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The Performance Measure and Efficiency Analysis of National Priority Science and Technology Programs in Taiwan

 台灣經濟研究院
孫智麗、黃奕儒
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NPSTP

- Taiwan government has initiated several **National Priority Science and Technology Programs (NPSTPs)**, namely **Hazards Mitigation (1997)**, **Telecommunications (1998)**, **Agricultural Biotechnology (1999)**, **Pharmaceuticals and Biotechnology (2000)**, **Genomic Medicine (2002)**, **Digital Archives (2002)**, **Systems on Chip (2003)**, **Nanotechnology (2003)**, **e-Learning (2003)**, and **Energy (2010)**.

NPSTP

- Distinguished from other government-funding R&D projects, they are formed by special institutional arrangements, across different government agencies at cabinet level, and their budgets have first priority to claim.
- In 2008 the funding of NPSTPs is NT\$11.24 billion, approximately US\$350 million, and it accounts for 14.6% of Executive Yuan Science and Technology budget.

The Institutional Arrangement of National Priority Science and Technology Programs in Taiwan

Source: Planning & Evaluation Division, National Science Council, R.O.C.

I. Goals

- Enhancing national competitiveness
- Addressing major social & economic issues
- Coordinating and integrating national research & development resources

II. Criteria

NPSTPs should

- have clear and long term goals for developing innovative technology and significant contribution to industrial competitiveness and social welfare.
- be those that need interdepartmental and interdisciplinary efforts and to be directed by the government with long term supports.
- be those that engender great and vast impact, implemented through the cooperation and integration of R&D resources in academic, research, industrial and governmental instructions and formulated with international and perspective vision.

III. Steering Committee for NPSTP

- Co-chaired by the Chairman of National Science Council and a Minister without Portfolio, the Executive Yuan
- Members: Vice and Deputy Ministers responsible for R&D of related agencies of central government

Mission

- Appointing Director-General (DG) and approving Working Group (WG) members, of individual NPSTP.
- Giving R&D direction to individual NPSTP.
- Organizing Consultation Group (CG) for each individual NPSTP to assist its program plan preparation and implementation.

IV. NPSTP Working Group (NPSTP WG)

Mission:

- Planning Program Plan
- Coordinating, integrating & managing
- Reporting progress to the steering committee and the NSC's Board Meeting

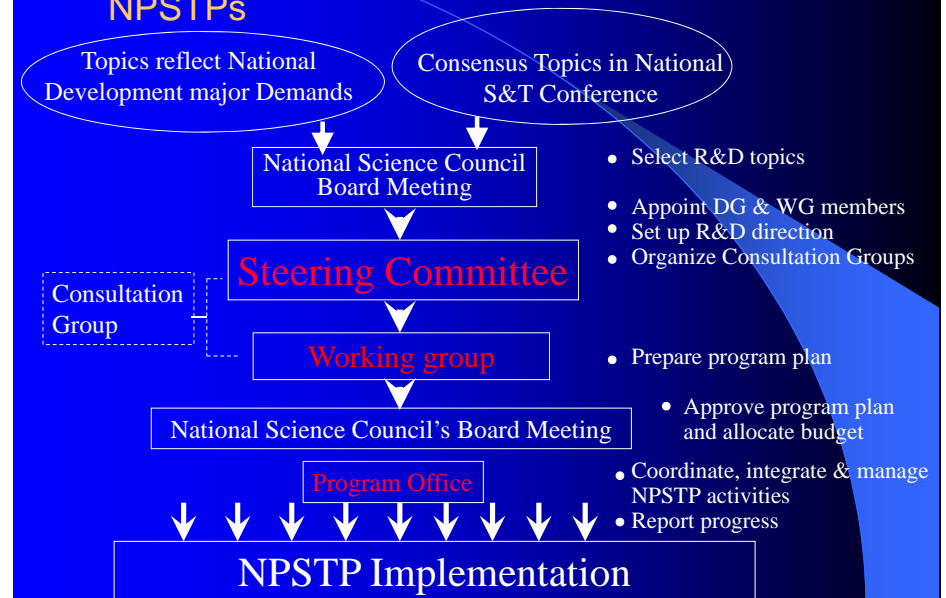
V. Budgeting

- NPSTP program plans approved by NSC's Board meeting shall receive top priority in budget allocation.
- Program Plans preparation and logistic supports are funded by NSC, STAG and / or related ministries / agencies.

