Yearbook of Science and Technology
Republic of China
2004

National Science Council
TAIWAN, ROC

http://www.nsc.gov.tw/pub/yearbook

Preface

As it faces the challenges and opportunities of the knowledge-based economy, the government is upgrading overall competitiveness by vigorously promoting S&T development, integrating technological resources, and raising academic research standards. The government is also continuing to strengthen industrial technology development so as to achieve a competitive advantage in a diverse global community. The announcement of the *Fundamental Science and Technology Act* and the Executive Yuan's approval of the "National Science and Technology Development Plan" (2001~2004) has given the country a basis for the formulation of S&T policy and the implementation of S&T development. Furthermore, the *White Paper on Science and Technology* (2003~2006) lays out long-term S&T prospects and strategies. These undertakings underscore the government's determination to build a technologically and scientifically advanced country.

The "Challenge 2008 – National Development Plan" seeks to realize the vision of Taiwan as a "Green Silicon Island" with a humane outlook, a core value of sustainable development, and balanced concern for the environment and economic effectiveness. In particular, the plan's "e-Taiwan Construction Plan" seeks to foster highly promising emerging digital industries. The plan calls for bringing broadband to six million households by 2007, making Taiwan one of Asia's most networked countries. As the plan unfolds, the country will place growing emphasis on the deployment and use of S&T funding and manpower, the strengthening of knowledge creation and technological innovation, the establishment of a sound legal foundation for S&T undertakings and a flexible S&T organizational system, and the development of a high-tech nation concerned about its citizens' welfare.

According to the World Economic Forum's 2003 global competitiveness report, the ROC ranked fifth in terms of "Growth Competitiveness," second in terms of "Innovation Competitiveness," and third in terms of "Technology Competitiveness." In addition, the International Institute for Management Development (IMD) in Lausanne ranked the ROC 12th in the world in terms of overall competitiveness on its 2004 report. These scores – the best ever – make it clear that the country's S&T development achievements have earned international recognition.

As for R&D results in 2003, the ROC ranked 18th in terms of number of academic papers (12,313) cited in *Science Citation Index* (*SCI*) and 11th in terms of papers (7,518) cited in *Engineering Index* (*EI*); a total of 5,298 US patents were granted to applicants from Taiwan, giving the country a rank of fourth; the output value of Taiwan's semiconductor design industry was second only to that of the US, and the output value of the domestic contract semiconductor manufacturing

industry was first in the world; and the TFT-LCD industry maintained technological parity with the rest of the world, and was second in the world in terms of output value. Furthermore, the ROCSAT-II satellite was launched successfully from Vandenberg in California on May 21, 2004. These and other very gratifying results are the fruits of the government's and private sector's closely coordinated R&D development efforts.

The NSC compiles the *Yearbook of Science and Technology* on an annual basis to record the country's S&T development milestones and results. The *Yearbook* serves as a long-term reference and historical record for those in Taiwan and abroad who wish to understand our S&T development. We are indebted to all relevant government departments and agencies for their participation and assistance in the compilation of this edition of the *Yearbook*. We offer our sincere thanks to all who helped in the successful completion of this task; please do not hesitate to point out any error or omission that may have been made.

Maw-kuen Wu

National Science Council, Executive Yuan
Minister

October 2004

Foreword

The National Science Council, Executive Yuan, (NSC) has compiled the *Yearbook of Science and Technology, Republic of China*, annually since 1983. The *Yearbook* contains an overview of the country's S&T policies, the government's supporting measures, and the research results achieved by industry, government, schools, and research institutions during the year. The *Yearbook* thus aids policy-making by giving government a better grasp of S&T development trends, while increasing public awareness of the country's S&T development achievements.

In order to strengthen the international community's knowledge of the state of science and technology in the ROC, the NSC has again provided for this edition (2004) a separate English abstract containing the key points of the Chinese original.

This edition of the *Yearbook* consists of two special reports and four parts containing a total of 28 chapters. The two special reports describe forward-looking R&D policies and results in areas of particular importance. Reflecting the tremendous impact that the SARS outbreak had on Taiwan's society in 2003, the first special report provides an overview of the government's implementation of basic research on SARS, R&D of anti-viral drugs and vaccines, and relevant disease control efforts and insights. The second special report introduces the Executive Yuan's implementation of the "Challenge 2008 – National Development Plan," which seeks to transform Taiwan into one of Asia's most networked countries. This report emphasizes the results of the "e-Taiwan Construction Plan."

Part I, "S&T Policies and Development Performance," summarizes the country's main S&T development policies, the current state of implementation, and performance results. The government's S&T research results are introduced in Part II, "Academic Research," which mainly presents the Academia Sinica's and NSC's R&D achievements. Part III, "S&T Domain Projects," surveys the results of government S&T projects in 35 disciplines. Part IV, "Supporting Measures for S&T Development," describes the results of measures taken by the government to support S&T development.

This year's two special reports are "The SARS Outbreak and Future Outlook" and "Building e-Taiwan"

Part I, "S&T Policies and Development Performance," consists of two chapters. Chapter 1, "S&T Policies," sketches out the country's organizational framework for S&T development, while Chapter 2, "Overall Performance of S&T Development," portrays the results of the government's S&T projects and explains research indicators.

Part II, "Academic Research," consists of seven chapters. Chapter 1 contains a general overview, while Chapter 2 through Chapter 7 summarize research manpower and funding, as

well as major results, in the six areas of natural sciences, engineering, medicine, agriculture, humanities and social sciences, and science education. Research project manpower, funding, and major results are summarized for the six areas' numerous disciplines.

Part III, "S&T Domain Projects," consists of 15 chapters. This part introduces the results of government S&T projects in 35 individual disciplines. Each chapter presents a summary of the current state of development, results, and future prospects. Chapters respectively address the areas of information, communications and opto-electronics; machinery and automation; materials and chemical engineering; pharmaceuticals; biotechnology; medicine and health; agriculture; earth science; energy, resources, and environmental protection; construction, civil engineering, and transportation; e-Business; common technology; national science and technology programs; infrastructure construction projects; and other fields.

Part IV, "Supporting Measures for S&T Development," contains four chapters. Chapter 1 describes the training, recruiting, and rewarding of S&T personnel, Chapter 2 surveys the S&T research environment, Chapter 3 discusses technology diffusion, intellectual property rights, and standardization, and Chapter 4 addresses international S&T cooperation.

While the information contained in the *Yearbook* generally conforms to a calendar year period (from January 1, 2003 to December 31, 2003), MOE data is based on the academic year (from August 1, 2002 to July 31, 2003).

We extend our sincere thanks to everyone who helped complete the *Yearbook*, including the agencies providing data and those organizations and individuals who participated in writing, reviewing, editing, translating, and proofreading the text. If this *Yearbook* contains any errors or omissions that were overlooked in the short time available, we urge readers to point them out and help us to improve in the future.

Contents

Special Reports

Report A The SARS Outbreak and Future Outlook 1
Report B Building e-Taiwan 7

Part I S&T Policies and Development Performance

Chapter 1 S&T Policies 13
Chapter 2 Overall Performance of S&T Development 31

Part II Academic Research

Chapter 1 Overview 37
Chapter 2 Natural Sciences 39
Chapter 3 Engineering 41
Chapter 4 Medical Sciences 44
Chapter 5 Agricultural Sciences 47
Chapter 6 Humanities and Social Sciences 49
Chapter 7 Science Education 51

Part III S&T Domain Projects

Chapter 1 Information, Communications, and Opto-electronics 53
Chapter 2 Machinery and Automation 58
Chapter 3 Materials and Chemical Engineering 62
Chapter 4 Pharmaceuticals 65
Chapter 5 Biotechnology 67
Chapter 6 Medicine and Health 69
Chapter 7 Agriculture 71
Chapter 8 Earth Science 76
Chapter 9 Energy, Resources, and Environmental Protection 79
Chapter 10 Construction, Civil Engineering, and Transportation 84
Chapter 11 e-Business 87

Chapter 12 Common Technology 89
Chapter 13 National Science and Technology Programs 92
Chapter 14 Infrastructure Construction Projects 98
Chapter 15 Other Fields 100

Part IV Supporting Measures for S&T Development

Chapter 1 Educating, Training, Recruiting, and Rewarding of S&T Personnel 103
Chapter 2 The S&T Research Environment 106
Chapter 3 Technology Diffusion, Intellectual Property Rights, and Standards 110
Chapter 4 International S&T Cooperation 113

APPENDICES

Figure Appendix 115
Table Appendix 118

Comparative Table of Abbreviations and Full Names

Abbr.	Full Name
Agency	
AEC	Atomic Energy Council
APEC	Asia-Pacific Economic Cooperation
CCA	Council for Cultural Affairs
CLA	Council of Labor Affair
COA	Council of Agriculture
DOH	Department of Health
EPA	Environmental Protection Administration
ITRI	Industrial Technology Research Institute
MND	Ministry of National Defense
MOE	Ministry of Education
MOEA	Ministry of Economic Affairs
MOI	Ministry of the Interior
MOTC	Ministry of Transportation and Communications
NHRI	National Health Research Institutes
NSC	National Science Council
HSP	Hsinchu Science Park
STSP	Southern Taiwan Science Park
Terminology	
FY	Fiscal Year
GDP	Gross Domestic Product
IC	Integrated Circuit
IP	Intellectual Property
ITS	Intelligent Transportation Systems
KBE	Knowledge-based Economy
R&D	Research and Development
S&T	Science and Technology
SMEs	Small and Medium Enterprises
SoC	Systems-on-Chip

Exchange Rate versus US Dollar, 1999~2003

Yearly average	'99	'00	'01	'02	'03
NTD/USD	32.266	31.225	33.880	34.575	34.418
JPY/USD	113.91	107.77	121.53	125.39	115.93
EUR/USD	0.9386	1.0854	1.1175	1.0626	0.8860

Source: The Central Bank of China

Note: Exchange rates are based on US Dollar as quoted currency.

Special Reports

Report A The SARS Outbreak and Future Outlook

Severe Acute Respiratory Syndrome (SARS) first reached the Taiwan area when one possible case was found at National Taiwan University Hospital in March 2003. The SARS outbreak soon engulfed the island and severely impacted society. The World Health Organization (WHO) formally announced that the pathogen responsible for SARS was a type of variant coronavirus on April 16 of the same year, and officially named this coronavirus the "SARS virus."

1. Introduction

The Executive Yuan of the Republic of China convened an interdepartmental response conference in March 2003 to deliberate on policies for preventing the spread of this disease, and the Department of Health (DOH) was charged with formulating medical, disease prevention, and residential quarantine response measures. As the disease spread during April of the same year, the Executive Yuan submitted the draft SARS R*esponse and* H*andling* S*tatute* to the Legislative Yuan for deliberation. Following the public announcement of the "Interim Regulations for SARS Control," the ministries and agencies under the Executive Yuan began active implementation of the following measures:

1.1 Medical and disease control measures: The DOH mobilized nationwide medical resources, determined relevant standard operating procedures (such as for centralized quarantine after the mass infection of hospital employees), and took immediate steps to assemble and deploy a sufficient number of hospital beds.

1.2 Economic and industry responses: The Council for Economic Planning and Development (CEPD), Ministry of Economic Affairs (MOEA), Ministry of Transportation and Communications (MOTC), and DOH determined relevant measures in accordance with the "Interim Regulations for SARS Control."

1.3 Border controls: The Mainland Affairs Council (MAC), MOTC, Ministry of the Interior (MOI) and DOH determined standard operating procedures and intensified disease control work.

1.4 Compulsory quarantine: The MOI worked with local governments to mobilize the greatest possible amount of resources and manpower for the purpose of strictly implementing residential quarantine and follow-up work.

The central government allocated up to NT$50 billion in accordance with special budget procedures to provide funds needed for SARS control by all levels of the government. The implementation period of this funding was from March 1, 2003 to December 31, 2004.

This special report consists of an overview of SARS science, medicine, therapeutic drugs and vaccines, and disease control work.

2. Biomedical Research on SARS

The special budget for SARS control includes NT$2 billion earmarked for SARS research projects. The Executive Yuan organized a research task force and established eight research sections and the SARS Epidemic Control Grid to bear responsibility for implementing research projects in various relevant areas. An international cooperation division was later added in October 2003 to promote cooperative research on SARS involving researchers in the European Union (EU).

The mission of the SARS research task force consists of alleviating emergency situations in the short term and establishing necessary infrastructure in the long term. SARS research projects implemented by the DOH, National Science Council (NSC), and Academia Sinica and involving 180 person-years of research labor had received funding totaling roughly NT$620 million as of the end of 2003. See Fig. A-1 below for a breakdown of research funding uses.

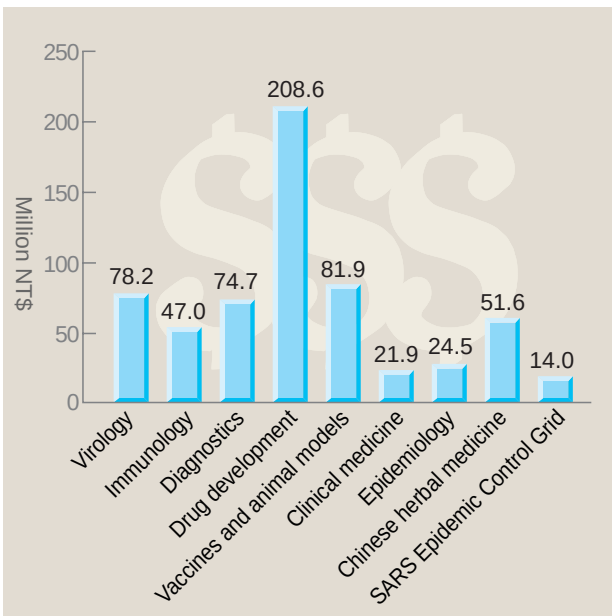


Figure A-1 Breakdown of Funding for SARS Research Projects by Area in FY2003

Source: SARS Research Task Force

The following is an overview of FY2003 research and major results:

2.1 Virology Section

Researchers obtained 25 clones of the SARS CoV genome and sequenced the entire the

genome of 11 of those strains; performed the expression of SARS virus nucleocapsid proteins and envelope proteins; produced rabbit antiserum against nucleocapsid proteins, spike proteins, and Coronavirus-Like (CL) protease; and expressed spike proteins from the SARS virus in the coat of insect rhabdovirus and discovered that the altered rhabdovirus could infect the host cells of SARS virus.

2.2 Immunology Section

Cytokine analysis of serum from SARS patients revealed that interferon-γ (IFN-γ) and related cytokines and chemokines possibly play major roles in the disease-causing process. The autoantibodies against lung epithelial cells detected in the serum of SARS patients show that an autoimmune response most likely plays an important role in the pathological destruction following infection by the SARS virus.

2.3 Diagnostics Section

It was discovered that peptide fragments of spike proteins have very high antigenic activity. Immunogold technology was used in the development of a test kit for SARS antibodies. Molecular diagnostic technology for the SARS virus was developed. Primers were designed for different DNA fragments of the SARS virus genome.

2.4 Drug Development Section

A Grade 4 biohazard protection laboratory was completed. After approximately 13,000 compounds had been tested for anti-SARS properties, it was found that the anti-psychotic Promazine and the anti-parasitic drug Niclosamide could significantly inhibit the replication of the SARS virus.

2.5 Vaccines and Animal Models Section

An inactivated vaccine made from the SARS virus was successfully used to induce the production of neutralizing antibodies in rabbits. Analysis of viral spike protein, nucleocapsid proteins and plasmic proteins determined the most strongly antigenic regions. ELISA test reagents were produced.

2.6 Clinical Medicine Section

It was found that when the fluorescence immunoassay technique is used to test serum samples from children, cross reaction to other common viruses of children may easily yield false positive results. While there is indeed a correlation between rise in TNF-α, IL-6 and progression of the disease, there was found to be relatively great variability in changes in IL-8.

2.7 Epidemiology Section

Researchers attempted to locate genes correlated with susceptibility to the severe form of SARS among a population of 184 patients. Analysis of environmental samples collected from Hoping Hospital during the period of quarantine revealed that environmental contamination may have been a channel for the transmission of SARS.

2.8 Chinese Herbal Medicine Section

Researchers tested 131 crude extracts from 37 herbal medicines and eight preparations, and found that while eight extracts displayed activity against the 229E human coronavirus at a low concentration of 50mg/ml, 19 showed activity against the virus at the concentration of 200mg/ml.

