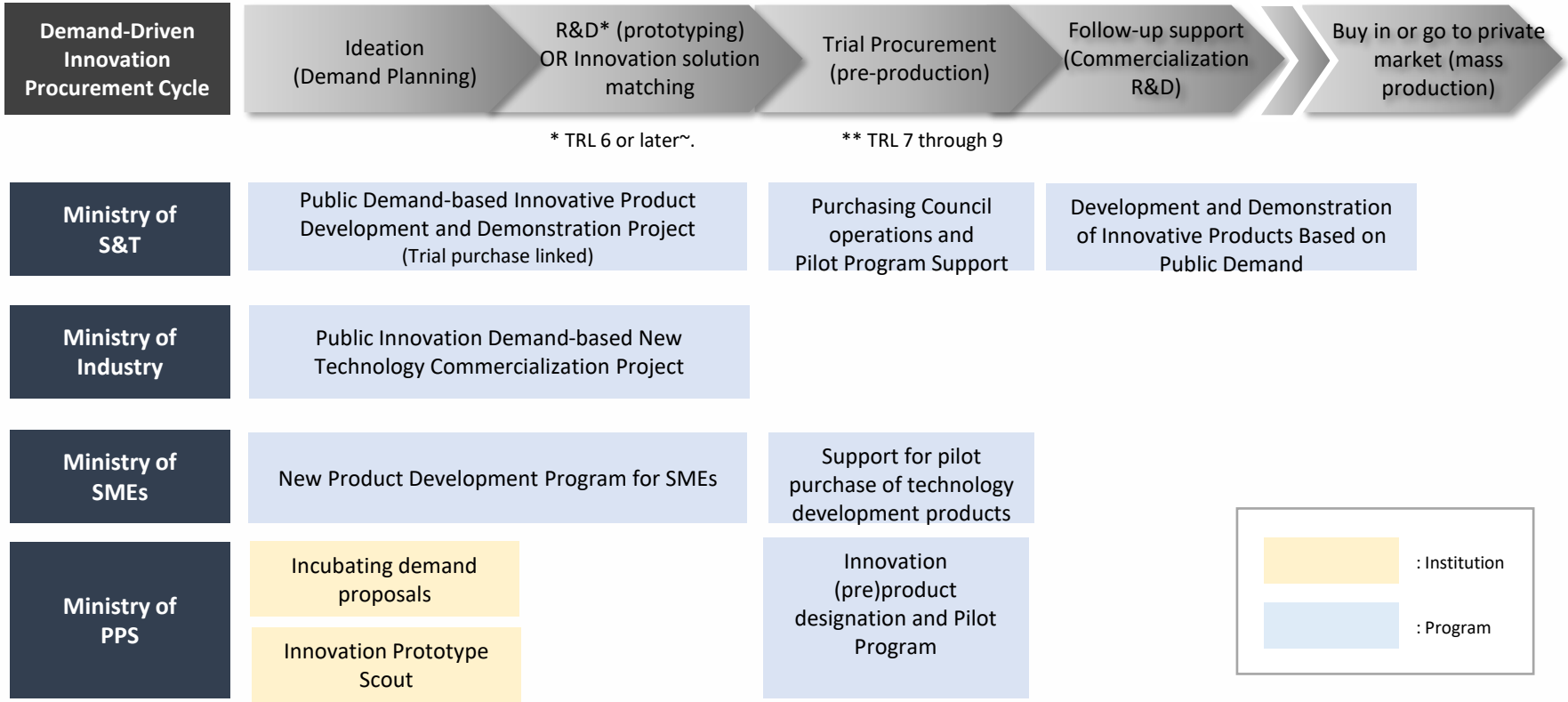


Source : 『Innovation-oriented Public Procurement Guide, 2020.5』Ministry of Strategy and Finance