VI. Control & Evaluation

- NSC takes charge of schedule control, progress audit and performance evaluation.
- NPSTP is normally supposed to carry out its mission to meet the goal within the period of ten year.

VII. Flow Chart for Formation & Implementation of NPSTPs



NPSTPs

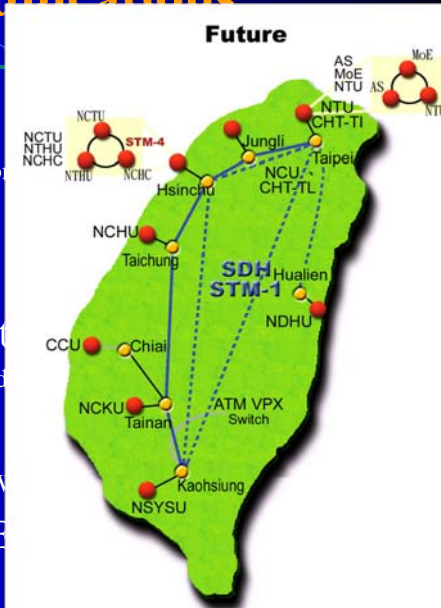
Program name	Annual Funding	Participating agencies
1. Hazards Mitigation*	NT\$0.54B	MOEA, COA, MOI, NSC, DOH, EPA
2. Telecommunications	NT\$1.79B	MOEA, MOTC, MOE, NSC
3. Agricultural Biotechnology	NT\$0.68B	COA, Academia Sinica, NSC, MOEA
4. Pharmaceuticals and Biotechnology	NT\$1.22B	DOH, NSC, MOEA
5. Genomic Medicine	NT\$1.58B	Academia Sinica, DOH, NSC, MOEA
6. Digital Archives	NT\$0.71B	Academia Sinica, NSC, MOE, CCA, NHL, NPM, NTU
7. Systems on Chip	NT\$1.99B	MOEA, MOE, NSC
8. Nanotechnology	NT\$3.02B	MOEA, NSC, MOE, Academia Sinica
9. e-Learning	NT\$0.65B	MOEA, MOE, COLA, CCA, DOH, NSC

Hazards Mitigation

- Assessing hazard potentials of typhoon and earthquake (islandwide)
- Reviewing and evaluating the present Hazards Mitigation Management System and Plans (islandwide)
- Assessing risks of typhoon and earthquake (pilot project areas)
- Simulating disaster scenario (pilot project areas)
- Developing mitigation plans (model plan)

Telecommunications

- Broadband Internet
 - DWDM (dense wavelength division multiplexing)
 - Broadband Access
 - QoS Oriented Networking
 - Broadband Application
- Wireless Communication
 - WB-CDMA WLL (wide band code division multiple access for wireless local loop)
 - 3G Mobile Radio Systems
 - Wireless Internet and High Speed Wireless
- National Broadband Backbone (NBEN)



Agricultural Biotechnology

- Floral (Chrysanthemum and orchids)
- Chinese herb based functional food.
- Shrimp, Cobia, Grouper and Taiwan tilapia
- Swine and chicken
- Animal vaccine and adjuvant
- Post-harvest technology for vegetables and fruits
- Stress tolerant varieties, bio-fertilizers
- Agricultural waste recycling
- Functional genomics based technologies
- Marker-assisted breeding.
- Bioreactor technologies
- Transgenic technology
- Establishment of GMO assessment and accrediting systems

Pharmaceuticals and Biotechnology

- The research and the development of Chinese herbal medicines, new chemical drugs and protein drugs
- Focus on four fields: cancer, diabetes, cardiovascular and neurological diseases
- The preclinical evaluation unit, industry promotion unit, chemical core Lab
- Academic- industry bridging program

Genomic Medicine

- Research Program
- Liver Cancer
- Lung Cancer
- Infectious Diseases
- Highly Heritable Diseases
- ELSI (Ethical, Legal, and Social Issues)
- Innovative Research
- Industrial/Academic Collaboration Program
- International Collaboration Program
- National Core Facilities