2.9 SARS Epidemic Control Grid

The "SARS Epidemic Control Grid Project" sought to establish the domestic SARS Epidemic Control Grid tracking and medical information system, which will provided a platform for communication among physicians, those in residential quarantine, and the outside world.

3. SARS Control Programs

The Executive Yuan allocated NT$23.9 billion out of its SARS control budget for use by the DOH. These funds have been primarily used for the establishment of a disease outbreak early warning system and medical notification system, the implementation of compulsory quarantine and treatment, subsidies and incentives for medical care and working personnel, the requisition of disease control equipment, and the disposal of medical waste.

The Center for Disease Control (CDC) drafted the "SARS Epidemic Control Battle Mobilization Plan" to rapidly respond to a resurgence of SARS during the flu season and ensure the quick differentiation of SARS patients and flu patients. At the following is a summary of major control strategies contained in this plan:

3.1 Establishment of a Sensitive and Effective Emergency Disease Control Response System

The CDC established the "SARS Control Battle Mobilization Organization" at the end of 2003, after the worst of the outbreak had passed. This organization is intended to meet the needs exposed by the outbreak, while also dispelling the fear SARS caused in the public mind. In addition, the CDC also established a platform for interdepartmental cooperation in conjunction with the Executive Yuan's "SARS Control Command Center."

3.2 Simplification and Consolidation of Monitoring System Tasks and Functions

The CDC has integrated various infectious disease monitoring systems and established the "Highly Infectious Disease Monitoring Network," which offers the advantages of quick response, diversity, user-friendliness, and multiple interaction methods. The CDC has also established a fast syndrome monitoring system.

3.3 Strengthening Implementation of a Series of Effective Border Control Measures Aimed at High Risk Groups; Rebuilding and Strengthening Border Disease-control and Quarantine Measures

The central government has strengthened local governments' role in border disease control and quarantine work in an effort to tighten border controls and prevent the entry of diseases. A "Quarantine Chapter" has been added to the newly revised I*nfectious* D*isease* C*ontrol* A*ct*. Continuing

efforts are being made to check entering and exiting visitors, crew on international aircraft flights, and crewmen on ships traveling to mainland China under the "Mini - Three Links" for fever and fill out "SARS and Other Infectious Disease Control Survey Forms."

3.4 Establishment of an Infectious Disease Medical Network; Realization of a Multi-level Treatment System and Strengthening of Hospital Infection Control

The CDC has established an infectious disease medical network that is activated by disease outbreaks, and different modes of operation can be adopted according to the severity of the disease. As for the strengthening of infection control at hospitals, the hospital evaluation system is being employed to require hospitals and clinics to invest more in infection control equipment, personnel assignment and standards, and line of motion planning.

3.5 Establishment of Health Education and Policy Communication Mechanisms and Platforms

The CDC has implemented the "SARS Hygiene Education and Image Plan" and continued promotion of hand-washing, body temperature checking, and the habit of seeking medical attention when needed in order to check the spread of SARS.

3.6 Establishment of International Cooperation Mechanisms, Channels, and Platforms

The SARS experience has helped re-establish mechanisms of contact between the Taiwan and the WHO. The CDC has cooperated with disease control experts and researchers affiliated with the WHO, APEC, and other organizations to devise SARS control measures and perform various disease surveys and research tasks.

3.7 Strengthening Community Disease Control Mobilization, Integrating Community Disease Control Groups, and Creating Opportunities for Community Resident Participation

This work has encouraged communities to perform rapid grassroots monitoring and notification, while also enabling them to take immediate action to control local disease outbreaks.

3.8 Close Monitoring of the Flu Virus and Suspected Flu Cases

The CDC expanded the scope of flu vaccination and implemented the "Peak Flu Period Anti-viral Drug Pioneer Program": Besides those persons 65 years of age or older who already received flu vaccinations, the CDC purchased an additional 300,000 doses of flu vaccine for the purpose of vaccinating hospital personnel during the first stage of vaccinations for 2003 fall and winter flu season.

3.9 Revision of Disease Control Laws and Regulations

The CDC completed the revision of the I*nfectious* D*isease* C*ontrol* A*ct* on January 20, 2004. This revision included addition of the new chapter "Disease Control Measures for Emergent Infections."

4. Future Prospects

Future disease control mechanisms must heed the principle that investing in health should supersede paying for treatment. The government will actively revamp the public health and

health insurance system and sponsor SARS research under the emergency SARS Research Program. It is expected that the hard work of Taiwan's outstanding research teams will yield more theoretical insights concerning the SARS virus and improved anti-SARS drugs and vaccines.
The followings are some of the main objectives of ongoing research on SARS:

Selection of SARS virus strains for the production of vaccines; development of non-infectious SARS virus replication or transmission systems for use in drug screening and work with therapeutic antibodies; structural analysis of coronavirus genes that may serve as the target of drugs; development of vaccine products; research on the pathological damage-causing mechanism of the SARS virus and signal transduction; the hosts' immunological response to the virus; research on the SARS virus and mechanism of human immune cell apoptosis; research and development of immunotherapy and antiviral drugs; and in-depth study of risk factors for the severe form of the disease.

Key disease control tasks will include the accelerated integration of resources at various government agencies; the enhancement of border quarantine manpower at ports and airports; the revision of the *Infectious Disease Control Act* to strengthen technological research and the disease control system in response to emerging infectious diseases; the establishment of channels and platforms for international cooperation; the accelerated integration of the disease monitoring, detection, and notification system and network deployment; the implementation of hospital infection control work; and the active promotion and implementation of an "infectious disease control network" grading and activation mechanism.

While SARS exacted a heavy price from Taiwan, it was nevertheless a valuable experience. It made us keenly aware that only a more comprehensive disease control system with more mobility and response powers can provide the public a safety net in the event of further outbreaks of emerging infectious diseases.

Report B Building e-Taiwan

According to a report issued by the World Economic Forum (WEF) in February 2003, among 82 countries covered, the ROC ranked ninth on the organization's "Networked Readiness Index" (NRI), second on the "Government Readiness Component Index," and fourth on the "Government Usage Component Index." This suggests that Taiwan is gradually evolving from a center of electronic and computer hardware production to a computer network applications specialist.

1. Introduction

The Executive Yuan established the "National Information Infrastructure" (NII) task force in 1996 to promote development of the Internet and implement projects aimed at enhancing the country's information technology and infrastructure. The Executive Yuan set a target of "Three million Internet subscribers in three years" in September of the same year. The government opened the mobile phone and data communications markets to private participants in 1997. Thanks to dedicated teamwork on the part of the government and private businesses, the "Three million Internet subscriber" goal was achieve ahead of time in January 1999. The government opened the fixed network, domestic telecommunications, and online service and applications markets in May of the same year. These developments paralleled the increasing depth and breadth of Internet use by Taiwanese society.

The National Information and Communication Initiative (NICI) Committee began planning the "e-Taiwan Construction Plan" in 2001. The Executive Yuan approved the e-Taiwan Construction Plan in May 2002 and authorized the designation of this program as the sixth subitem of the "Challenge 2008 – National Development Plan" in September of the same year. The Science and Technology Advisory Group (STAG) is in charge of coordinating implementation of the program.

Responding to the third IT revolution, the Executive Yuan included a proposed "Ubiquitous Network" composed of personal computers, the Internet, and mobile communications in the "M-Taiwan Program" of the 2003 "Ten New Major Construction Projects Plan." The MOI and MOEA are jointly in charge of implementing this program.

2. The e-Taiwan Construction Plan

Many of the world's countries began proposing national-level IT development and deployment programs at the end of the 20th century. For instance, Japan proposed the "e-Japan Program," Singapore proposed "Infocomm 21," and South Korea proposed "Cyber-Korea." All of

these programs called for the full-scale development of computer and network applications meeting the needs of government, businesses, and society. See Table B-1 below for an overview of information policy in several leading nations.

Thanks to the government's diligent efforts, Taiwan's Internet subscribers and Internet use rate have increased steadily over the years. Survey data indicates that Taiwan currently has 7.9 million Internet users and an Internet use rate of 35%. In terms of broadband Internet, household Internet use rate was 27.4%, while business Internet use rate was 26.4%. Nevertheless, Taiwan still has plenty of room for the development of computer applications in comparison with such leading nations as the US and Japan.

2.1 Program Vision and Objectives

The e-Taiwan Construction Plan's vision is to use information and communications technology for the purpose of establishing a highly-efficient government and a high-quality informa-

Table B-1 Information Policy Focal Points in Several Leading Nations

Country	Policy vision	Policy (Agency in charge)	Major issues	Notable features
USA	To make the best use of information technology for the purpose of improving living standards and promoting e-Commerce opportunities.	Global EC Framework (Federal EC Coalition)	• The digital divide • e-Government • Online society	• Privately-led • International cooperation, establishment of a global consensus • Legal standards, promotion of US standards
Britain	To make Britain the world's finest e-Commerce development environment.	UK Online (Department of Trade and Industry)	• e-Government • e-Business • Leadership and assessment	• Multi-stage development (understanding, applications, reliance) • Innovative, corporate-spirited government • Process improvement focused on electronic transactions
Japan	To make Japan the world's most advanced information technology power.	e-Japan (IT Strategy Headquarters)	• Fast Internet • e-Government • Human resources	• Privately-led • Clear-cut objectives, methodical implementation • Technology-oriented, emphasis on R&D and human resources
Korea	To make Korea become a creative knowledge economy power.	Cyber-Korea21 (Ministry of Information and Communication)	• Fast Internet • e-Government • Network industry	• Privately-led • Use of cybercafes and cyber-apartments to raise Internet access rate • Big vision, few policies, slow action
Singapore	To develop Singapore as the world's second largest information/communications economic system.	Infocomm21 (Infocomm Development Authority)	• Information/communications industry • e-Government • e-Business	• Government-led, fast speed, high efficiency • Industry-oriented, emphasizes manpower qualifications • Com Hub, brand recognition

Source: NICI Committee, Executive Yuan

tion society, creating an intelligent transportation environment, accelerating Taiwan's progress towards a knowledge-based economy, and making the ROC one of the most network-enabled countries in Asia. The plan's new target is "Bring broadband to the home for six million households" within six years. The program has been allocated funding of NT$36.6 billion from 2002 to 2007. See Table B-2 for the targets of the various projects in each year.

2.2 Project Content

2.2.1 The "Bring broadband to the home for six million households" project includes the development of information and communications infrastructure, deployment of a secure online environment, and establishment of an integrated wired, wireless, mobile, and fixed broadband telecommunications network. The project calls for 50% of the general population to be using the Internet by the end of 2007, along with a broadband access rate of over 70%.

2.2.2 The "Promote e-Society" project seeks to establish a rich body of cultural information, improve the quality of learning and entertainment, and narrow the digital divide. It will accelerate the development of a digital environment, and create a high-efficiency Internet-enabled society characterized by humane concern and a sense of justice.

2.2.3 The "Promote e-Commerce" project will assist Taiwan's transformation into a high value-added manufacturing and service center via promotion of network applications. Project items include the establishment of R&D and design systems, strengthening of the supply chains and logistics management mechanisms, and expansion of international marketing channels and financial and customer service.

2.2.4 The "Promote e-Government" project seeks to enable government agencies, enterprises, and the public to conveniently obtain various government services at any time or place via multiple channels. Services include information queries, applications, and other innovative government services.

2.2.5 The "Promote e-Traffic system" project calls for the establishment of "Intelligent Transportation Systems" (ITS) on a par with world standards, resolution of transportation problems, creation of integrated transportation information centers, deployment of advanced transportation management systems, and assistance for the development of domestic transportation industry.

Table B-2 Annual Subproject Targets, 2002~2007

Year / Subproject indicators	2002	2003	2004	2005	2006	2007
Number of broadband subscribers	2.0 million	3.0 million	3.8 million	4.6 million	5.3 million	6.0 million
e-Industry (WEF index rank)	18th	16th	14th	12th	11th	10th
e-Government (WEF index rank)	7th	7th	6th	6th	6th	5th
Networked society (WEF index rank)	15th	12th	9th	8th	6th	5th
Satisfaction with e-Government public opinion	30%	50%	60%	65%	70%	75%

Source: Science and Technology Advisory Group

2.3 Implementation Results

2.3.1 "Bring broadband to the home for six million households" project: There were 3.04 million broadband Internet users in Taiwan as of the end of 2003, which met the target for that year as shown in Fig. B-1. The MOI issued the first "Citizens' digital certificate IC card" in March 2003, and a total of 221,405 cards have been issued to date. The NICI committee force established the IPv6 Steering Committee.

2.3.2 "e-Society" project: Technology was developed to handle missing Chinese characters and parse Chinese words. Vocabulary database and technical language translation technology was also developed. Plans were made for a "Network Science Park for e-Learning" and digital television hardware was purchased for the establishment of a "Digital Microwave Communication Link System."

2.3.3 "e-Commerce" project: This project has promoted cooperative design involving international customers, vendors, and strategic partners; developed an agricultural knowledge gateway and value-added platform system for knowledge applications; assisted seven industry chain systems to establish global digital nervous systems; and assisted the Tatung Company to deploy a cooperative operations platform.

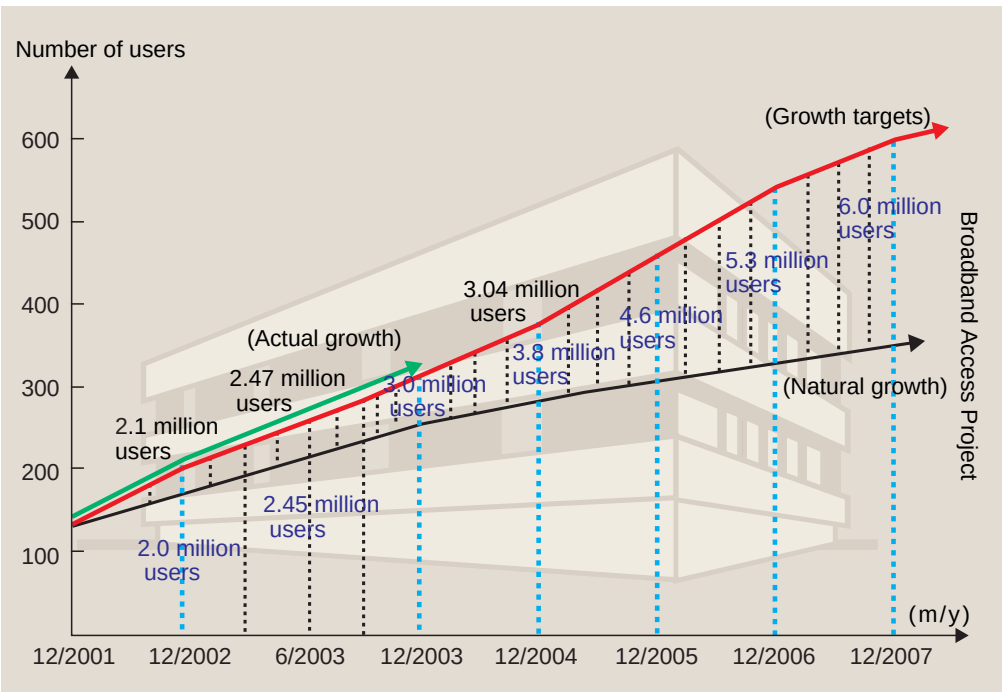


Figure B-1 Broadband User Targets for the Broadband Access Project, 2001~2007

Source: NICI Committee

2.3.4 "e-Government" project: This project completed plans for innovative interagency e-Services; issued a comprehensive planning report on G2B2C document conversion and a planning report on a public construction portal website; developed a search engine for large quantities of data; promoted the digitization of 57.8% of files at administrative agencies (which exceeded the target for the year by 14%); installed video network circuits, video backbone networks, terminal access circuits, and joint videoconferencing systems; and installed terminal hardware and software at 220 agencies.

2.3.5 "e-Traffic system" project: This project completed real-time information systems reporting road conditions along intelligent transportation corridors; completed a bus monitoring system and automatic bus scheduling system for Kaohsiung City; and helped local governments to deploy the "e-Traffic System Safety – Operational Safety Management System for Commercial Vehicles and Taxis."