Adoption of inno-focused public procurement policies

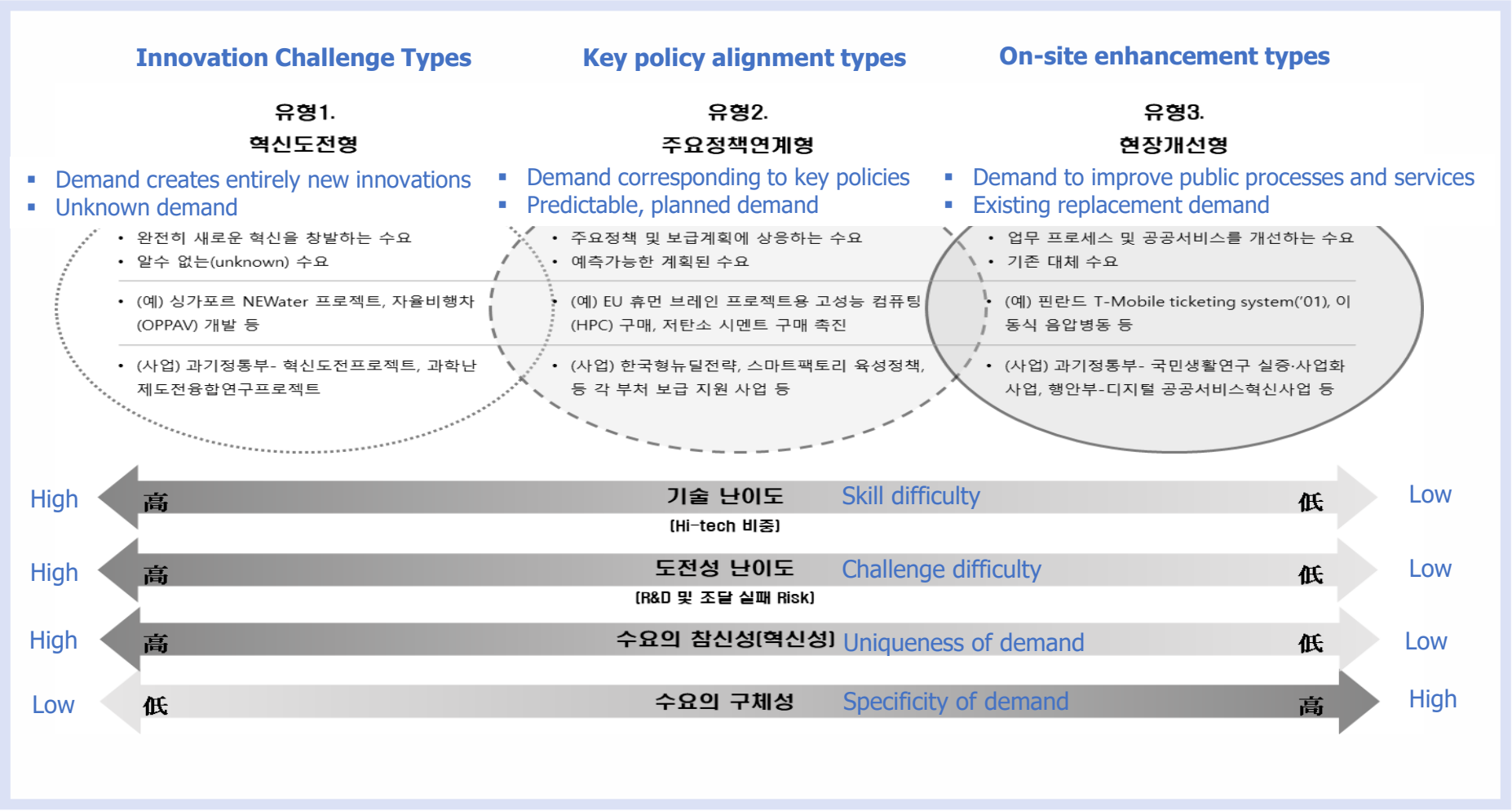
Through this process, the policy took shape and became a practical framework for a variety of initiatives, including