Digital Archives

- Collections of indigenous cultures in Taiwan
- Fishes, shell fishes, plants, insects, minerals and animals and birds in and around Taiwan
- Archaeological, fossil and ancient calligraphy
- Jade, porcelain and bronze
- Image database of rare books
- An archive of drawings in ancient books
- Contemporary historical Archives
- Selected gazetteer documents published

Systems on Chip

- **Project Goal**
 - To promote the renewal of design industries.
- **Subjects**
 - To establish the new design environment for SoC design
 - To establish the new service model for SoC design
 - To promote IP Mall service
 - To promote platform service
 - To promote innovative design

Nanotechnology

- Academic Excellence Research Program
 - Basic research on nanoscience
 - Synthesis, assembly and processing of Nanomaterials
 - Development of manipulation techniques and fabrication of functional nanodevices
 - Nano-biotechnology
 - Energy applications
- Education Program
- Core Facilities Program
- Nanotechnology Industrialization Program
 - To enhance core facility and network
 - To speed up the development of nanotechnology
 - To develop and apply novel properties of nano-materials
 - To leverage the existing industrial knowledge and create new opportunities
 - To integrate new technical findings into the most competitive technologies and industries in Taiwan

e-Learning

- Digital learning platform
- Digital learning content and digital science park
- E-Bag and digital learning-aided devices
- Digital learning centers of the community
- Reducing digital gap
- Basic cognitive research for digital learning
- Study of long-term digital learning policy, strategy and human resource development

The Performance Measure of National Priority Science and Technology Programs in Taiwan

Table 1. Summary Statistic of Input, Output variable of NPSTP, 2004-2008^{a)}

Program type ^{a)}	Program name ^{a)}	Input fund ^{a)} (thousand dollar) ^{a)}	Academic output ^{a)}		Economic output ^{a)} (thousand dollar) ^{a)}		Social output ^{a)} personnel training ^{a)}
			journal articles ^{a)}	patents count ^{a)}	technology transfer fees ^{a)}	investment promotion ^{a)}	
Economic ^{a)}	Telecommunications ^{a)}	1,799,689 ^{a)}	944 ^{a)}	139 ^{a)}	140,008 ^{a)}	34,023,065 ^{a)}	456 ^{a)}
	System on Chip ^{a)}	1,995,693 ^{a)}	971 ^{a)}	77 ^{a)}	78,622 ^{a)}	22,205,040 ^{a)}	1,991 ^{a)}
	Nanotechnology ^{a)}	3,019,215 ^{a)}	1,481 ^{a)}	217 ^{a)}	159,472 ^{a)}	1,759,691 ^{a)}	1,766 ^{a)}
Biotechnology ^{a)}	Agricultural Biotechnology ^{a)}	682,568 ^{a)}	355 ^{a)}	9 ^{a)}	20,856 ^{a)}	49,342 ^{a)}	825 ^{a)}
	Pharmaceuticals and Biotechnology ^{a)}	1,218,479 ^{a)}	428 ^{a)}	34 ^{a)}	15,341 ^{a)}	315,224 ^{a)}	193 ^{a)}
	Genomic Medicine ^{a)}	1,582,176 ^{a)}	447 ^{a)}	9 ^{a)}	2,025 ^{a)}	8,601 ^{a)}	421 ^{a)}
Social ^{a)}	Digital Archives ^{a)}	709,935 ^{a)}	240 ^{a)}	5 ^{a)}	1,693 ^{a)}	15,873 ^{a)}	82 ^{a)}
	e-Learning ^{a)}	656,120 ^{a)}	478 ^{a)}	7 ^{a)}	11,848 ^{a)}	621,470 ^{a)}	612 ^{a)}
	Average ^{a)}	1,457,984 ^{a)}	668 ^{a)}	62 ^{a)}	53,733 ^{a)}	7,374,788 ^{a)}	793 ^{a)}