3. The M-Taiwan Program

Taiwan is the world's leading wireless LAN equipment producer and has the highest cell phone ownership rate. This program seeks to take advantage of these attributes and enable citizens to use information and communications technology to enjoy superior convenience at all times and places in line with the international trend towards integrated cell phone and wireless LAN networks.

3.1 Vision

The program's vision is to realize "M-Taiwan, infinite applications, and a brave new mobile world." The program aims to bring Taiwan fully into the mobile age and make the communications industry the country's third trillion-dollar industry (besides the semiconductor and display industries).

3.2 Program Content

The M-Taiwan Program's NT$37 billion in funding includes NT$7 billion for the establishment of a wireless network environment and application services and NT$30 billion to assist local governments to deploy 6,000 kilometers of broadband conduits, which will be leased to fixed network, cable television, and cell phone operators for the installation of broadband circuits.

This program looks forward to the time when Taiwan's communications industry will produce easy-to-use GSM-WLAN cell phones enabling citizens to make phone calls and access broadband application services at home, at school, and at work. By integrating cell phone networks with wireless LAN, the program hopes to improve citizens' quality of life.

4. Future Prospects

4.1 In light of the fact that the country must intensify efforts to develop information and communi-

cations applications for individuals and businesses, while meeting the public's desire for even more benefits of Internet use, the government will strive to deepen information and communications technology from the point of view of the user.

4.2 The e-Taiwan Construction Plan's "e-Commerce" project, which currently emphasizes B2B e-Commerce, will pay more attention to user-oriented B2C aspects in the future, especially by promoting key B2C e-Commerce applications.

4.3 The goal of "e-Government" will be the establishment of an e-Democracy that facilitates expression of the will of the people, rational dialog, and convenient participation.

4.4 As information technology continues to develop and the network environment grows more mature, the government's information infrastructure efforts will focus on how to offer ubiquitous information services and shrink the digital divide.

4.5 The "Four-year Plan for Narrowing the Digital Divide" will be listed among the country's major policies and included in the "e-Taiwan Construction Plan." The goal of this effort will be to bring Internet access everywhere, eliminate barriers to network use, give everyone new opportunities, and greatly improve people's lives.

The Executive Yuan's implementation of the e-Taiwan Construction Plan as part of the "Challenge 2008 – National Development Plan" will transform the ROC into one of Asia's most network-enabled countries. In addition, the M-Taiwan Program – one of the "Ten New Major Construction Projects" – will bring Taiwan fully into the mobile age and give the public a superior quality of living enriched by information and communications services.

Part I

S&T Policies and Development Performance

Part I S&T Policies and Development Performance

The *Fundamental Science and Technology Act* was enacted in 1999 to establish basic principles and directions for the promotion of S&T development. The "Sixth National Science and Technology Conference" was held in January 2001, and the "National Science and Technology Development Plan" (2001~2004) was drafted on the basis of the conference's resolutions. The Plan's long-term prospects and strategies for S&T development form the basis for the government's S&T policies and promotion of S&T research and development. Two years after the drafting of the National Science and Technology Development Plan, the government completed the *White Paper on Science and Technology* (2003~2006) after reviewing the state of S&T development.

There must of course be policies, organizational frameworks, major systems, and goals to guide S&T development. This part of the *Yearbook* will introduce the ROC's S&T organizational framework, including its evolution, policy formation mechanisms, and effectiveness.

Chapter 1 S&T Policies

1. Organizational Framework for S&T Development

Please see Fig. I-1 for an overview of the ROC's organizational framework for S&T development. The principal executive and implementing organizations and planning and assessment system are described below.

1.1 Executive Organizations

Established in 1967, the "Science Development Steering Committee" was reorganized by the Executive Yuan in 1969 as the "National Science Council, Executive Yuan" (NSC). The NSC's primary mission consists of drafting S&T development policies, strategies, programs, and mid-/long-term plans; planning and implementing basic research and pioneering application research; improving the research environment; and training and recruiting S&T manpower.

The Executive Yuan enacted the "Science and Technology Development Program" and established the "Science and Technology Advisory Group" (STAG) in 1979. Prominent international S&T experts are invited to serve as STAG Board Members and advise the premier concerning matters involving S&T. And since 1998, domestic S&T consultants have been invited to join STAG and help assess S&T development policy directions.

The ROC's S&T policies are based on the consensus positions reached at the National Science and Technology Conference. After the "National Science and Technology Development

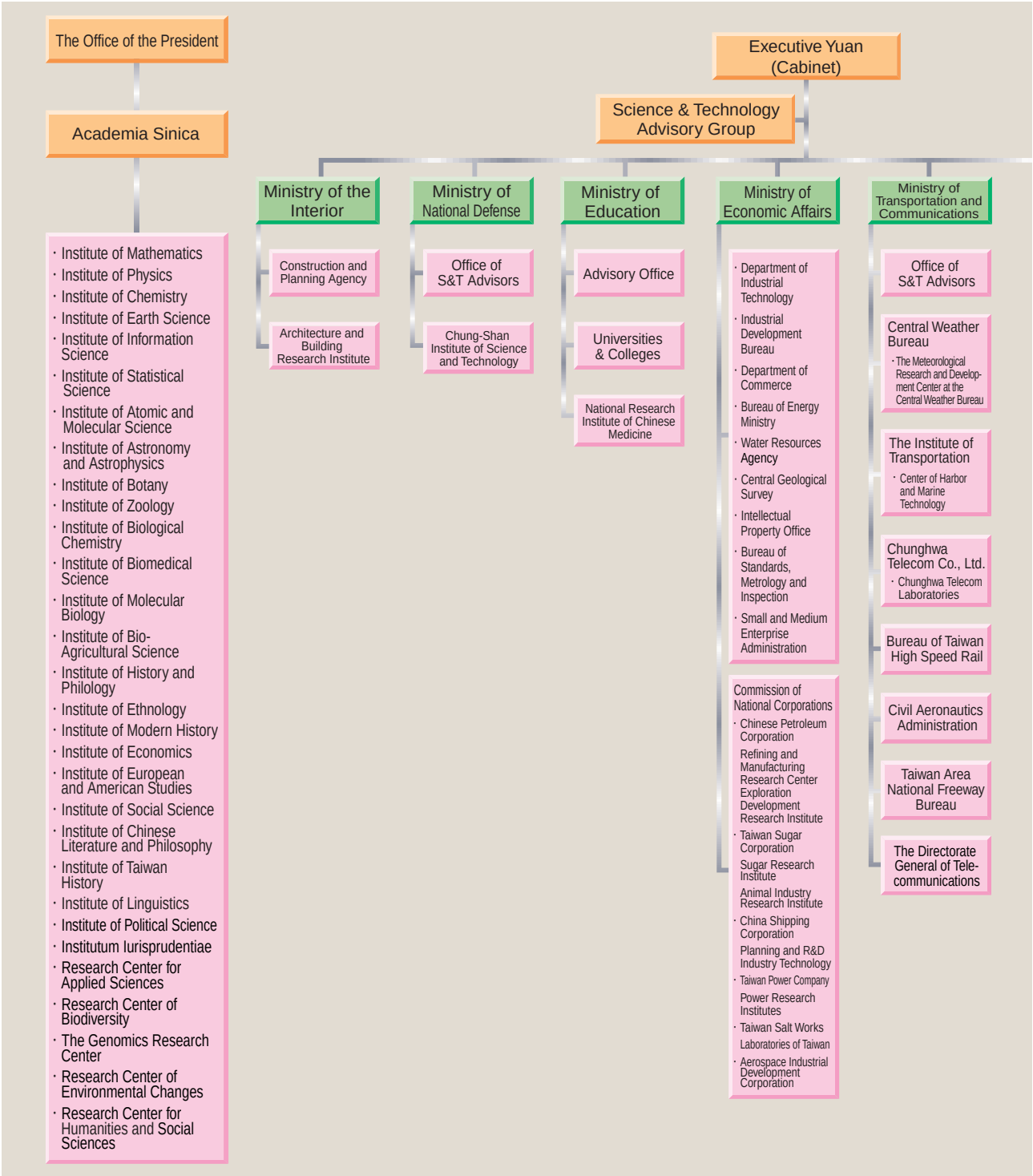
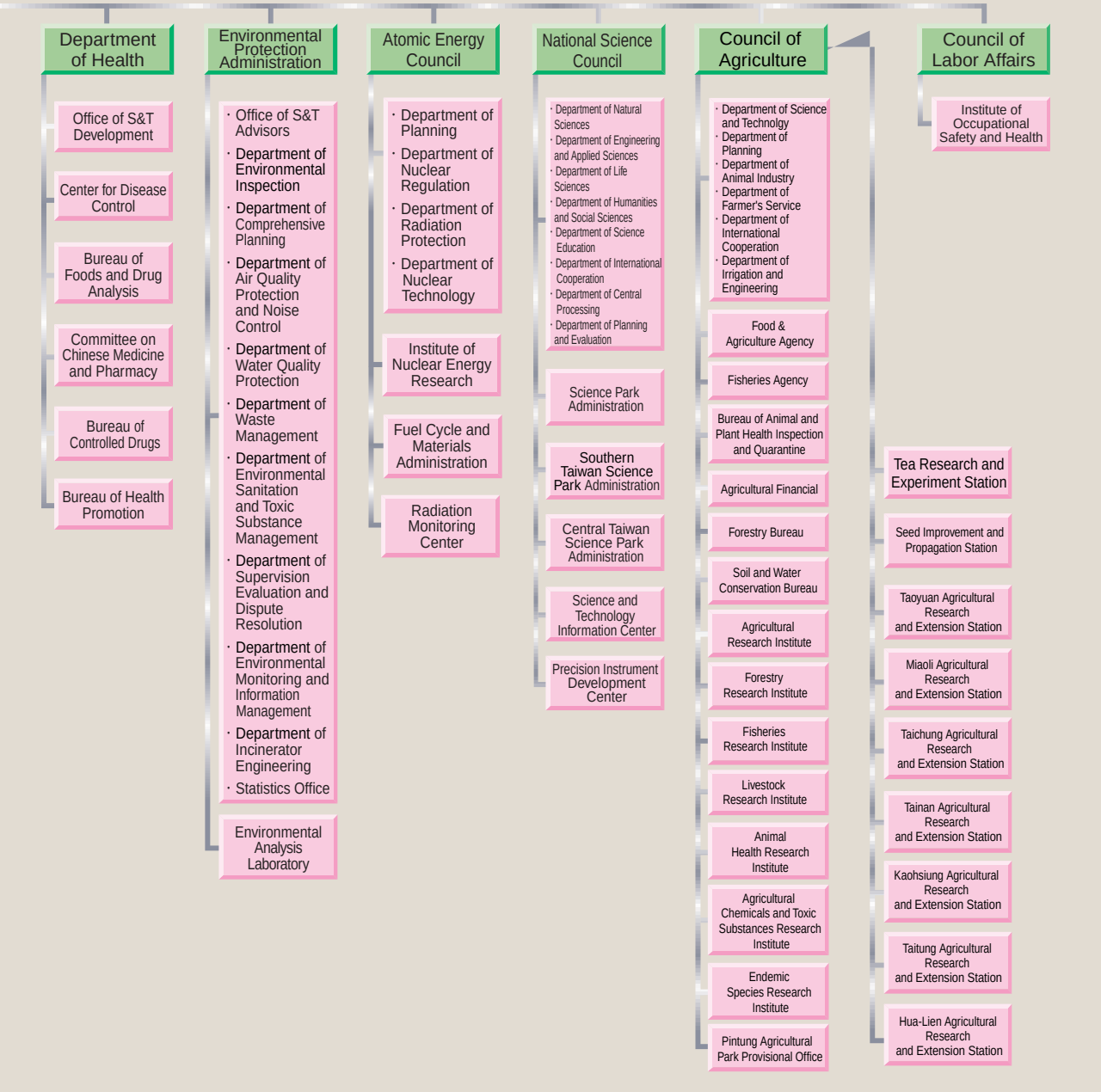


Figure I-1 Organizational Framework for S&T Development in the ROC

Source: Government agencies


Department of Health
Office of S&T Development
Center for Disease Control
Bureau of Foods and Drug Analysis
Committee on Chinese Medicine and Pharmacy
Bureau of Controlled Drugs
Bureau of Health Promotion
Environmental Protection Administration
· Office of S&T Advisors
· Department of Environmental Inspection
· Department of Comprehensive Planning
· Department of Air Quality Protection and Noise Control
· Department of Water Quality Protection
· Department of Waste Management
· Department of Environmental Sanitation and Toxic Substance Management
· Department of Supervision Evaluation and Dispute Resolution
· Department of Environmental Monitoring and Information Management
· Department of Incinerator Engineering
· Statistics Office
Environmental Analysis Laboratory
Atomic Energy Council
· Department of Planning
· Department of Nuclear Regulation
· Department of Radiation Protection
· Department of Nuclear Technology
Institute of Nuclear Energy Research
Fuel Cycle and Materials Administration
Radiation Monitoring Center
National Science Council
· Department of Natural Sciences
· Department of Engineering and Applied Sciences
· Department of Life Sciences
· Department of Humanities and Social Sciences
· Department of Science Education
· Department of International Cooperation
· Department of Central Processing
· Department of Planning and Evaluation
Science Park Administration
Southern Taiwan Science Park Administration
Central Taiwan Science Park Administration
Science and Technology Information Center
Precision Instrument Development Center
Council of Agriculture
· Department of Science and Technolgy
· Department of Planning
· Department of Animal Industry
· Department of Farmer's Service
· Department of International Cooperation
· Department of Irrigation and Engineering
Food & Agriculture Agency
Fisheries Agency
Bureau of Animal and Plant Health Inspection and Quarantine
Agricultural Financial
Forestry Bureau
Soil and Water Conservation Bureau
Agricultural Research Institute
Forestry Research Institute
Fisheries Research Institute
Livestock Research Institute
Animal Health Research Institute
Agricultural Chemicals and Toxic Substances Research Institute
Endemic Species Research Institute
Pintung Agricultural Park Provisional Office
Council of Labor Affairs
Institute of Occupational Safety and Health
Tea Research and Experiment Station
Seed Improvement and Propagation Station
Taoyuan Agricultural Research and Extension Station
Miaoli Agricultural Research and Extension Station
Taichung Agricultural Research and Extension Station
Tainan Agricultural Research and Extension Station
Kaohsiung Agricultural Research and Extension Station
Taitung Agricultural Research and Extension Station
Hua-Lien Agricultural Research and Extension Station

Plan" submitted by the NSC Council Meeting is approved by the Executive Yuan, relevant government departments and agencies implement the Plan's items. STAG regularly reviews and assesses the implementation policy, while providing its recommendations. S&T development in the ROC thus complies with the principles of comprehensive planning and decentralized implementation.

1.2 Implementing Organizations

Implementing agencies and organizations are responsible for performing basic and applied research, experimental development, and commercialization and applications. See Fig. I-2 for a schematic view of the division of labor between executive and implementing organizations.