Demand-based Innovation Procurement Cycle Support by Ministries



Adoption of inno-focused public procurement policies

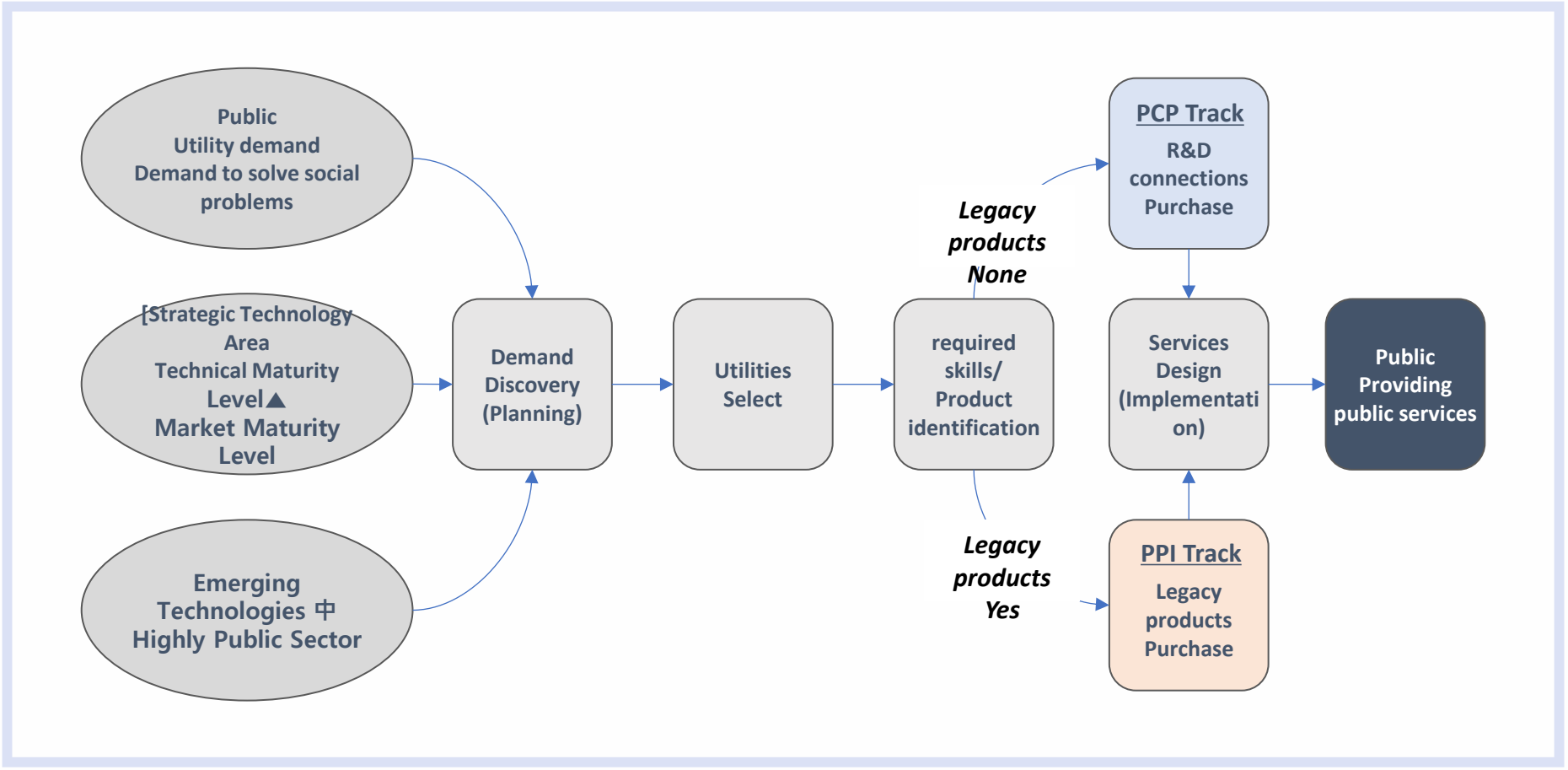
The demand for innovation financing can come in many forms, which can be broken down into three broad concepts