Journal articles

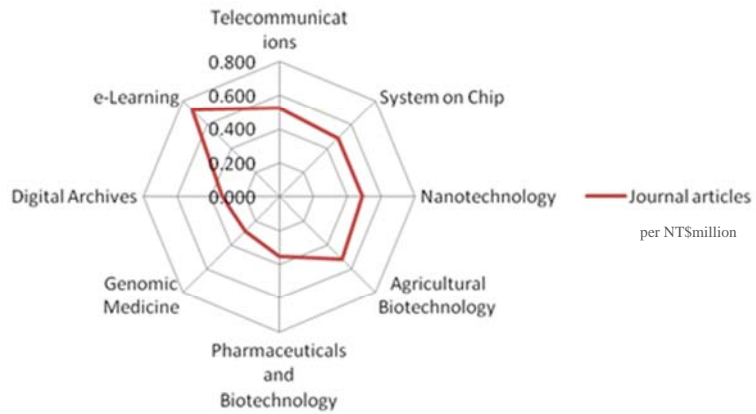


Figure 1 Output/input ratio of Journal articles

Patents count

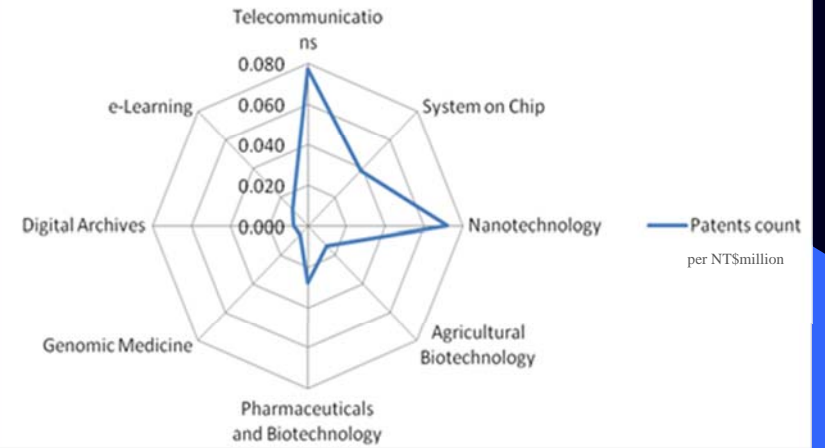


Figure 2 Output/input ratio of Patent count

Technology transfer fees

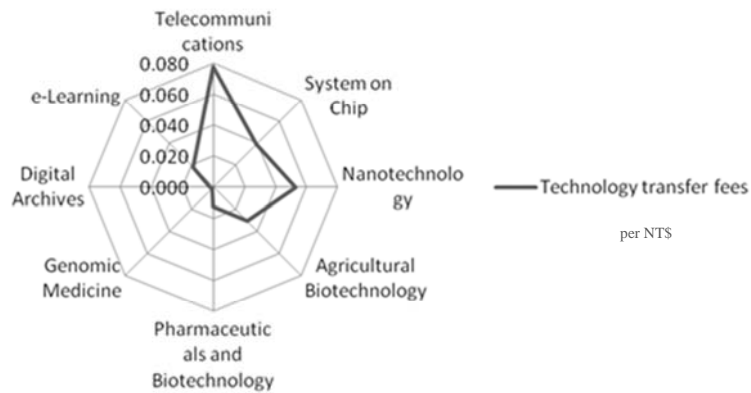


Figure 3 Output input ratio of Technology transfer fees

Investment promotion

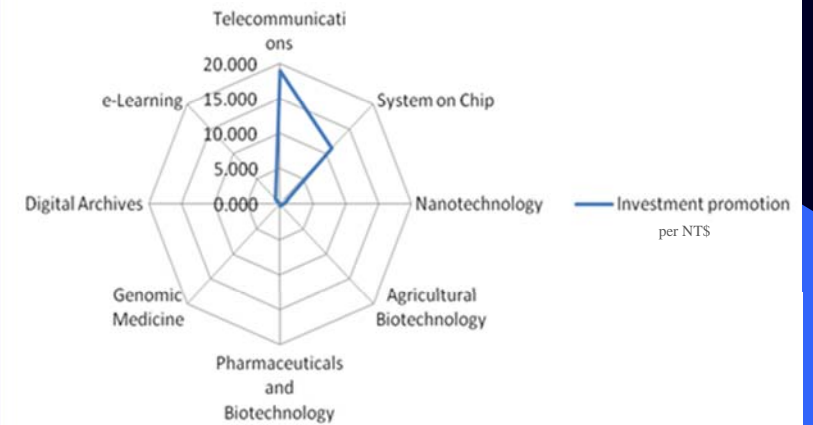


Figure 4 Output input ratio of Investment promotion

Personnel training

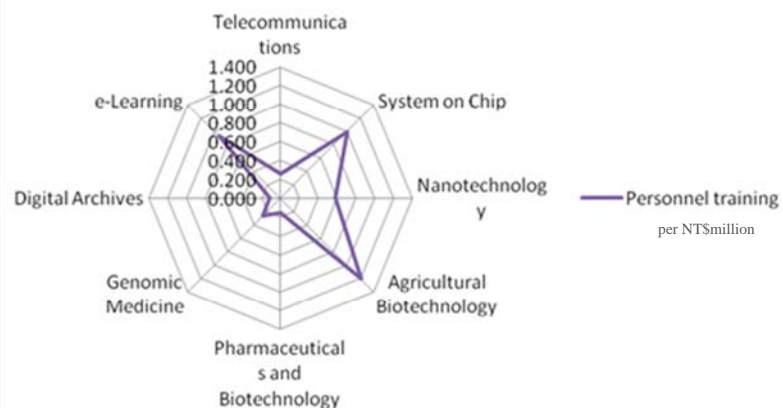


Figure 5. Output input ratio of Personnel training^{a)}

Table 2. Average Efficiency Score of NPSTPs—Academic, Economic and Social Output^{a)}

Program type ^{a)}	Program name ^{a)}	Academic output ^{a)}		Economic output ^{a)}		Social output ^{a)}	
		CCR ^{a)}	BBC ^{a)}	CCR ^{a)}	BBC ^{a)}	CCR ^{a)}	BBC ^{a)}
Economic ^{a)}	Telecommunications ^{a)}	0.970 ^{a)}	0.977 ^{a)}	1.000 ^{a)}	1.000 ^{a)}	0.206 ^{a)}	0.267 ^{a)}
	System on Chip ^{a)}	0.785 ^{a)}	0.836 ^{a)}	0.630 ^{a)}	0.656 ^{a)}	0.716 ^{a)}	0.825 ^{a)}
	Nanotechnology ^{a)}	0.961 ^{a)}	1.000 ^{a)}	0.681 ^{a)}	0.898 ^{a)}	0.467 ^{a)}	0.815 ^{a)}