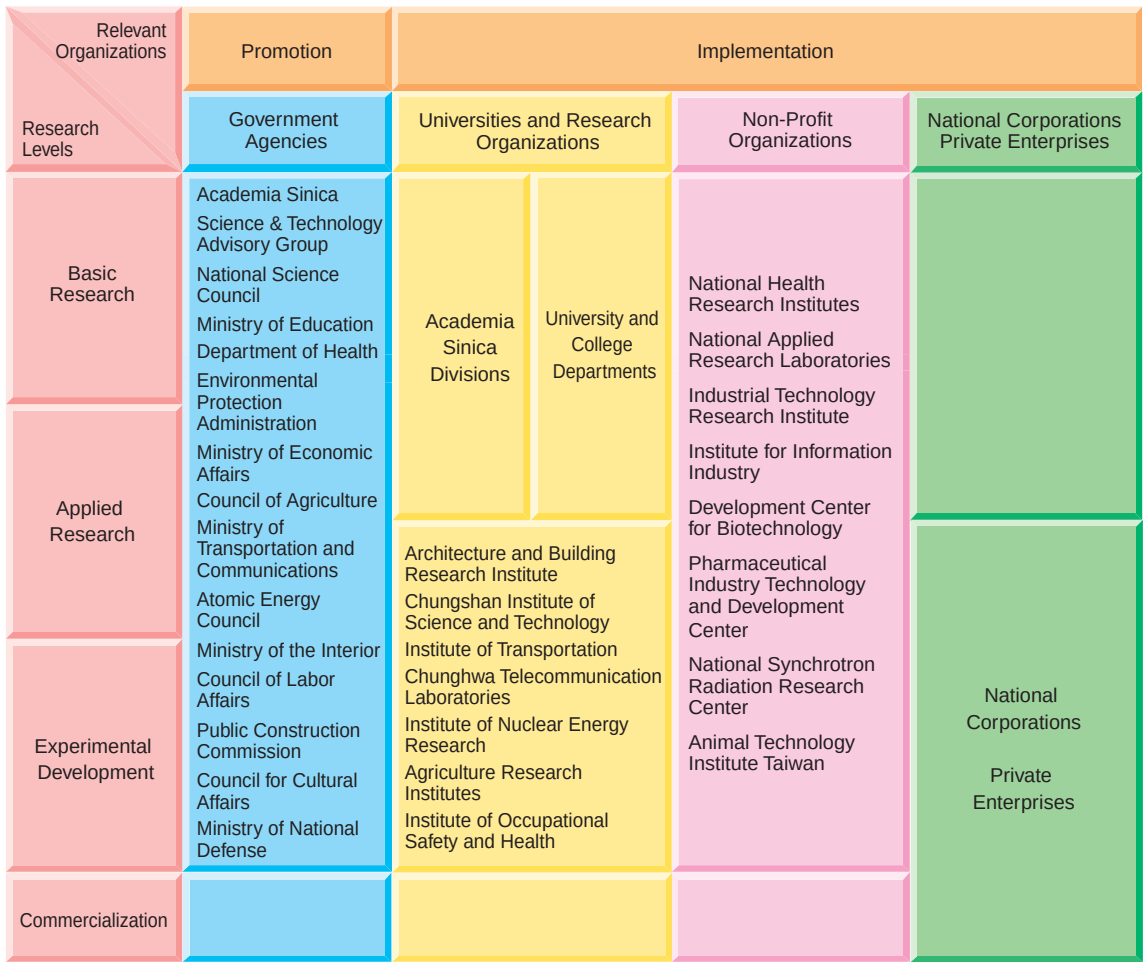


Figure I-2 Schematic View of the Division of Labor between Executing and Implementing Organizations

Source: NSC

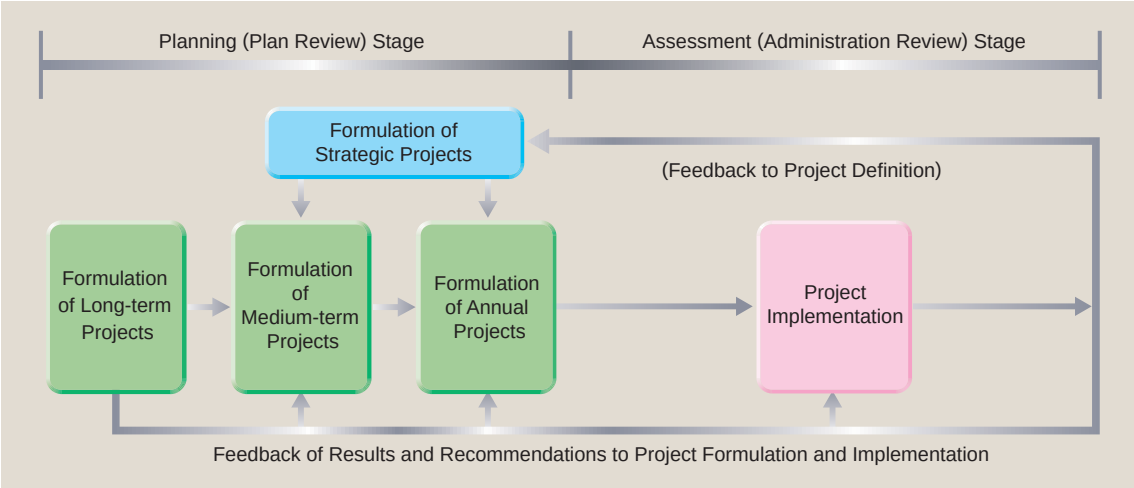


Figure I-3 S&T Project Planning and Assessment System

Source: NSC

1.3 Planning and Assessment System

The S&T project planning and assessment system is shown in Fig. I-3. The annual S&T project review and control system is shown in Fig. I-4.

2. Formulation of S&T Policies

The ROC's S&T policies are formulated on the basis of the consensus reached at national conferences, including the "National Science and Technology Conference," "STAG Board Meeting," and "Industrial Technology Strategy Review Board (SRB) Meeting of the Executive Yuan." See Fig. I-5 for an overview of the ROC's S&T policy and its evolution. The following section explains the role played by major conferences and the Science and Technology Meeting of the Executive Yuan in the formulation of S&T policy.

2.1 National Science and Technology Conference

Held once every four years since 1978, the "National Science and Technology Conference" is intended to produce specific recommendations concerning the nation's S&T development, challenges, and vision. Held in January 2001, the most recent conference – the Sixth National Science and Technology Conference – drafted the "National Science and Technology Development Plan" (2001~2004).

2.2 STAG Board Meeting

Held once every year since 1980, the "STAG Board Meeting of the Executive Yuan" discusses policy recommendations submitted by invited S&T advisors concerning the nation's S&T development plans and major interdepartmental R&D issues.

The following issues were discussed at the 24th STAG Board Meeting, which was held in November 2003: control, risk management, and medical policy with regard to SARS, Taiwan's

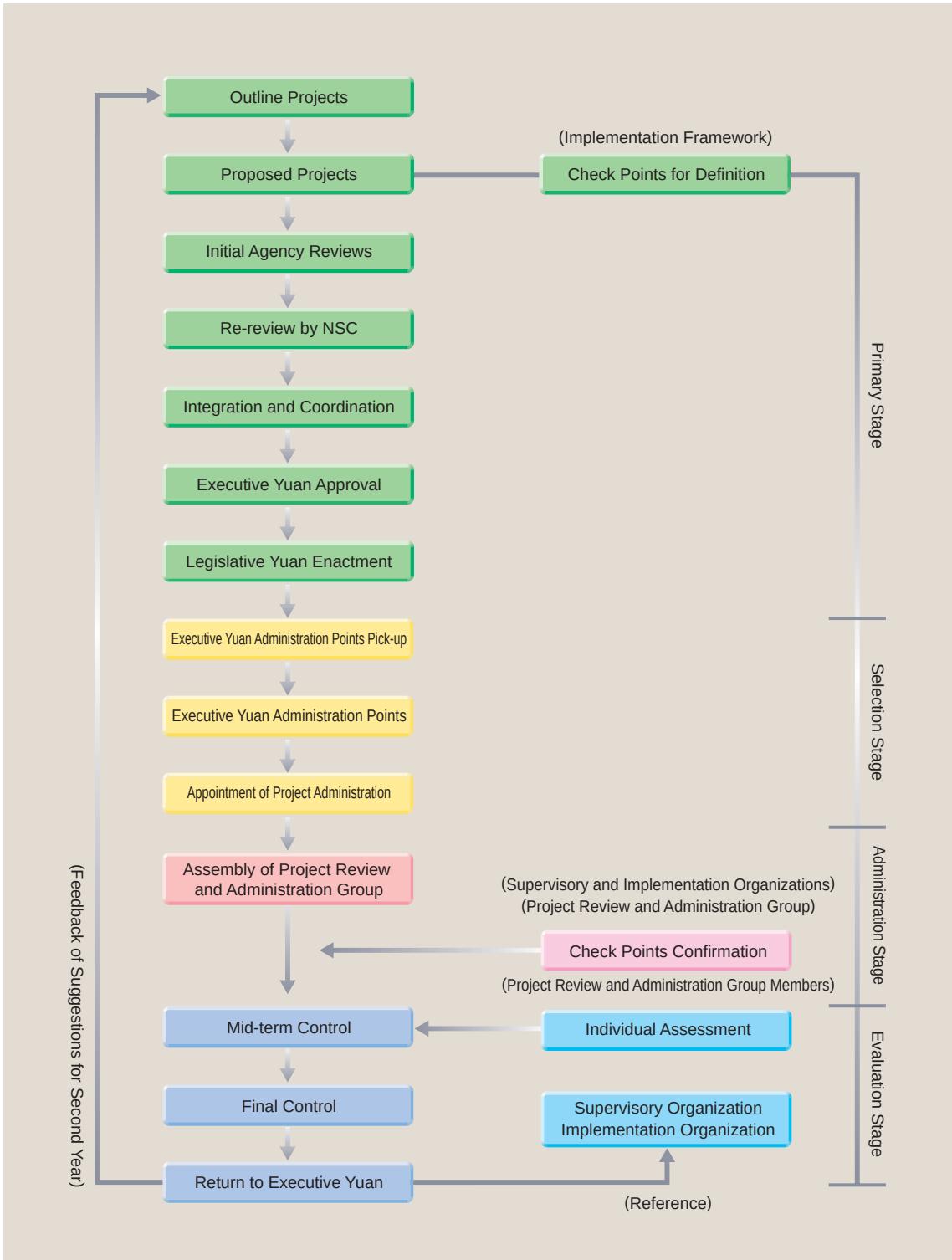


Figure I-4 Annual S&T Project Review and Control Framework

Source: NSC

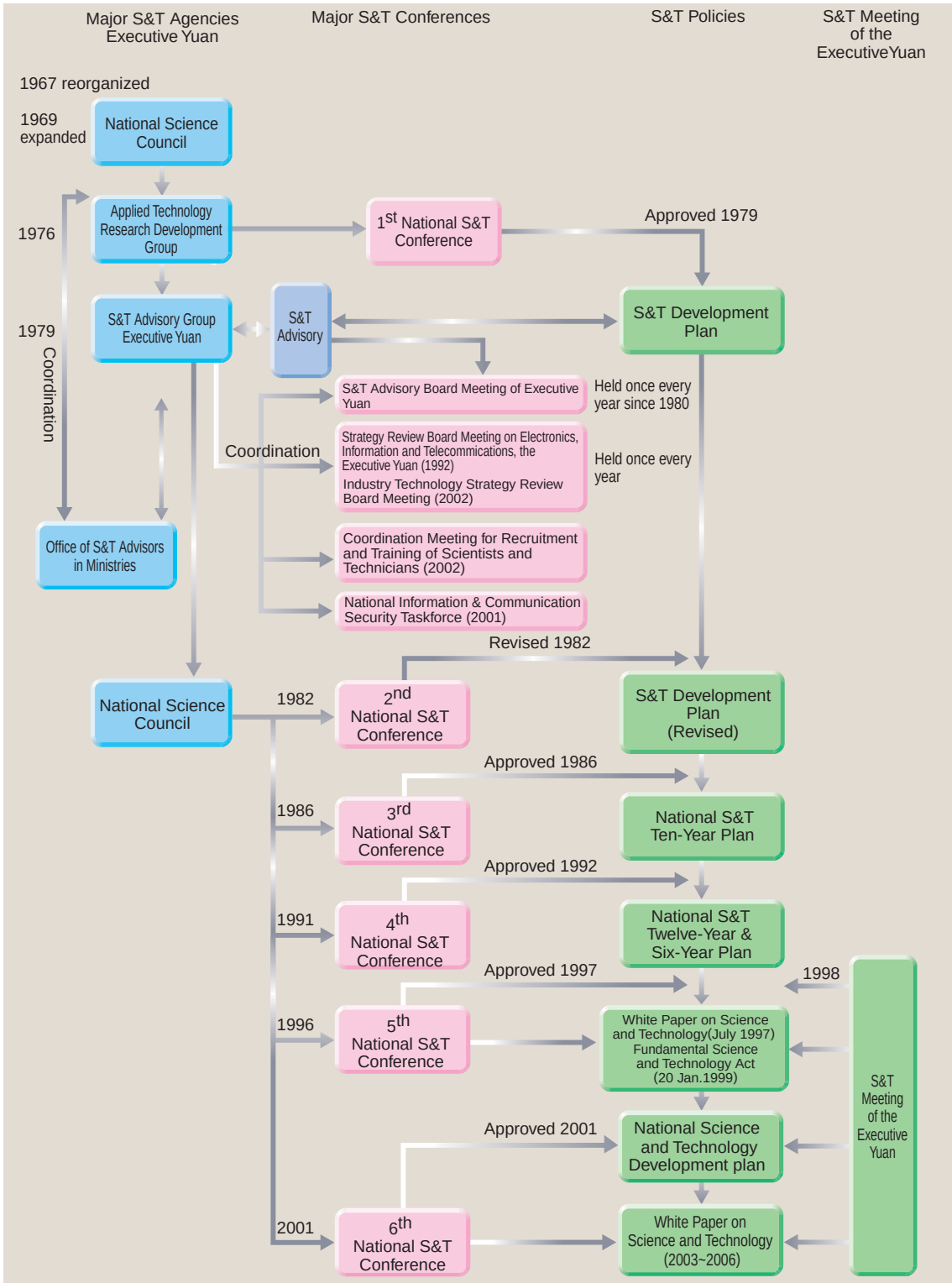


Figure 1-5 Development of the ROC's S&T Framework and Evolution of Policies

Source: NSC

sustainable development and industrial policy, and implementation of methods for realizing an "innovation" economy.

2.3 Industrial Technology SRB Meeting of the Executive Yuan

The SRB Meeting on Consumers Electronics, Computers, and Communications has been merged with the SRB Meeting on Biotechnology as the "Industrial Technology SRB Meeting" since 2002, expanding the scope of the industries discussed.

The SRB meeting held in August 2003 discussed the issues of strategies for developing medical/health care service industries, strategies for developing strategic service industries and a supporting environment, and strategies for involving the defense technology industry in private industrial development.

2.4 Science and Technology Meeting of the Executive Yuan

Held since June 1998, the "Science and Technology Meeting of the Executive Yuan" discusses and acts on major S&T matters.

The Science and Technology Meeting of the Executive Yuan discussed the following issues during the three times it was held in 2003: assessment of R&D effectiveness; the hiring of international-class R&D and managerial personnel; the planning and establishment of at least one world-class university by the Ministry of Education (MOE) and NSC; higher education institution classification and positioning, operating mechanisms and legal system, industry-academic cooperation, development of private universities and colleges, and higher education supply and demand policy; and implementation of the "Final Report on Macroscopic Planning of Higher Education."

3. National Science and Technology Development Plan (2001~2004)

The "National Science and Technology Development Plan" contains eight major strategies and 247 important measures. A total of 33 government ministries, councils, and agencies are jointly implementing the plan's measures.

Most important measures had been fully implemented or reached their objectives by the end of 2003. Twenty-two measures controlled by the implementing unit were subject to continued tracking, and three measures controlled by the Executive Yuan were also subject to continued tracking.

The following is an overview of the results of implementation for relevant important measures:

3.1 Strategy 1 – Strengthening the Training, Recruiting, and Utilization of Technological Manpower

3.1.1 Research personnel with at least a university degree numbered 81,197 persons in 2002, and holders of M.S. and Ph.D. degrees (and above) accounted for 66.1% of these research personnel. Holders of M.S. and Ph.D. degrees accounted for 52.4% of all corporate

research personnel with at least a university degree.

3.1.2 The NSC and MOE have jointly promoted goal-oriented research projects aimed at strengthening the training of S&T manpower; 23 such projects were approved in 2003. The Academia Sinica implemented the "Taiwan International Graduate Program" in cooperation with domestic universities, and signed academic cooperation guidelines with 20 universities and colleges (including National Taiwan University).

3.1.3 In order to expand the recruiting and utilization of S&T manpower, the government established an overseas S&T manpower database and launched the English website "Taiwan Overseas High-Tech Talent Recruiting Mission."

3.1.4 The government has established a more flexible personnel affairs system. In addition, the original NSC National Laboratory Animal Breeding and Research Center, National Center for High Performance Computing, National Center for Research on Earthquake Engineering, National Nano Device Laboratories, National Space Program Office, National Chip Implementation Center, and Synchrotron Radiation Research Center were reorganized as the National Applied Research Laboratories and National Synchrotron Radiation Research Center in 2003.