Notes: STEPI 2021

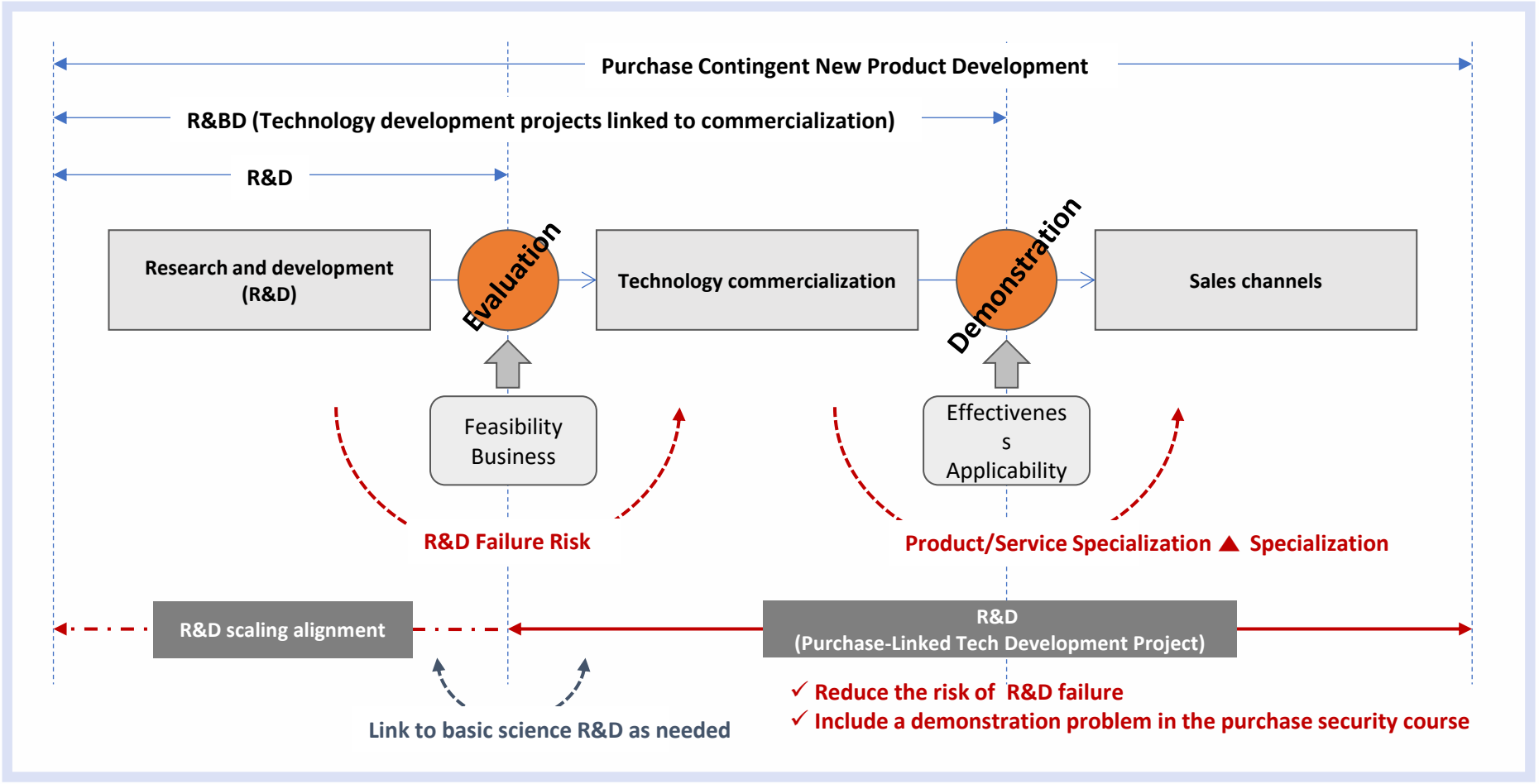
Adoption of inno-focused public procurement policies

The demand for such innovation procurement must go through a demand discovery and planning process that specifically plans for it, and includes cases of converting the necessary products, technologies, and services into actual public services.



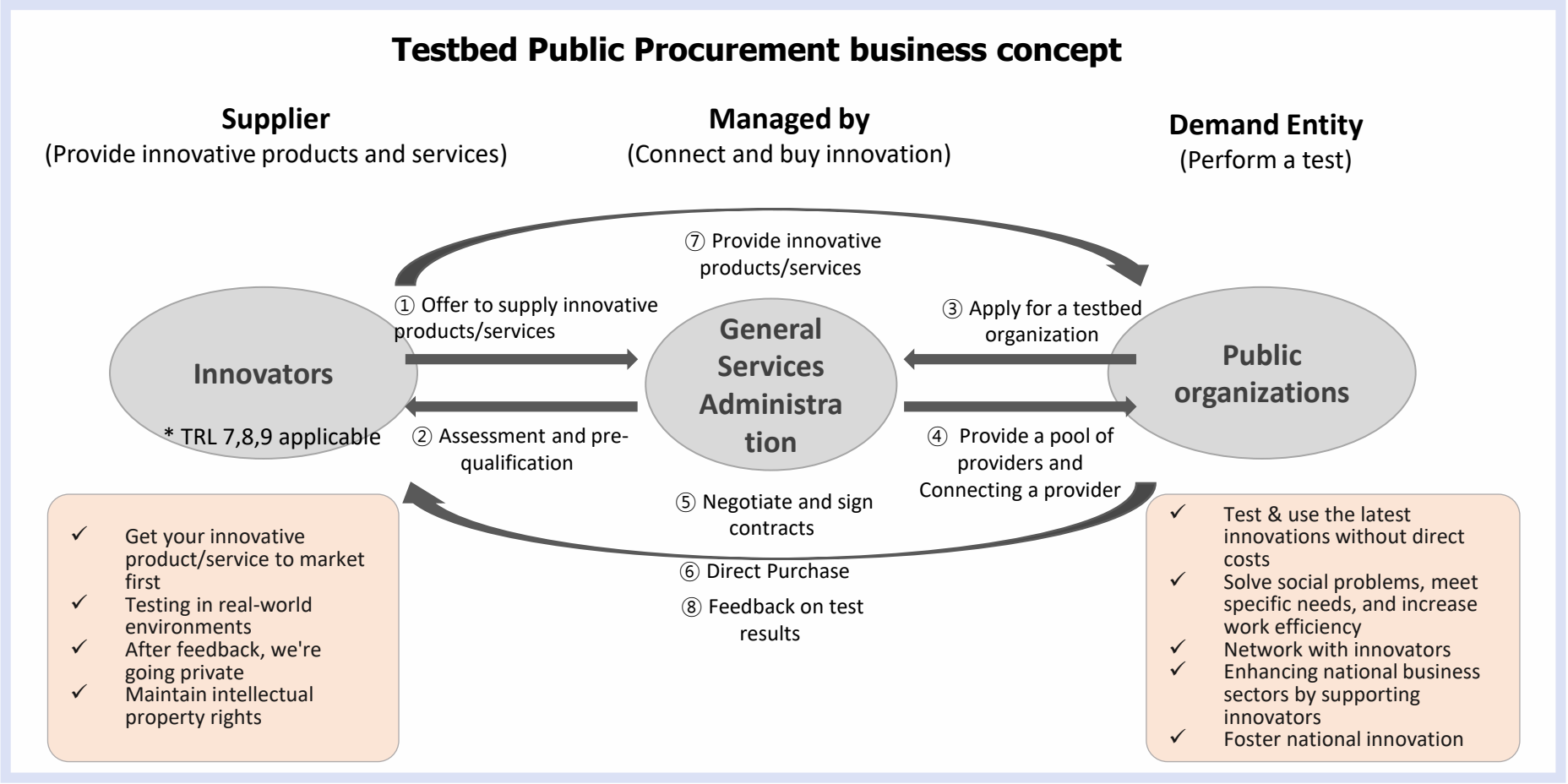
Adoption of inno-focused public procurement policies