Biotechnology ^{a)}	Agricultural Biotechnology ^{a)}	0.717 ^{a)}	0.845 ^{a)}	0.416 ^{a)}	0.818 ^{a)}	0.949 ^{a)}	0.999 ^{a)}
	Pharmaceuticals and Biotechnology ^{a)}	0.543 ^{a)}	0.662 ^{a)}	0.166 ^{a)}	0.225 ^{a)}	0.138 ^{a)}	0.171 ^{a)}
	Genomic Medicine ^{a)}	0.390 ^{a)}	0.446 ^{a)}	0.018 ^{a)}	0.020 ^{a)}	0.218 ^{a)}	0.276 ^{a)}
Social ^{a)}	Digital Archives ^{a)}	0.523 ^{a)}	0.604 ^{a)}	0.049 ^{a)}	0.215 ^{a)}	0.084 ^{a)}	0.271 ^{a)}
	e-Learning ^{a)}	0.932 ^{a)}	0.975 ^{a)}	0.243 ^{a)}	0.776 ^{a)}	0.777 ^{a)}	1.000 ^{a)}
	Average ^{a)}	0.728 ^{a)}	0.793 ^{a)}	0.400 ^{a)}	0.576 ^{a)}	0.444 ^{a)}	0.578 ^{a)}

Table 3. Average Efficiency Score of NPSTPs— All output^{a)}

Program name ^{a)}	All output ^{a)}	
	CCR ^{a)}	BCC ^{a)}
Telecommunications ^{a)}	1.000 ^{a)}	1.000 ^{a)}
System on Chip ^{a)}	0.977 ^{a)}	1.000 ^{a)}
Nanotechnology ^{a)}	0.992 ^{a)}	1.000 ^{a)}
Agricultural Biotechnology ^{a)}	0.995 ^{a)}	1.000 ^{a)}
Pharmaceuticals and Biotechnology ^{a)}	0.543 ^{a)}	0.664 ^{a)}
Genomic Medicine ^{a)}	0.390 ^{a)}	0.470 ^{a)}
Digital Archives ^{a)}	0.526 ^{a)}	0.604 ^{a)}
e-Learning ^{a)}	0.981 ^{a)}	1.000 ^{a)}
Average ^{a)}	0.800 ^{a)}	0.842 ^{a)}