3.2 Strategy 2 – Making the Fullest and Most Effective Use of Technological Funding

3.2.1 Total national R&D expenditures accounted for 2.3% of GDP in 2002.

3.2.2 The government's S&T budget will grow at an annual rate of 10% in 2004, and total NT$62.1 billion.

3.2.3 Strategy conferences were held on electronics and 12 other technological fields in 2003; an assessment was made of the results of projects receiving funding of NT$10 million or more.

3.3 Strategy 3 – Strengthening Academic Research, Pursuing Academic Excellence

3.3.1 Beginning in 2003, seven universities (National Taiwan University, National Yang Ming University, National Central University, National Chiao Tung University, National Tsing Hua University, National Sun Yat-Sen University, and National Cheng Kung University) established research centers promoting interdisciplinary research.

3.3.2 The NSC and MOE provided focused assistance to universities under the four-year "Program for Promoting Academic Excellence of Universities."

3.3.3 The MOEA implemented "Technology Development Programs" for the academic sector, and helped enterprises establish R&D alliances strengthening industry-academic cooperation.

3.4 Strategy 4 – Strengthening Technological Innovation, Promoting Industrial Upgrading

3.4.1 Formulation of industrial development focal points: In computer and software technology, participation in the drafting of international standards and protocols, development of core technologies; in telecommunications system technology, completion of specification drafting. There were a total of at least 2.94 million broadband users as of the end of 2003.

3.4.2 The government is encouraging transnational corporations to establish R&D centers in

Taiwan; 15 R&D center plans were approved in 2003.

3.4.3 Forty-five industrial investment cases involving investment of NT$5.9 billion were implemented.

3.4.4 The Hsinchu Science Park (HSP) developed outlying sites at Chunan and Tungluo. The road and pipeline construction has begun at the Taichung site of the Central Taiwan Science Park. As of the end of 2003, a total of 111 projects had been implemented at the Southern Taiwan Science Park as part of the first phase of site development.

3.5 Strategy 5 – Improving Public Welfare and Environmental Quality

3.5.1 The government promoted environmental protection and global change research, integrated industrial waste source management, and performed flow control and pollution audit work.

3.5.2 Disaster mitigation technology advances included the drafting of a flooding mitigation plan and approval of the deployment of a drought response decision-making support system.

3.5.3 Aquatic and marine resources technology included the attainment of flood prevention goals on flood-prone segments of 24 river systems under central management.

3.5.4 Energy technology efforts included the setting of national fuel cell R&D goals for electric vehicles, electric generators, electronics products, and basic infrastructure.

3.5.5 e-Government efforts included the strengthening of citizen-wide information education and training, and the provision of full subsidies for Internet connection fees and equipment maintenance fees at 1,171 schools in remote areas.

3.5.6 Medical and hygiene technology progress included the establishment of the "Genetically Modified Foods Interdepartmental Working Group."

3.5.7 Agricultural technology efforts included the development of GM crop seed and seedling testing technology and implementation of a monitoring system.

3.5.8 Transportation technology undertakings included the implementation of the "National Intelligent Transportation Infrastructure" (NITI) program.

3.5.9 Construction technology efforts included the promotion of green architecture.

3.6 Strategy 6 – Promoting the Mutual Development of Technology and a Humane Society

3.6.1 Utilization of information technology to establish a superior liberal arts research environment and implementation of the National Digital Archives Program.

3.6.2 Ethical, legal, and social implications of emerging technologies; revision and announcement of the *Statute for Human Organ Transplants* by the DOH.

3.7 Strategy 7 – Implementing Nationwide Technology Education and Improving Citizens' Technical Knowledge

3.7.1 Strengthening of citizens' technological attainment; implementation of the "2003 Sustainable Ecosystem Conservation for Primary and Secondary Students in Eight Cities of Southern Taiwan" special exhibition by the NSC.

3.7.2 The NSC implemented the "Popular Science Education Research and Promotion Plan" in

order to promote the dissemination of new technological knowledge.

3.7.3 The NSC completed the design and validation of the "Science Attainment Survey Tool" as part of an effort to develop indicators for measuring citizens' S&T attainment.

3.8 Strategy 8 – Establishing an Autonomous Defense Technology Industry and R&D System

3.8.1 Institution of the "Chung-Shan Institute of Science and Technology Technological Project Promotion Plan."

3.8.2 Development of defense technology and establishment of an autonomous defense system in conjunction with private undertakings.

3.8.3 Strengthening of existing organizational functions, completion of high-speed precision detection technology for the SARS virus.

4. National Science and Technology Programs

The government has lent its long-term support to national science and technology programs promoting the integration of up-, mid-, and down-stream R&D resources and responding to the country's major socioeconomic problems. The government is also committed to the training of up-, mid-, and down-stream R&D personnel for major S&T projects and the establishment of project implementation and cooperation mechanisms. National Science and Technology Programs have consequently been given high priority. The "Guidelines for the Management and Operation of National Science and Technology Programs" was drafted by the NSC in 1998, and approved by the 134th NSC Council Meeting. See Table I-1 for the periods, budgets, and participating agencies of approved national science and technology programs.

4.1 National Science and Technology Program for Hazards Mitigation

This program received total funding of NT$1.04 billion during its first phase (1998~2001). Funding has been set at NT$3.39 billion for the 2002~2006 second phase. Main goals include the systematic promotion of up-, mid-, and down-stream technology R&D involving relevant government agencies, and realization of R&D results as technologies that can be applied in practical disaster mitigation work.

4.2 National Science and Technology Program for Telecommunications

This program received total funding of NT$12.4 billion during its first phase (1998~2003). The plan for the program's second phase was approved at the 162nd NSC Council Meeting in October 2003; this plan calls for funding of NT$13.4 billion over the period of 2004~2008. Apart from the original areas of wireless communications and broadband Internet, the program will add the item of applications services in an effort to establish a broad spectrum of telecommunications service and systems technologies.

4.3 National Science and Technology Program for Agricultural Biotechnology

This program received total funding of NT$790 million during its first phase (1998~2001). Funding has been set at NT$1.99 billion for the 2002~2004 second phase. The program's goal is

Table I-1 National Science and Technology Program Periods, Total Funding, and Participating Agencies

Program name	Period (FY)	Total Funding (Billion NT$)	2003 Funding (Billion NT$)	Participating agencies
Hazards mitigation	1998~2001 2002~2006	1.0 3.4	 0.5	Ministry of Economic Affairs, Council of Agriculture, Ministry of the Interior, National Science Council, Department of Health, Environmental Protection Administration, Ministry of Transportation and Communications, Ministry of Finance, Public Construction Commission, Ministry of Education, Council of Indigenous Peoples, National Disaster Prevention and Protection Commission
Telecommunications	1998~2003 2004~2008	12.4 13.4	2.1	Ministry of Economic Affairs, Ministry of Transportation and Communications, Ministry of Education, National Science Council
Agricultural biotechnology	1998~2001 2002~2004	0.8 2.0	 0.5	Council of Agriculture, Academia Sinica, National Science Council, Department of Health
Pharmaceuticals and biotechnology	2000~2002	1.1		Department of Health, National Science Council, Ministry of Economic Affairs
Biotechnology and pharmaceuticals	2003~2006	7.6	1.4	
Genomic medicine	2002~2005	7.3	2.3	Academia Sinica, Department of Health, National Science Council, Ministry of Economic Affairs.
Digital archives	2002~2006	2.8	0.3	Academia Sinica, Council for Cultural Affairs, National Palace Museum, Ministry of Education, National Science Council
Si-Soft National Systems-on-chip	2002~2005	7.7	1.7	Ministry of Economic Affairs, Ministry of Education, National Science Council
Nanoscience and nanotechnology	2003~2008	23.2	2.6	Ministry of Economic Affairs, Ministry of Education, National Science Council, Atomic Energy Council, Environmental Protection Administration.
e-Learning	2003~2007	4.0	0.6	Ministry of Economic Affairs, Ministry of Education, Council of Labor Affairs, Council for Cultural Affairs, Department of Health, National Science Council, Ministy of National Defense, Tainan County Government, National Palace Museum, Council of Indigenous Peoples, Council for Hakka Affairs

Source: NSC

to integrate up-, mid-, and down-stream manpower, material resources, and technology in the field of agro-biotechnology, strengthen localized research with industrial potential, and realize industrial applications.

4.4 National Science and Technology Program for Biotechnology and Pharmaceuticals

Originally named the "National Science and Technology Program for Pharmaceuticals and Biotechnology," this program received total funding of NT$1.06 billion during its first phase (2000~2002). Now renamed, the second phase of the program will extend from 2003 to 2006 and involve funding of NT$7.59 billion. The program seeks to integrate domestic pharmaceutical and biotechnology manpower and resources, and promote R&D on new drugs, pharmacology,

toxicology, the clinical testing system, and drugs to combat diseases common among the people of Taiwan.

4.5 National Research Program for Genomic Medicine

This program is slated to receive NT$7.27 billion over the period of 2002~2005. The program is focusing on the prevention, diagnosis, and treatment of disease (particularly the most commonly-seen diseases of Taiwan) via genomic science. R&D work includes basic research, animal model testing, clinical testing, technology transfer, and industrial development.

4.6 National Digital Archives Program

This program is slated to receive NT$2.78 billion over the period of 2002~2006. The primary goals of this program include the digitization of the nation's important artifacts and collections, and the use of a national digital archive to promote cultural, social, industrial, and economic development.

4.7 Si-Soft National System-on-Chip Program

This program will receive funding of NT$7.67 billion over the period of 2002~2005. The program's goal is to harness the strengths of industry, government, academia, and the research community, and establish Taiwan as a global chip implementation center. The program is comprised of five sub-programs on diversified manpower training, forward-looking product design, advanced platform development, forward-looking SIP development, and development of new industrial technology.

4.8 National Science and Technology Program for Nanoscience and Nanotechnology

This program will receive funding of NT$23.2 billion over the period of 2003~2008. The intent of this program is to channel the efforts of industry, academia, and research organizations for the purpose of establishing nanometer platform technologies needed for academic excellence and applications industries, and to accelerate the training of nanotechnology personnel. All effort will be made to promote innovation and integration, and foster the development of a high value-added knowledge industry based on technological innovation and IPR creation.

4.9 National Science and Technology Program for e-Learning

This program will receive funding of NT$4.01 billion over 2003~2007. The program's goals are to expand opportunities for lifelong study, promote the development of e-Learning industries, and encourage academic research on e-Learning.

5. Challenge 2008 - National Development Plan

The "Challenge 2008 - National Development Plan" embraces the basic concepts of the "Green Silicon Island" plan, seeks to establish a harmonious and complementary relationship between economic development, cultural attainment, and the living environment, while realizing the core values of humanism and sustainable development. The program's goals can be summarized as "humanizing technology, vitalizing culture, and ensuring sustainable development."

Three subplans of the National Development Plan connected with science and technology were implemented in 2003: "International Innovation and R&D Base Plan" (25 projects), "Industrial Value Heightening Plan" (41 projects), and "e-Taiwan Construction Plan" (11 projects). The following is an overview of these plans' achievements:

5.1 International Innovation and R&D Base Plan

5.1.1 Attract international R&D personnel: This project recruited 599 overseas hi-tech personnel to work in Taiwan; a bilateral exchange student program attracted 1,283 formal students; 14 research personnel participated in short-term S&T research projects overseas.

5.1.2 Provide NT$50 billion in R&D loans: The government provided NT$2.5 billion in R&D loans under this NT$50 billion loan program; 90 R&D projects were approved to receive loans.

5.1.3 Establish key-industry technical colleges: A semiconductor college was established and began training of 901 persons in 29 classes, and a digital content college provided formative training 1,227 person-times and in-service training 1,910 person-times.

5.1.4 Establish innovation and R&D centers: A plan to attract multinational firms to set up regional R&D centers resulted in the establishment of R&D centers by 15 multinationals including Microsoft, IBM, Intel, and others. A plan to encourage the establishment of private innovation and R&D centers prompted 27 firms to set up R&D centers.

5.1.5 Promote key industrial technology research: 246 papers were published and 683 persons received training under the "National Science and Technology Program for Agricultural Biotechnology," 212 research reports and conference papers were issued and 779 persons received training under the "National Science and Technology Program for Biotechnology and Pharmaceuticals," 71 papers were published and 955 persons received training under the "National Research Program for Genomic Medicine," a cumulative total of 249 papers were published and 82 patent applications made under the "National Science and Technology Program for Nanoscience and Nanotechnology," 59 training classes were held under the "Si-Soft National System-on-Chip Program," and two R&D alliance research projects contracts signed under the "Telecommunications Technology Development Program."

5.2 Industrial Value Heightening Plan

5.2.1 Raise a venture capital fund of NT$100 billion: 20 investors were approved under this project to raise NT$100 billion venture capital.

5.2.2 Provide assistance for the development of core industrial technologies: 30 R&D centers were established by universities, 53 R&D alliance projects were implemented, and 99 patent applications made.

5.2.3 Promote key industries: A high-tech textile project completed the development of high-tech textiles that are health-promoting, innovative, and comfortable. A functional health food and health product project completed the draft *Development Strategies and Measures for the Functional Health Food Industry*. A precision materials project developed materials

technology needed for the packaging of wireless communications products.

5.2.4 Provide incentives for investment in international distribution channels and brands: An international brand development project offered training to brand managers over 1,000 person-times and provided branding consulting and diagnostic services to 33 companies.

5.2.5 Construct industrial parks: The government signed an agreement with National Taiwan University for the development of a biomedical park. Thirty-four firms and two incubation centers were cleared to occupy the new Central Taiwan Science Park. Environmental impact assessment contracting work was completed with regard to a planned agro-biotechnology industrial park.

5.3 e-Taiwan Construction Plan

5.3.1 Bring broadband to the home for six million households: The number of broadband users reached 3.04 million persons; eight wireless broadband network demonstration areas were established with the participation of over 40 up-/midstream firms; a standards testing laboratory was established; 1,125 SMEs were given assistance in adopting basic broadband applications.

5.3.2 Promote e-Society: Labor health and safety classes in 30 subjects were held under the National Science and Technology Program for e-Learning; 13,911 completion certificates were issued. A total of 4,260 persons received training and 38,546GB (38.55TB) worth of materials were digitized under the National Digital Archives Program.

5.3.3 Promote e-Commerce: Assistance was provided to 19 firms including the Giant Mfg. Co., Ltd. and the Pou Chen Group under an industrial design computerization project; 56 key issues of concern to SMEs in eight categories were compiled under an SME knowledge management and utilization project.

5.3.4 Promote e-Traffic system: A series of research projects on passenger behavior and the collection, processing, and dissemination of intelligent transportation information were completed.

6. White Paper on Science and Technology (2003~2006)

The *White Paper on Science and Technology* (2003~2006) contains the following two main sections: "Visions and Strategies for the Development of Science and Technology" and "Science and Technology Development at Government Agencies." The following is an overview of the content of the *White Paper*:

Part One Visions and Strategies for the Development of Science and Technology

6.1 Chapter 1 – Introduction

The ROC enters the knowledge-based economy age with sound computer and communications infrastructure, high educational standards, excellent accumulated R&D capabilities and

manufacturing experience, well-developed capital markets, and plentiful international trade experience. As domestic and foreign technology continues to evolve rapidly, the government must place more emphasis on S&T funding and manpower training and utilization, strengthen knowledge creation and technological innovation, put the S&T legal system on a sound basis, enhance the flexibility of the S&T organizational system, and develop technologies promoting general public welfare.

6.2 Chapter 2 – The Current State of Science and Technology in Taiwan

Gross domestic expenditure on R&D was equivalent to 2.3% of GDP in 2002, and was thus still some distance from the target of 3% of GDP. The number of research personnel holding at least a university degree had grown significantly, but more effort must be made to boost the number of Ph.D.-holding research personnel. As for technological results, the ROC ranked 18th (10,831 papers) in terms of the number of academic papers cited in the 2002 *Science Citation Index* (*SCI*) and 11th (5,350 papers) in terms of papers cited in the *Engineering Index* (*EI*). In addition, the ROC leaped to fourth in terms of number of US patents granted. As far as national competitiveness was concerned, the World Economic Forum's 2003 report ranked the ROC fifth in the world in terms of growth competitiveness and third in terms of technology.

In the area of academic research, funding for academic research in Taiwan has enjoyed steady growth in recent years. Most government S&T projects are classified under 35 fields, and R&D focal points have been drafted for each of these fields in order to guide mid- and long-term implementation. The government has approved nine national science and technology programs intended to respond to the country's major socioeconomic issues and integrate up-, mid-, and down-stream technological resources; these programs were granted approximately NT$11 billion in funding in 2003.