In addition, South Korea's program is structured in such a way that technology commercialization and procurement are linked to the same program at the same time as R&D, reducing disconnects at each stage.



Adoption of inno-focused public procurement policies

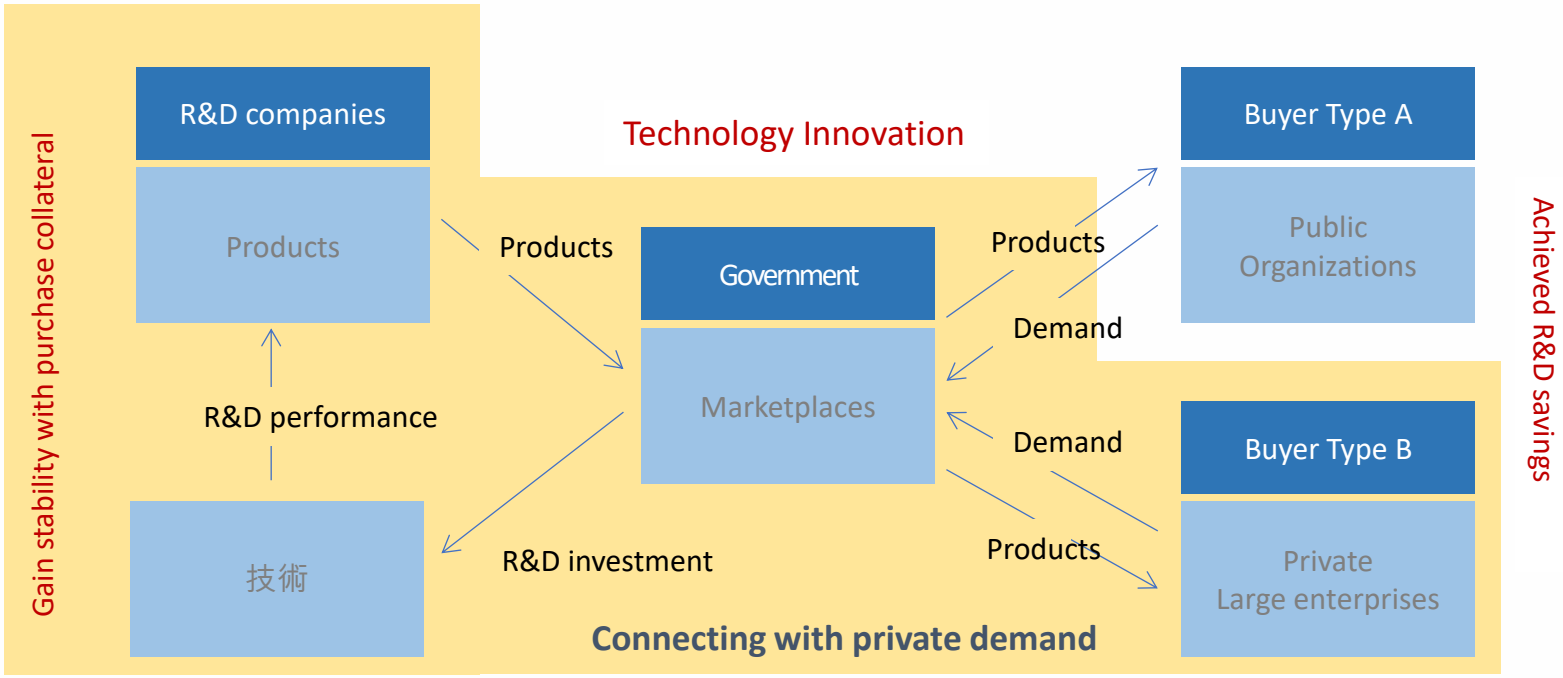
It is also characterized by the fact that the government (procurement agency) has a program with a structure that takes on these risks to minimize the threats posed by R&D companies and public demand organizations.