Table 4. Malmquist productivity index—Academic output^{a)}

Program name ^{a)}	Academic output ^{a)}			
	TEC ^{a)}	TC ^{a)}	SEC ^{a)}	TFP ^{a)}
Telecommunications ^{a)}	0.966 ^{a)}	0.993 ^{a)}	0.997 ^{a)}	0.959 ^{a)}
System on Chip ^{a)}	0.987 ^{a)}	1.059 ^{a)}	1.009 ^{a)}	1.046 ^{a)}
Nanotechnology ^{a)}	1.047 ^{a)}	1.012 ^{a)}	1.047 ^{a)}	1.059 ^{a)}
Agricultural Biotechnology ^{a)}	1.000 ^{a)}	1.062 ^{a)}	1.000 ^{a)}	1.062 ^{a)}
Pharmaceuticals and Biotechnology ^{a)}	0.948 ^{a)}	1.071 ^{a)}	0.997 ^{a)}	1.016 ^{a)}
Genomic Medicine ^{a)}	0.922 ^{a)}	1.080 ^{a)}	1.013 ^{a)}	0.996 ^{a)}
Digital Archives ^{a)}	0.703 ^{a)}	1.111 ^{a)}	0.944 ^{a)}	0.780 ^{a)}
e-Learning ^{a)}	0.998 ^{a)}	1.092 ^{a)}	0.979 ^{a)}	1.090 ^{a)}
Average ^{a)}	0.941 ^{a)}	1.059 ^{a)}	0.998 ^{a)}	0.996 ^{a)}

Table 5 Malmquist productivity index—Economic output^a

Program name ^a	Economic output ^a			
	TEC ^a	TC ^a	SEC ^a	TFP ^a
Telecommunications ^a	1.000	1.136	1.000	1.136
System on Chip ^a	1.388	1.289	1.002	1.790
Nanotechnology ^a	1.105	1.191	0.987	1.316
Agricultural Biotechnology ^a	1.021	1.191	0.878	1.215
Pharmaceuticals and Biotechnology ^a	0.851	1.191	0.841	1.013
Genomic Medicine ^a	0.673	1.191	0.996	0.802
Digital Archives ^a	0.340	1.191	1.219	0.405
e-Learning ^a	0.837	1.191	0.714	0.996
Average ^a	0.843	1.195	0.945	1.008

Table 6 Malmquist productivity index—Social output^a

Program name ^a	Social output ^a			
	TEC ^a	TC ^a	SEC ^a	TFP ^a
Telecommunications ^a	0.918	1.138	1.146	1.045
System on Chip ^a	1.362	1.138	1.144	1.550
Nanotechnology ^a	0.989	1.138	1.091	1.125
Agricultural Biotechnology ^a	0.988	1.138	0.988	1.124
Pharmaceuticals and Biotechnology ^a	1.043	1.138	1.084	1.187
Genomic Medicine ^a	0.889	1.138	1.116	1.012
Digital Archives ^a	0.991	1.138	1.874	1.128
e-Learning ^a	0.744	1.138	0.744	0.847
Average ^a	0.978	1.138	1.115	1.113

Table 7 Malmquist productivity index—All output^a

Program name ^a	All output ^a			
	TEC ^a	TC ^a	SEC ^a	TFP ^a
Telecommunications ^a	1.000	0.995	1.000	0.995
System on Chip ^a	1.031	1.302	1.031	1.342
Nanotechnology ^a	1.011	1.083	1.011	1.094
Agricultural Biotechnology ^a	1.000	1.123	1.000	1.123
Pharmaceuticals and Biotechnology ^a	0.948	1.071	0.992	1.016
Genomic Medicine ^a	0.922	1.094	1.045	1.009
Digital Archives ^a	0.701	1.112	0.941	0.779
e-Learning ^a	0.975	1.064	0.975	1.037
Average ^a	0.942	1.103	0.999	1.039