6.3 Chapter 3 – Vision and Strategies for the Development of Science and Technology

6.3.1 Overall Goals

The overall goal of S&T development in the ROC is to strengthen knowledge innovation systems, help industry build competitive advantages, improve citizens' quality of life, promote sustainable development, improve nationwide technological standards, and reinforce the country's autonomous defense capability.

6.3.2 Vision

The nation's S&T development vision calls for reaching the scientific and technological standards of a developed nation by 2010. R&D input and output targets include increasing R&D funding to the equivalent of 3% of GDP and increasing the number of research personnel holding at least a university degree to 32 persons per 10,000 by 2007. In addition, by 2007, at least 3.5% of all patents granted by the US (not including new design patents) will go to ROC applicants. Finally, at least one university in Taiwan will have become a first-rate world-class institution by 2013, and there will be more than six million broadband users by 2007.

6.3.3 Strategies

The following six S&T development strategies have been formulated as means of achieving the aforementioned S&T development goals and vision:

Strategy 1 – Strengthening the cultivation, training, recruitment, and utilization of scientific and technological manpower resources.

Strategy 2 – Maximizing and augmenting funds for R&D and innovation, effectively utilizing existing scientific and technological resources.

Strategy 3 – Emphasizing academic research, developing distinctive fields of world-class research.

Strategy 4 – Stimulating technological innovations, building an environment suitable for industrial development.

Strategy 5 – Fostering the interactive development of S&T, society, and the environment; improving public welfare and environmental quality.

Strategy 6 – Building a superior defense technology system, promoting the development of military-civilian dual-use technologies.

Part Two Science and Technology Development at Government Agencies

This part of the *White Paper* explains the goals, strategies, and resources of the government agencies involved in S&T development from 2003 to 2006. These agencies include the Academia Sinica, STAG, MOI, Ministry of National Defense (MND), MOE, MOEA, MOTC, DOH, Environmental Protection Administration (EPA), Atomic Energy Council (AEC), NSC, Council of Agriculture (COA), Council for Cultural Affairs (CCA), Council of Labor Affairs (CLA), and Public Construction Commission (PCC). See Table I-2 for a breakdown of S&T development funding at individual agencies.

Prospects

In view of the fact that S&T development is an ongoing undertaking, current circumstances, strategies, and long-term prospects will be alternately included in the respective *White Paper on Science and Technology* and "National Science and Technology Development Plan" at two-year intervals, see Fig. I-6.

Table I-2 Sci-Tech Spending Plans for Government Agencies, 2003~2006

Unit: million NT$

Agency	2003	2004	2005	2006	Total
Academia Sinica	5,843	6,708	7,513	8,415	28,479
Science and Technology Advisory Group	–	–	–	–	–
Minister of the Interior	184	314	319	258	1,075
Ministry of National Defense	–	–	–	–	–
Ministry of Education	991	1,167	1,085	1,085	4,328
Ministry of Economic Affairs	24,383	28,982	31,861	35,047	120,273
Ministry of Transportation and Communications	674	808	970	1,165	3,617
Department of Health	2,832	3,115	3,427	3,770	13,144
Environmental Protection Administration	47	71	77	86	281
Atomic Energy Council	646	975	1,097	1,255	3,973
National Science Council	24,104	26,997	28,542	30,228	109,871
Council of Agriculture	3,197	3,517	3,868	4,255	14,837
Council for Cultural Affairs	20	25	25	25	95
Council of Labor Affairs	143	173	207	248	771
Public Construction Commission	55	62	64	65	246

Source: NSC

Note: Figures above represent the government's research and development funding budget.

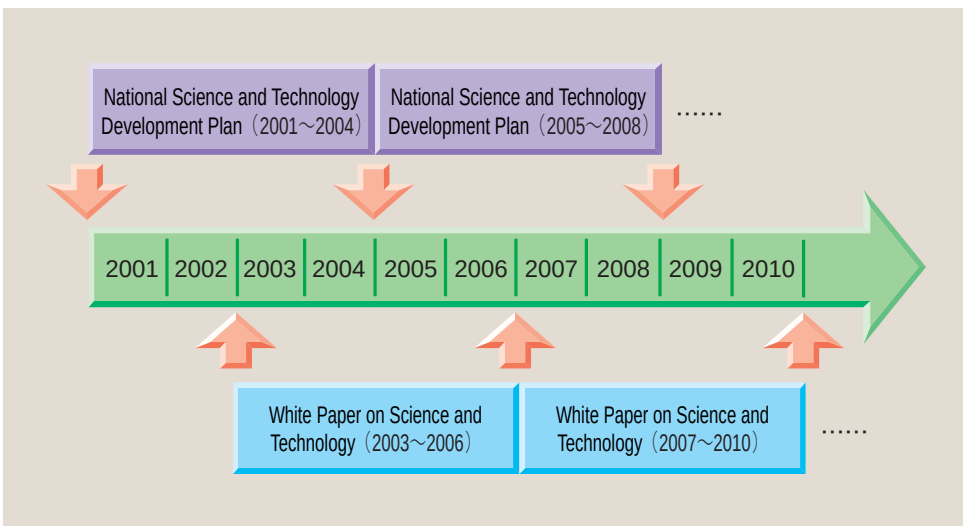


Figure I-6 Schematic Diagram for the Timetable of "National Science and Technology Development Programs" and the *White Paper on Science and Technology*

Source: NSC

Chapter 2 Overall Performance of S&T Development

1. S&T Activity Funding and Manpower

The government spent a total of NT$66.8 billion on scientific and technological activities in 2003. These activities include "academic research" implemented by the Academia Sinica and NSC (described in Part II), and "research in technological fields" encompassing government S&T projects in 35 fields (described in Part III).

Sixteen government agencies funded S&T research activities in 2003, including the Academia Sinica, NSC, MOEA, MOE, COA, DOH, and AEC. A total of NT$47.3 billion was spent on S&T projects by these agencies. See Table I-3 for a detailed breakdown of government agency spending on S&T research activities from 1999 to 2003. Relative spending by agency on S&T activities is shown in Fig. I-7. A distribution of project funding by type of research is shown in Fig. I-8.

Government agencies committed the greatest amount of S&T manpower to applications research in 2003, followed by basic research, while experimental development received the least manpower input. See Fig. I-9 for a breakdown of relative manpower input.

By agency, the NSC committed the greatest amount of manpower, and was followed by the MOEA, COA, DOH, and Commission of National Corporations in that order. See Fig. I-10 for a breakdown of manpower input by agency.

2. Research Result Indicators

Each NT$1 billion that the government invested in research in 2003 generated 873 academic papers, 19.2 patents, 155.6 technical reports, 8.1 technological innovations, 65.1 copyrights, 2.4 technology acquisitions, 36.7 technology transfers, and 1,050.5 instances of technical service.

Table I-3 S&T Research Activities Funding by Agency, FY1999~2003

Unit: Million NT$

Year	Agencies														Total
	Academia Sinica	National Science Council	Commission of National Corporations	Ministry of Transportation & Communications	Atomic Energy Council	Council of Agriculture	Environmental Protection Administration	Department of Health	Ministry of the Interior	Ministry of Education	Council of Labor Affairs	Ministry of Economic Affairs	Public Construction Commission	Others	
1999	4,470	19,690	(7,380)	1,950	2,650	1,830	110	1,430	150	1,010	130	18,880	80		59,760
2000	6,720	32,660	(11,040)	700	3,920	2,450	80	2,290	220	1,410	140	27,650	40		89,320
2001	5,050	19,150	(4,210)	580	3,920	3,120	50	2,030	190	970	130	20,330	50	50	59,830
2002	5,260	20,950	(4,500)	550	2,780	3,060	50	2,630	30	770	120	20,770	60	50	61,580
2003	6,770	22,210	4,720	640	2,610	3,090	100	2,650	140	913	140	22,650	50	40	66,723

Source: NSC
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

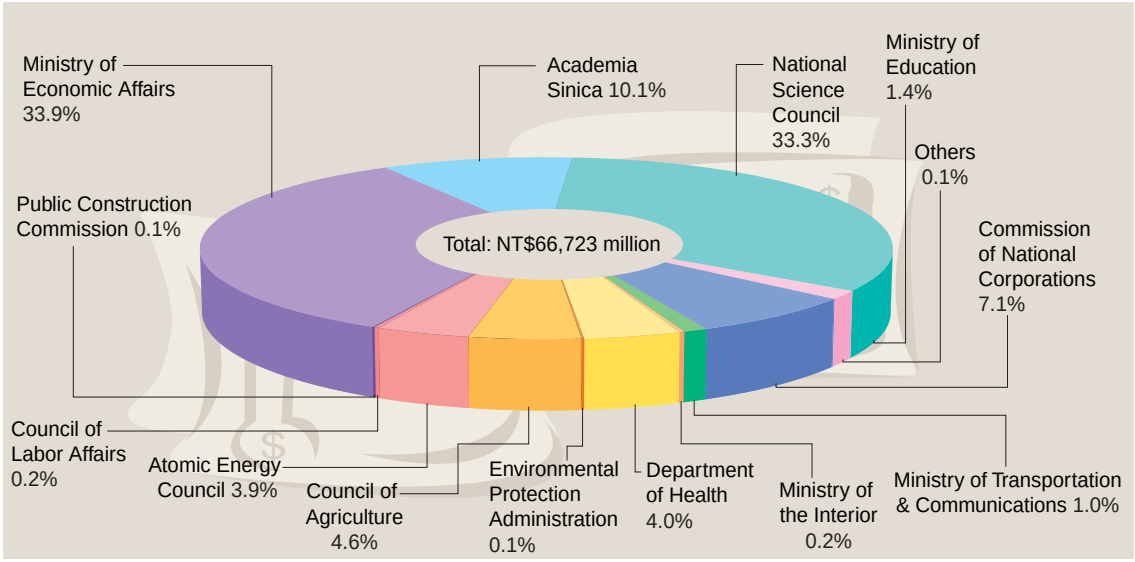


Figure I-7 Distribution of Government S&T Research Activities Funding in FY2003 by Agency

Source: NSC

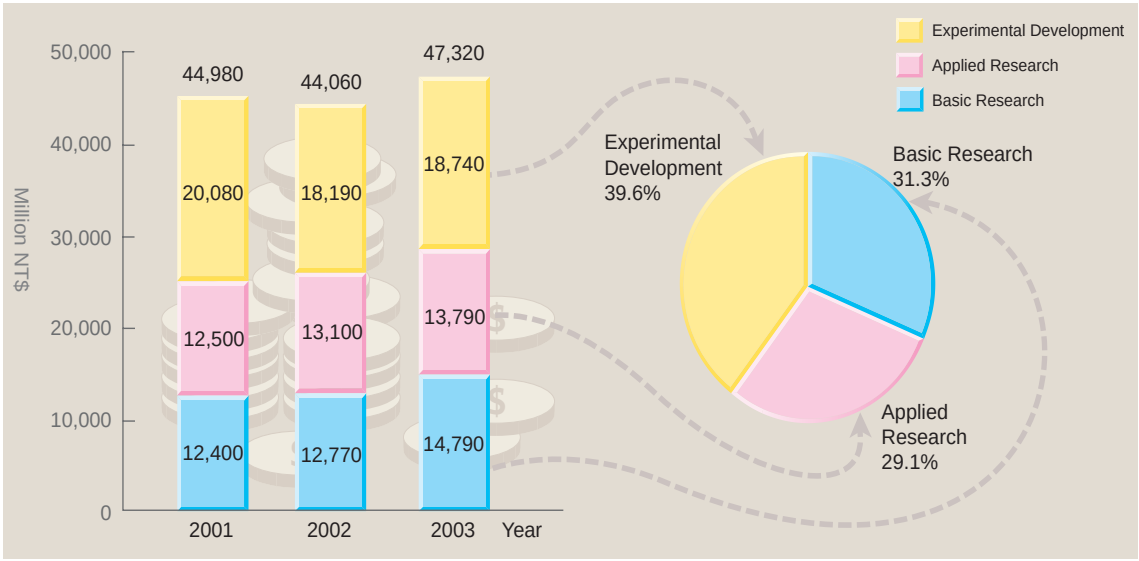


Figure I-8 Distribution of Government S&T Research Activities Funding by Type of Research, FY2001~2003

Source: NSC

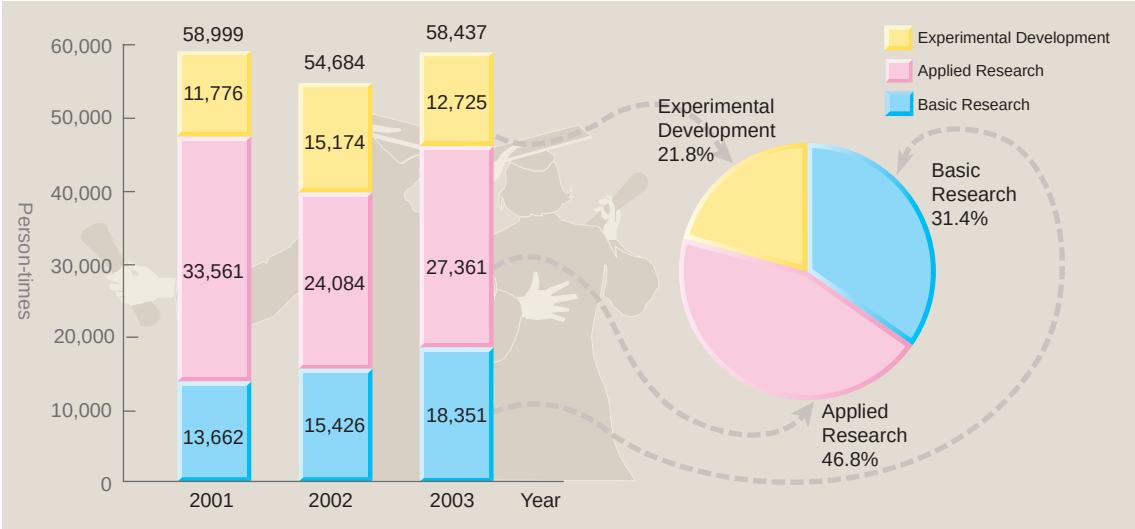


Figure I-9 Government S&T Research Activities Manpower by Type of Research, FY2001~2003

Source: NSC

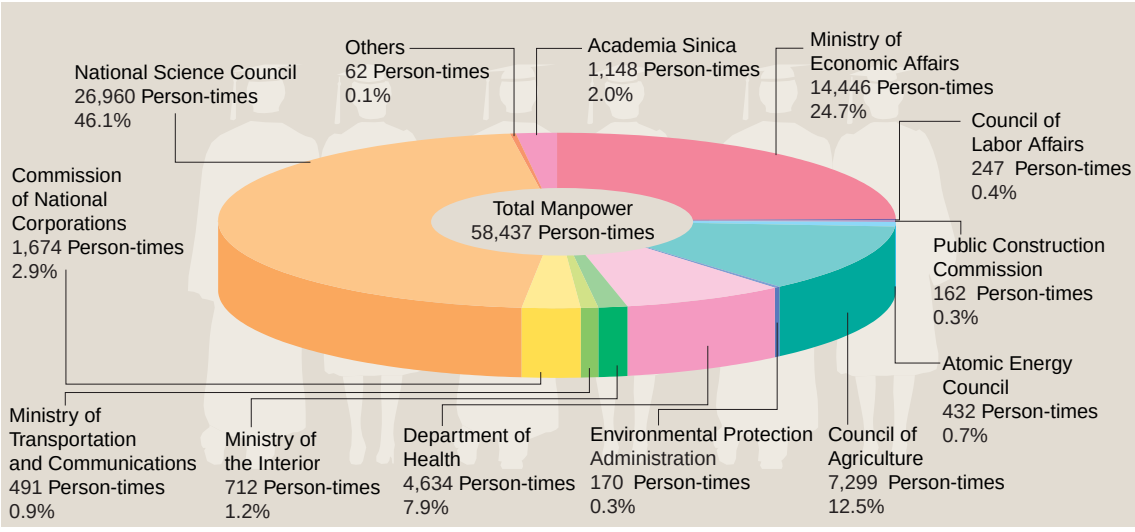


Figure I-10 Manpower of Government Agency S&T Research Activities Projects in FY2003 by Agency

Source: NSC

3. Academic Papers and Patents

See Fig. I-11 for the total numbers of ROC papers cited in *Science Citation Index* (*SCI*) and Fig. I-12 for papers cited in *Engineering Index* (*EI*) in 2003.