Adoption of inno-focused public procurement policies

There is also a Catalytic Public Procurement program where the government acts as an intermediary to match private demand with R&D companies and procurement is carried out in the private market to overcome government demand limitations.

Need to build private demand and capital investment structure as government demand and budget limits must be exceeded



Notes: STEPI 2014

Adoption of inno-focused public procurement policies

Through this process, South Korea's innovation procurement has

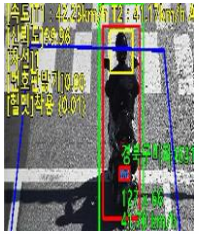
Streamline public affairs

Fire department's 'wearable robots'		➢ A 'firefighter wearable robot' that assists firefighters in life-saving and fire-fighting activities has been developed by Korea Robotics ➢ Received KRW 1 billion in support for about a year from 2015 to 2016 through the 'Market Creation Robot Supply Project' of the Korea Industrial Promotion Agency to verify the market.
Korea Environment Agency's 'National Water Supply Energy Integrated Management System		➢ The Korea Environment Corporation, a quasi-governmental organization under the Ministry of Environment, established the National Water Supply Energy Integrated Management System in 2014 with KRW 1 billion in government funding. ➢ 'Water supply energy integrated management system' means a system that attaches smart sensors to large-capacity pumps that account for 85% of water supply electricity consumption, and supports optimal pump operation by automatically collecting and analyzing data through the attached sensors.
Naval Ship Simulator from the Korea Shipbuilding Institute	 FMB 선교 정면 사진	➢ Provide mock-ups and navigation and control consoles that mimic real-world missions to provide a realistic ship's wheelhouse and control room ➢ Provide a simplified piloting system with an integrated pilot console and large monitor without missions

Adoption of inno-focused public procurement policies

Through this process, innovation procurement in South Korea has seen examples of

National Health • Welfare Improvement

Utilizing Artificial Intelligence Recycling Recycling robots (PET type)		➢ Utilizes AI to sort, recover, separate, discharge, reject, etc. of inputted domestic waste ➢ Leveraging Vision AI to recognize waste that meets environmental guidelines, including foreign objects and label removal ➢ Estimated demand organizations: Ministry of Environment, local governments, etc.
Ring Medical Device and Monitoring Platform Services		➢ Ring medical devices and the remote monitoring of vital signs with them ➢ Easy to wear and carry as a ring, and provides monitoring results such as ECG and oxygen saturation to medical staff via cloud server ➢ Estimated demand organizations: Local governments and affiliated welfare organizations, etc.
Fixed CCTV system utilizing AI		➢ Overcoming the limitations of two-wheeler enforcement (recognizing the front and rear license plates of two-wheelers and whether they are wearing safety helmets, detecting distant objects and generating trajectories to crack down on reckless driving, etc.) ➢ Estimated demand organizations: local governments, police, etc.

Adoption of inno-focused public procurement policies

Through this process, South Korea's innovation procurement has

Driving innovation and growth

The world's first top-down DLP 3D printer		➢ 3D printer topped with strong illumination and multi-engine screen ➢ DLP-style technology is highly productive and can reliably produce large-scale output in a top-down fashion ➢ Matched with pilot purchase project and tested by public institutions ((Korea Institute of Production Technology, Korea Ceramic Technology Institute)
All-in-one firewall Solar road lights		➢ Create a safe environment with solar-powered renewable energy lighting products and unique features of concrete median barriers ➢ Matched with pilot purchase project and tested at Korea Expressway Corporation Boeun Branch

Adoption of inno-focused public procurement policies

Through this process, South Korea's innovation procurement has

Improving citizen's Lives

Mobile access control booths to prevent the spread of infectious diseases		➢ Increased efficiency of access control by applying an access lock to block unattended access to people with abnormal body temperature ➢ Unattended access control improves efficiency and stops infectious pathways with confidence
Expandable Negative Pressure Isolation System		➢ Mobile expandable negative pressure hospital room with low cost, quick installation, and excellent scalability through various combinations of air tents that are easy to set up, take down, and store, and functional panels that allow for a variety of functionalizations and quick installation.

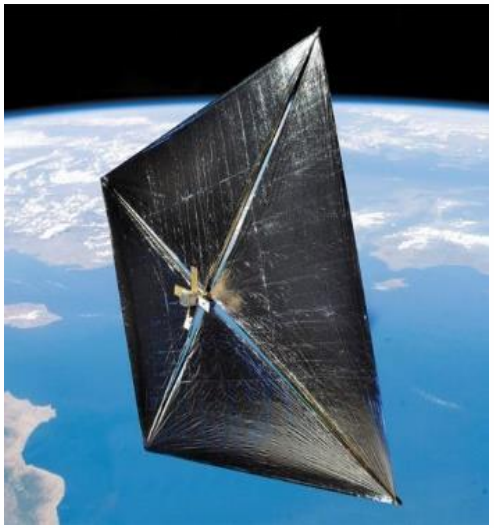
Addressing future demand

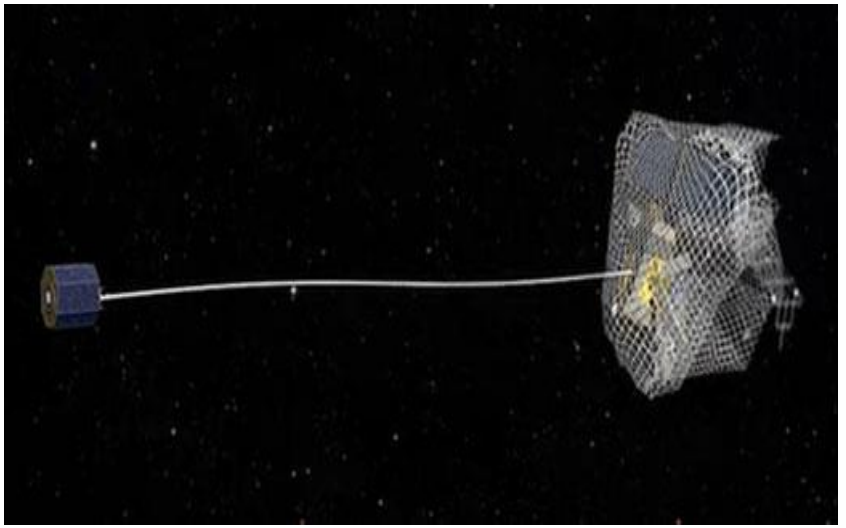
Toward South Korea, an innovation leader

Implementing an enabling framework to foster industries meet future demand

Toward South Korea, an innovation leader

For Korea to further sustain this innovation, procurement policy must be able to play a role in more challenging and highly innovative areas, and we believe this is a way to proactively purchase needs that do not currently exist but will be needed in the future.





Ministry of S&T, X-Project

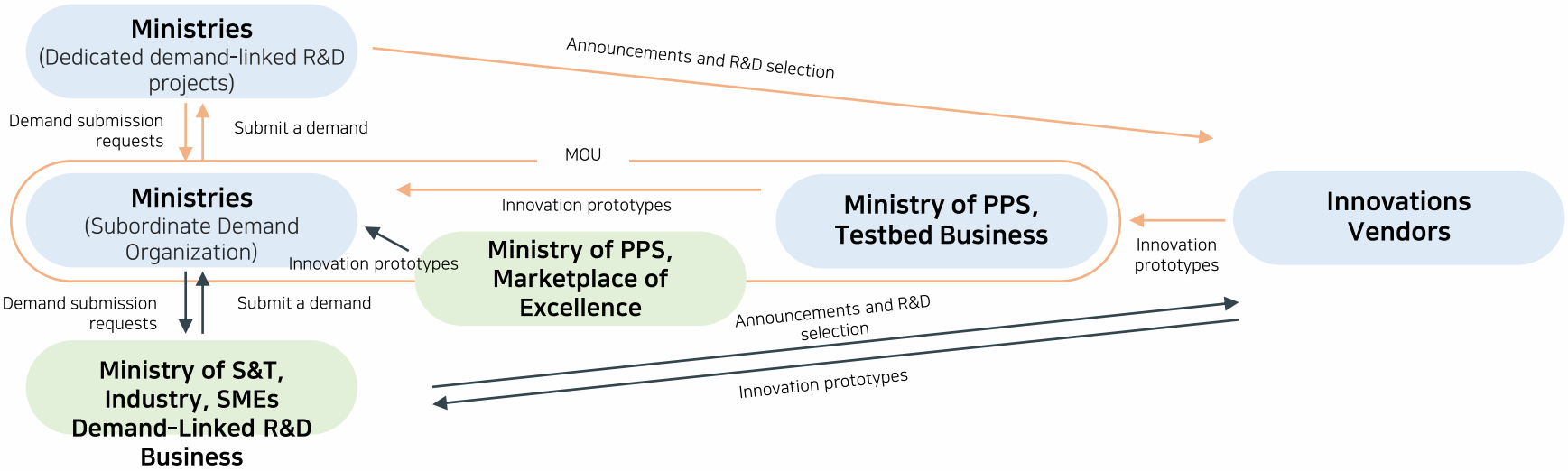
- Space debris is a big threat to satellites and space stations, and how to solve it is recognized as a big problem by NASA and others.
- NASA is investigating a variety of ways to deorb space debris, including solar sails, trash nets, laser interceptors, and sprayers, to oxidize and destroy it in the atmosphere.