A total of 5,298 US patents were awarded to recipients from the ROC in 2003 (see Table I-4). This figure put the ROC behind only the US, Japan, and Germany in terms of US patents granted.

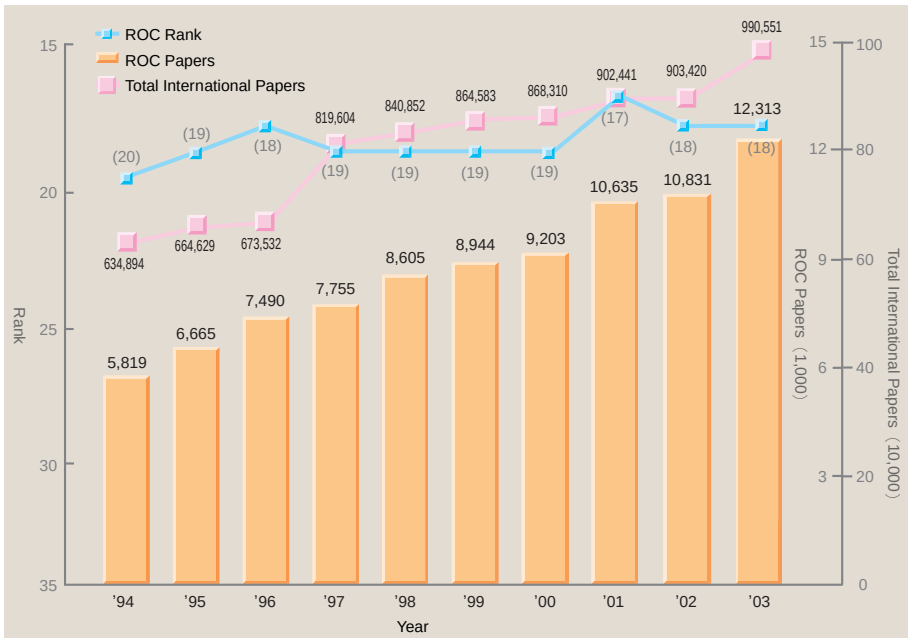


Figure I-11 Number of ROC Papers Cited in *SCI*

Source: NSC

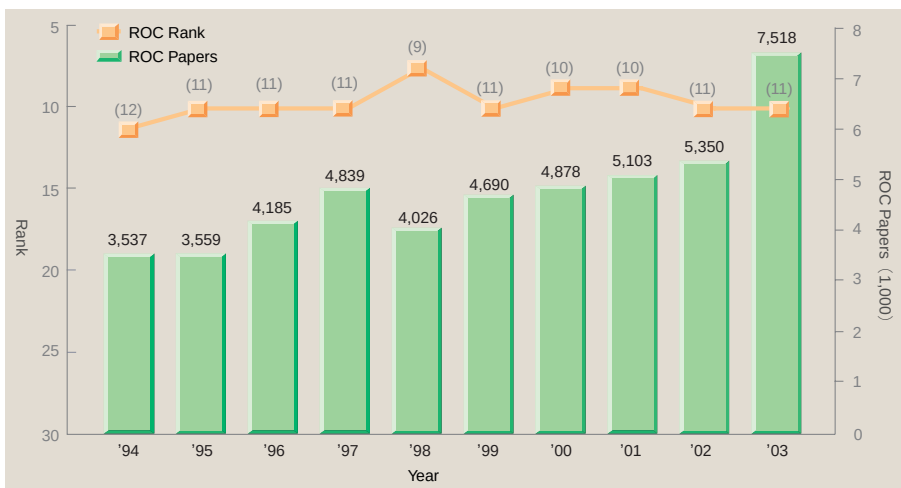


Figure I-12 Number of ROC Papers Cited in *EI*

Source: NSC

Table I-4 US Patents Granted (excluding New Design) and Rank

Country	1999		2000		2001		2002		2003	
	Number	Rank	Number	Rank	Number	Rank	Number	Rank	Number	Rank
United States	83,905	1	85,072	1	87,607	1	86,977	1	87,901	1
Japan	31,104	2	31,296	2	33,232	2	34,859	2	35,517	2
Germany	9,337	3	10,234	3	11,260	3	11,277	3	11,444	3
R.O.C	3,693	5	4,667	4	5,371	4	5,431	4	5,298	4
South Korea	3,562	7	3,314	8	3,538	8	3,786	7	3,944	5
France	3,820	4	3,819	5	4,041	5	4,035	5	3,869	6
United Kingdom	3,572	6	3,667	6	3,965	6	3,838	6	3,627	7
Canada	3,226	8	3,419	7	3,606	7	3,431	8	3,426	8
Italy	1,492	9	1,714	9	1,709	10	1,750	9	1,722	9
Sweden	1,401	10	1,577	10	1,743	9	1,675	10	1,521	10

Source: U.S. Patent and Trademark Office

Part II
Academic Research

Part II Academic Research

Our increasingly sophisticated state of technological development has made S&T even more inseparable than ever before, and the results of scientific research are transformed into applied technologies with even greater speed. Hoping to strengthen their competitive advantage, all industrialized nations now place great emphasis on academic research as the driving force of S&T development. This part introduces the ROC's various areas of academic research, including its funding, manpower, and major results.

Chapter 1 Overview

The main research-performing academic organizations in the ROC include the Academia Sinica, universities, and university research centers. The first of two major sources of research funding consists of support from the implementing organization's own budget and funding granted by the NSC via an application process. The second type of funding derives from public or private organizations that have commissioned work.

The 16,731 specific-topic research projects funded by the NSC in 2003 received a total of NT$16.7 billion. This part of the *Yearbook* chiefly describes the results of academic research supported by the NSC and Academia Sinica.

Please see Fig. II-1, Fig. II-2, and Fig. II-3 for the amount of funding, number of projects, and level of manpower input respectively with regard to NSC- and Academia Sinica-funded projects from FY1999 to FY2003.

Full-time university instructors totaled 43,050 persons during the 2003 academic year. The numbers of full-time professors and associate professors teaching in the fields of natural sciences, engineering, medicine, agriculture, and the humanities and social sciences from the 1999 to the 2003 academic years are shown in Fig. II-4 and Fig. II-5.

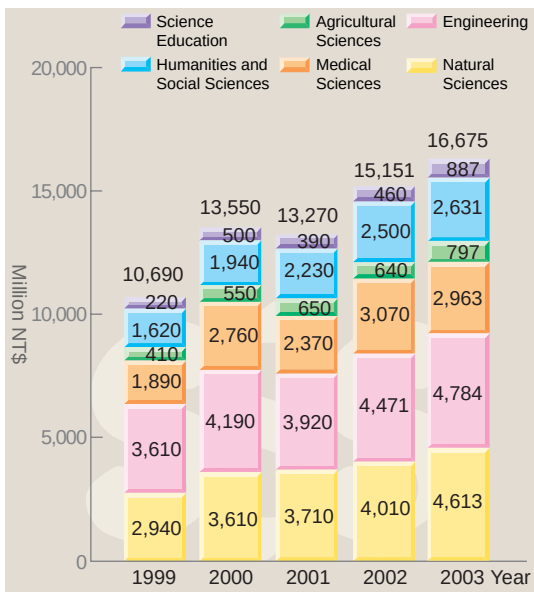


Figure II-1 Funding Provided by the NSC and Academia Sinica for Research Projects in Various Areas, FY1999~2003

Source: Academia Sinica, NSC

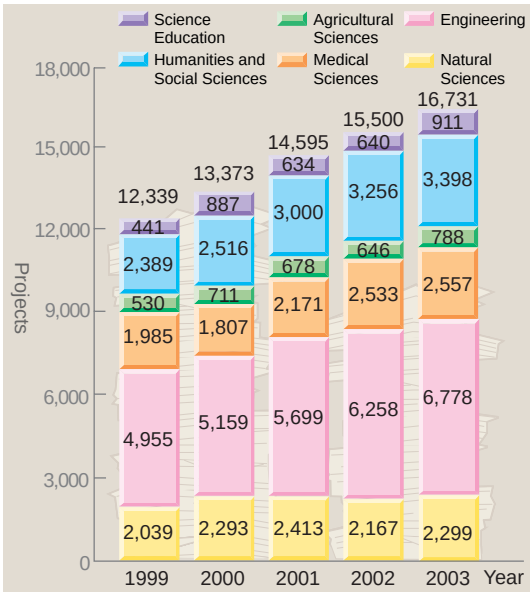


Figure II-2 Number of NSC- and Academia Sinica-funded Research Projects in Various Areas, FY1999~2003

Source: Academia Sinica, NSC

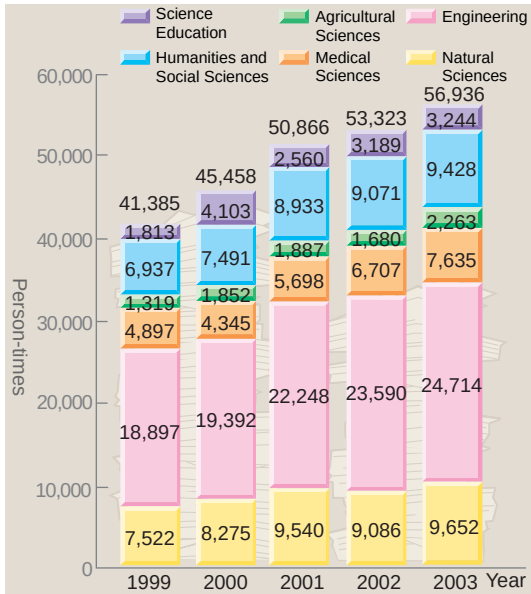


Figure II-3 Manpower of NSC- and Academia Sinica-funded Research Projects by Area of Research, FY1999~2003

Source: Academia Sinica, NSC

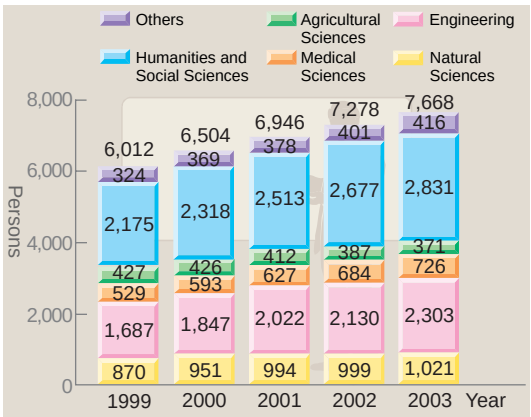


Figure II-4 Number of Full-time University Professors in Natural Sciences, Engineering, Medicine, Agriculture, Humanities and Social Sciences, 1999~2003

Source: MOE

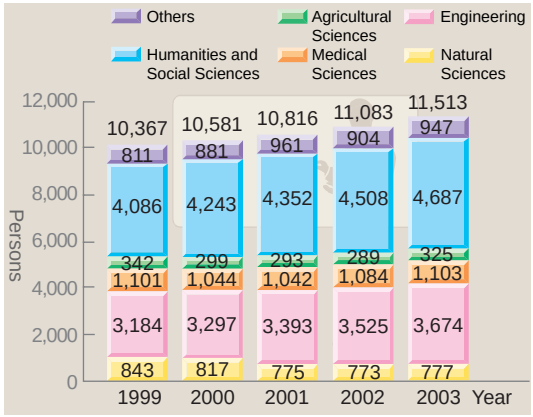


Figure II-5 Number of Full-time University Associate Professors in Natural Sciences, Engineering, Medicine, Agriculture, Humanities and Social Sciences, 1999~2003

Source: MOE

A total of 1,091 research projects were performed at university research centers in FY2003. These projects were under commission for other organizations or funded from university budgets.

Chapter 2 Natural Sciences

The scope of the natural sciences primarily consists of mathematics, statistics, physics, chemistry, earth science, atmospheric science, ocean sciences, zoology and marine biology, biochemistry and molecular biology, and botany. Natural science research is chiefly performed by the Academia Sinica and natural science departments at universities. See Table II-1 for a breakdown of the number, manpower, and funding of natural science research projects in FY2003.

The following is an overview of key natural science research areas in FY2003:

1. Mathematics: Algebra and number theory, geometry and topology, analysis, differential equations and dynamic systems, probability, discrete mathematics, numerical analysis and computational methods.
2. Statistics: Statistical theory and methodology, interdisciplinary research, analysis of the change over time of the water-quality-indicating pollutants in the Tamshui River, functional brain imaging, and use of discriminant analysis to study educational placement effectiveness.
3. Physics: Nonlinear systems, soft matter and biophysics, particle physics and field theory, applications of synchrotron radiation, magnetism and superconductivity, surface science, opto-electronics and semiconductor research.
4. Chemistry: Organic chemistry, hole transport materials, materials chemistry, biochemistry and biophysical chemistry, organic and inorganic synthetic method research and development.
5. Earth science: Shallow seismic reflection surveys near earthquake sources, the Taiwan Chelungpu Fault Drilling Project (TCDP).

Table II-1 Number, Manpower, and Funding of Academia Sinica- and NSC-sponsored Natural Science Research Projects in FY2003

Field of Research	Researchers										Source of Research Funding (Million NT$)			Research Projects		Total
	Supervisors					Assistants										
	Professors	Associate Professors	Assistant Professors	Lecturers	Other	Project Assistants	Lecturers	Teaching Assistants	Graduate Students	Total	Academia Sinica	National Science Council	Total	Academia Sinica	National Science Council	
Mathematics	137	76	79	1	1	20	0	0	436	750	0	136.3	136.3	0	274	274
Statistics	93	63	47	1	9	62	3	1	315	594	37.6	82.5	120.1	11	160	171
Physics	430	226	158	11	26	199	8	11	1,710	2,779	380.6	1,144.3	1,524.9	17	543	560
Chemistry	273	124	118	8	12	215	0	0	1,887	2,637	355.9	692.2	1,048.1	58	406	464
Earth Science	129	73	51	7	26	127	24	10	281	728	208.0	321.3	529.3	39	161	200
Atmospheric Science	83	33	34	0	15	71	20	3	203	462	52.0	123.3	175.3	7	103	110
Ocean Sciences	56	29	17	4	2	37	0	0	117	262	0	84.2	84.2	0	60	60
Zoology and Marine Biology	72	17	24	9	2	89	0	0	133	346	50.9	86.1	137.0	45	78	123
Biochemistry and Molecular Biology	97	84	59	12	23	134	0	1	339	749	432.0	244.2	676.2	16	163	179
Botany	84	20	23	6	10	54	3	0	145	345	81.9	99.7	181.6	73	85	158
Total	**1,454**	**745**	**610**	**59**	**126**	**1,008**	**58**	**26**	**5,566**	**9,652**	**1,598.9**	**3,014.1**	**4,613.0**	**266**	**2,033**	**2,299**

Source: Academia Sinica and NSC project data adapted by the Yearbook working committee

Note: Researcher, Associate Researcher, Assistant Researcher, and Assistant at the Academia Sinica are referred to as Professor, Associate Professor, Assistant Professor, and Assistant in this table, respectively.

6. Atmospheric sciences: Natural disaster topics, such as typhoon, heavy rainfall and climate change in meteorology and atmospheric and space science researches.
7. Ocean sciences: Environmental and ecosystem monitoring of the Taiwan Straits with telemetry, long-term observation and research of the East China Sea.
8. Zoology and marine biology: Molecular biology, physiology, group genetics and molecular evolution, stem cell research.
9. Biochemistry and molecular biology: 3-dimensional structures, determination of proteins with biological significance, research on the Vaccinia virus and its host.
10. Botany: Establishment of a rice pollen cDNA gene bank, molecular and cellular biology of plants.

Chapter 3 Engineering

The subfields of engineering include civil engineering, environmental engineering, ocean engineering and technology, solid mechanics, thermal-fluid and energy engineering, automation engineering, aerospace engineering, communication engineering, computer science and information engineering, control engineering, power engineering, biomedical engineering, microelectronics engineering, optics and photonics engineering, industrial engineering and management, chemical engineering, metals and ceramic, and polymer science and engineering. Organizations performing research in engineering include the Academia Sinica and various university departments. See Table II-2 for a breakdown of the number, manpower, and funding of engineering research projects in FY2003.