Toward South Korea, an innovation leader

In addition, the implementation of such a challenging system requires the establishment of a comprehensive system in which all levels of government are organically involved in demand-driven innovation policies, preferably designed as follows

- **(Weak demand coupling)** Innovation procurement-linked R&D, centered on the innovation supply sector, supports only demand-based R&D and demonstration and designation of excellent.
- **(Strong demand binding)** When each ministry organizes dedicated R&D for innovation procurement based on its own demand, it can be promoted in a form similar to purchase conditionality.

How we are moving forward with cross-sectoral demand-linked R&D



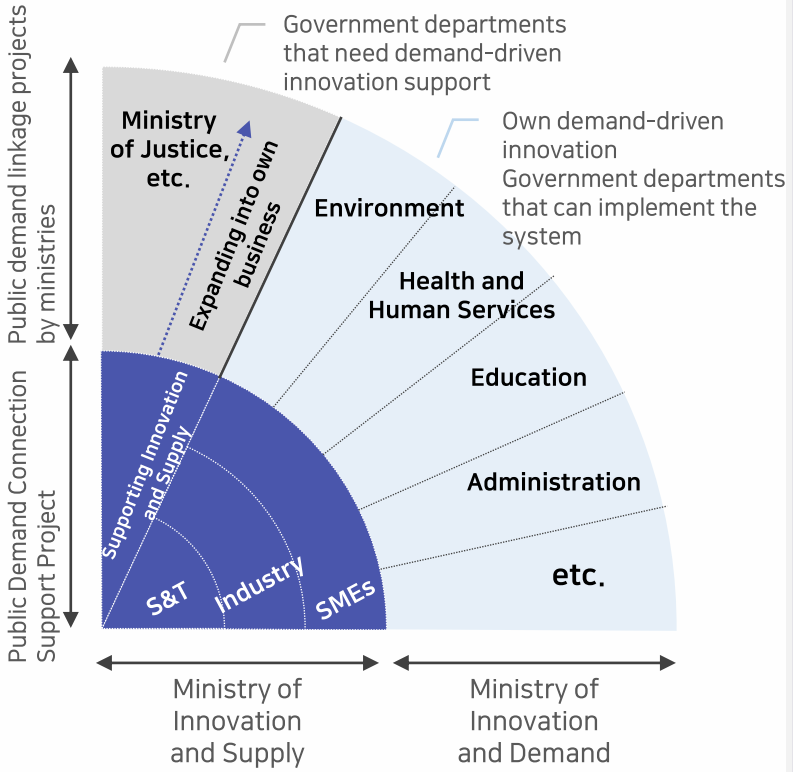
*Blue stream: Weak demand coupled with existing S&T/Industry/Mid-Market business

Toward South Korea, an innovation leader

In addition, the implementation of such a challenging system requires the establishment of a comprehensive system in which all levels of government are organically involved in demand-driven innovation policies, preferably designed as follows

- (Foundation) Improvement and expansion of innovation procurement-linked support projects of the Ministry of Innovation and Supply
  - For ministries that have difficulty in promoting their own demand-linked R&D projects among innovation demand ministries (e.g., Ministry of Justice, etc.), it is possible to secure innovative products and link procurement through projects established in innovation supply ministries.
- (Expansion of ministries) Promotion of dedicated projects for innovation procurement linkage based on the innovation needs of each department
  - When implemented as a dedicated project for innovation procurement linkage by ministries, ownership is strengthened by recognizing it as a ministry task, and motivation for active participation in achieving results such as discovering and demonstrating their own innovation demand is formed.

Demand-driven R&D cross-ministerial system



Source: STEPI (2021)

Thank You

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