Table II-2 Number, Manpower, and Funding of Academia Sinica- and NSC-sponsored Engineering Research Projects in FY2003

Field of Research	Researchers										Source of Research Funding (Million NT$)			Research Projects		Total
	Supervisors					Assistants										
	Professors	Associate Professors	Assistant Professors	Lecturers	Other	Project Assistants	Lecturers	Teaching Assistants	Graduate Students	Total	Academia Sinica	National Science Council	Total	Academia Sinica	National Science Council	
Civil Engineering	294	276	197	31	7	7	2	0	1,158	1,972	0	310.4	310.4	0	659	659
Environmental Engineering	171	136	116	1	4	1	0	0	540	969	0	233.5	233.5	0	319	319
Ocean Engineering and Technology	105	38	21	1	3	6	5	3	258	440	0	84.2	84.2	0	127	127
Solid Mechanics	254	289	134	10	1	5	36	5	994	1,728	0	320.1	320.1	0	529	529
Thermal-fluid and Energy Engineering	230	148	92	7	7	3	15	5	713	1,220	0	268.6	268.6	0	405	405
Automation Engineering	120	149	95	10	3	8	3	0	608	996	0	184.3	184.3	0	307	307
Aerospace Engineering	88	52	32	1	3	3	6	0	268	453	0	83.3	83.3	0	133	133
Communication Engineering	247	187	155	4	2	22	3	1	1,512	2,133	6.9	346.6	353.5	1	474	475
Computer Science and Information Engineering	338	400	286	23	10	247	26	3	2,475	3,808	245.6	462.7	708.3	25	859	884
Control Engineering	123	117	67	2	2	7	12	0	465	795	0	116.0	116.0	0	244	244
Power Engineering	110	144	47	7	0	11	71	1	527	918	0	162.8	162.8	0	260	260
Biomedical Engineering	178	158	95	16	58	12	11	0	570	1,098	0	182.9	182.9	0	297	297
Micro-electronics Engineering	274	227	200	7	1	28	2	1	1,725	2,465	0	564.6	564.6	0	486	486
Optics and Photonics Engineering	126	76	90	0	3	14	2	0	590	901	34.4	220.6	255.0	5	225	230
Industrial Engineering and Management	188	275	129	24	7	9	2	0	967	1,601	0	219.8	219.8	0	476	476
Chemical Engineering	207	92	59	1	1	3	0	1	741	1,105	0	252.6	252.6	0	334	334
Metal and Ceramic	235	99	58	8	2	6	0	0	811	1,219	4.6	269.7	274.3	1	336	337
Polymer Science and Engineering	162	93	39	5	1	2	0	0	591	893	0	210.0	210.0	0	276	276
Total	3,450	2,956	1,912	158	115	394	196	20	15,513	24,714	291.5	4,492.7	4,784.2	32	6,746	6,778

Source: Academia Sinica and NSC project data adapted by the Yearbook working committee

Note: Researcher, Associate Researcher, Assistant Researcher, and Assistant at the Academia Sinica are referred to as Professor, Associate Professor, Assistant Professor, and Assistant in this table, respectively.

The following is an overview of key engineering research areas in FY2003:

1. Civil engineering: "Research on Seismic Resistant Technologies of Historical Buildings (Listed or Unlisted) in Taiwan," "Master Transportation System Plan for Earthquake Disaster Prevention in Urban Areas."
2. Environmental engineering: "Research on Melting Process of Industrial Wastewater Sludge/ Waterworks Sludge," "Research on Biohydrogenation Mechanisms and Process Applications Using Multiple Substrates."
3. Ocean engineering and technology: "Distance Measurement Technology and Development of a Teleoperated Robotic Manipulator System for Underwater Constructions," "Application Research on Ship Resistance Reduction Techniques."
4. Solid mechanics: "Design, Manufacturing, and Reliability Analysis of a 3-D MCM Package," "Research on the Development of Intelligent CAE Software for Metal Forming Processes (III)."
5. Thermal-fluid and energy engineering: "Research on Renewable Energy Technology," "Investigation on Hydrogen Manufacture and Storage," "Development of Energy Efficiency Enhancement Technologies."
6. Automation engineering: "Development of a Factory Management System with Error-Detection and Function-Replacement Capabilities."
7. Aerospace engineering: Structures and materials, aerospace micro/nano electromechanical systems, and aerodynamics.
8. Communication engineering: Design and functional testing of thin film microwave passive components.
9. Computer science and information engineering: Data security, data mining, advanced network technical service research, algorithms and computing theory.
10. Control engineering: Special purpose service robot vehicle sensing, control, and systems research.
11. Power engineering: "Functional Planning and Research on Power Dispatch Centers under a Deregulated Environment."
12. Biomedical engineering: "Design of a New Type Biofeedback System for Psychosomatic Disorders," microfluidic biochip development and biomedical applications.
13. Micro-electronics engineering: Silicon semiconductor materials and design, VLSI testing and design.
14. Optics and photonics engineering: Dense wavelength division multiplexing (DWDM), research on optical communications elements and modules, fabrication, assessment, and calibration of experimental testing systems.
15. Industrial engineering and management: Semiconductor demand data mining, "Knowledge Discovery for Optimization of Capacity Allocation."
16. Chemical engineering: Application of precision solid-liquid separation in high tech industries.

17. Metals and ceramic: Integrated planning research on thin-film integrated passive devices.
18. Polymer science and engineering: Chemical interaction of layered silicate/polymer nano-materials and biopolymers.

Chapter 4 Medical Sciences

The scope of medical research includes the two fields of basic medicine and clinical medicine research. Organizations performing medical research include the Academia Sinica and various university departments and schools of medicine. See Table II-3 for a breakdown of the number, manpower, and funding of medical research projects in FY2003.

The following is an overview of key medical research areas in FY2003:

1. Basic medicine research

1.1 Physiology: Treatment and mechanism of septic shock induced by hypertension, hyperlipidemia, and endotoxins.

1.2 Medical biochemistry and molecular biology: Establishment of breast cancer cell lines BC-1 and 81N, expression of genes connected with cancer metastasis.

1.3 Public health and environmental medical science: Researchers found that the viability of bio-aerosols ranged from 0.32 to 1.0 after photocatalytic oxidation.

1.4 Microbiology and immunology: Hepatitis immunology, EB virus and human papilloma virus (HPV) research.

1.5 Parasitology: Research on immune related kinases and peptides of A*edes aegypti*, pathology of T*oxocara* infestation, cellular apoptosis induced by A*ngiostrongylus cantonensis* infection.

1.6 Medical technology: Research on lack of glucose-6-phosphate dehydrogenase (G6PD) in cancer cells and skin fibroblasts.

1.7 Anatomy: Establishment of a rat model of cerebral pressure, research on neural pathology of diabetes.

1.8 Pathology and forensic medicine: Research on hepatitis C virus core protein mutations and deletions when inducing liver cancer.

1.9 Pharmacology and toxicology: Researchers discovered that baicalein is highly effective at treating endotoxin-induced septicemia in white rats.

1.10 Nutrition: Research on the separation of soy fry oil hydrolysis products using reverse phase chromatography.

1.11 Pharmacy research: Drug design and synthesis, natural product drugs and their activity, virus research.

1.12 Biomedical engineering: Long-term animal testing of the NTU No. 1 ventricular assist device, biological controllers.

1.13 Nuclear medicine and radiology: Application of magnetic resonance imaging to the study of brain function, blood flow, and heart research.

1.14 Genomic medicine: Determination of new disease-causing genes, research on genetic treatment of disease.

Table II-3 Number, Manpower, and Funding of Academia Sinica- and NSC-sponsored Medical Research Projects in FY2003

Field of Research	Researchers										Source of Research Funding (Million NT$)			Research Projects		Total
	Supervisors					Assistants										
	Professors	Associate Professors	Assistant Professors	Lecturers	Other	Project Assistants	Lecturers	Teaching Assistants	Graduate Students	Total	Academia Sinica	National Science Council	Total	Academia Sinica	National Science Council	
Physiology	55	23	41	3	7	28	1	0	127	285	0	87.3	87.3	0	102	102
Medical Biochemistry and Molecular Biology	169	75	58	16	28	208	8	2	512	1,076	0	555.1	555.1	0	288	288
Public Health	67	74	57	6	19	50	2	0	136	411	0	101.8	101.8	0	145	145
Microbiology and Immunology	39	32	31	4	8	35	0	0	131	280	0	96.0	96.0	0	106	106
Parasitology	8	2	4	1	0	5	0	0	11	31	0	10.4	10.4	0	13	13
Medical Technology	29	51	29	4	12	30	2	0	114	271	0	68.6	68.6	0	95	95
Anatomy	15	21	9	1	1	5	0	0	35	87	0	27.6	27.6	0	38	38
Pathology and Forensic Medicine	18	13	4	0	10	21	0	0	11	77	0	25.4	25.4	0	36	36
Pharmacology and Toxicology	54	27	26	1	5	27	0	3	136	279	0	88.9	88.9	0	89	89
Nutrition	25	17	21	0	3	8	0	0	68	142	7.0	38.6	45.6	1	50	51
Pharmacy	66	52	33	5	6	26	2	0	123	313	0	88.6	88.6	0	115	115
Biomedical Engineering	59	47	28	7	16	14	1	1	127	300	0	71.1	71.1	0	81	81
Nursing	34	61	34	12	11	37	12	2	33	236	0	49.4	49.4	0	91	91
Dentistry	51	32	17	8	23	21	1	1	38	192	0	50.1	50.1	0	75	75
Psychology	9	12	9	5	27	19	0	1	2	84	0	24.2	24.2	0	37	37
Neurology	21	15	6	3	60	32	0	0	16	153	0	42.7	42.7	0	59	59
Cardio-thoracic Medicine	55	19	22	1	66	65	0	0	9	237	0	77.5	77.5	0	106	106
Radiology and Nuclear Medicine	40	72	32	3	78	33	0	2	50	310	0	54.8	54.8	0	88	88
Nephrology, Metabolism, and Endocrinology	32	12	9	0	33	25	0	0	11	122	0	39.2	39.2	0	51	51
Arthritis Immunology, Hematology, Oncology, and Infection	67	42	20	5	71	64	0	2	23	294	0	90.2	90.2	0	118	118
Gastrolintestinal Medicine	26	22	12	3	38	38	0	0	15	154	0	51.8	51.8	0	65	65
Surgery	114	65	27	8	108	77	0	0	30	429	0	106.7	106.8	0	141	141
Orthopedics	31	32	10	2	18	15	0	0	32	140	0	38.5	38.5	0	54	54
Rehabilitation	31	42	38	16	24	21	3	1	42	218	0	38.6	38.6	0	77	77
Otolaryngology	17	9	2	0	23	15	0	0	3	69	0	21.1	21.1	0	33	33
Ophthalmology	10	12	0	0	23	20	0	0	2	67	0	23.2	23.2	0	28	28
Dermatology	15	11	9	1	12	7	0	1	2	58	0	13.7	13.7	0	23	23
Gynecology, Obstetrics, Urology	55	38	34	2	78	57	0	0	21	285	0	80.7	80.7	0	111	111
Pediatrics	41	17	5	0	26	28	0	0	20	137	0	43.3	43.3	0	52	52
Biotechnology	168	47	43	2	9	155	2	0	327	753	0	372.8	372.8	0	159	159
Biomedicine	23	17	10	1	0	94	0	0	0	145	478.5	0	478.5	30	0	30
Total	1,444	1,011	680	120	843	1,280	34	16	2,207	7,635	485.5	2,477.9	2,963.4	31	2,526	2,557

Source: Academia Sinica and NSC project data adapted by the Yearbook working committee

Note: Researcher, Associate Researcher, Assistant Researcher, and Assistant at the Academia Sinica are referred to as Professor, Associate Professor, Assistant Professor, and Assistant in this table, respectively.

I.15 Virology: Molecular virology research primarily focusing on disease-causing viruses.

I.16 Biotechnology: Development of new biotech techniques.

I.17 Stem cell/regenerative medicine research: Establishment of a fully-equipped stem cell laboratory, development of a rapid multi-stage eight-color fluorescent cell isolation method.

2. Clinical Medicine Research

2.1 Nursing: Clinical nursing phenomena, nursing deployment, and innovative reform of nursing education.

2.2 Dentistry: Oral cancers, bone growth, clinical dentistry, and cellular biology.

2.3 Psychology: Schizophrenia and anxiety disorders.

2.4 Neurology: Peripheral nerve function in diabetes patients and cerebrovascular diseases.

2.5 Cardio-thoracic medicine: Research on the enhanced expression of cancer-suppressing in conjunction with other forms of treatment.

2.6 Nephrology, metabolism, and endocrinology: Research on nephrology, metabolism, and endocrinology.

2.7 Arthritis immunology, hematology, oncology, and infection: Research on arthritis immunology, hematology, oncology, and infection.

2.8 Gastrointestinal medicine: Research on hepatitis, H*elicobacter pylori*, and gastrointestinal cancers.

2.9 Surgery: Reconstruction of 3-D images from CAT data.

2.10 Orthopedics: Tissue engineering, basic and clinical research.

2.11 Rehabilitation: Basic, clinical, and applied research.

2.12 Otolaryngology: Research on the correlation between nasopharyngeal cancer metastasis and the genes FAK and SKP2.

2.13 Ophthalmology: Use of NF-kB inhibitor and anticoagulant snake venom proteins to inhibit formation of new blood vessels in the eye.

2.14 Dermatology: Causes of vitiligo and research on monoamines and their metabolites from the skin.

2.15 Gynecology, obstetrics, and urology: Mechanism of cervical cancer, stem cells, reproductive physiology, and genetic research.

2.16 Pediatrics: Children's allergic asthma and autoimmune disorders, neurology, and children's heart disease.

Chapter 5 Agricultural Sciences

The agricultural sciences include the five major fields of agriculture, forestry, fisheries, animal husbandry, and food science. Organizations performing agricultural research include Academia Sinica, various university departments, the Agricultural Research Institute, Forestry Research Institute, Fisheries Research Institute, Livestock Research Institute, Animal Technology Institute, and various agricultural research and extension stations. See Table II-4 for a breakdown of the number, manpower, and funding of agricultural research projects in FY2003.

The following is an overview of key agricultural science research areas in FY2003:

1. Agronomy and horticulture: Molecular biology and biotechnology, tissue culture, crop physiology, and crop cultivation.
2. Agricultural machinery and engineering: Control of biological and facility environment, agricultural automation, and biological and mechatronic technology.
3. Plant protection: Entomology and plant pathology.
4. Soil, agricultural chemistry, and environmental protection: Soil, environmental protection, and molecular biology of agricultural chemicals.

Table II-4 Number, Manpower, and Funding of Academia Sinica- and NSC-sponsored Agricultural Research Projects in FY2003

Field of Research	Researchers										Source of Research Funding (Million NT$)			Research Projects		Total
	Supervisors					Assistants					Academia Sinica	National Science Council	Total	Academia Sinica	National Science Council	
	Professors	Associate Professors	Assistant Professors	Lecturers	Other	Project Assistants	Lecturers	Teaching Assistants	Graduate Students	Total						
Agronomy and Horticulture	25	14	20	4	1	39	0	0	33	136	36.7	31.2	67.9	5	44	49
Agricultural Machinery and Engineering	23	14	16	0	1	8	0	0	64	126	0	27.7	27.7	0	42	42
Plant Protection	28	10	15	6	0	35	0	0	44	138	27.8	40.4	68.2	1	42	43
Soil, Agricultural Chemistry, and Environmental Protection	35	14	26	3	0	13	0	0	89	180	0	58.0	58.0	0	65	65
Forestry, Water and Soil Conservation, Ecology	45	36	17	4	1	29	1	0	97	230	0	60.9	60.9	0	83	83
Fisheries Science	61	28	11	3	13	36	1	0	107	260	6.8	83.2	90.0	5	86	91
Animal Husbandry and Veterinary Medicine	64	32	22	12	3	33	0	0	89	255	34.1	82.9	117.0	3	95	98
Food Science	120	48	51	11	1	26	0	1	249	507	28.9	147.4	176.3	3	185	188
Biodiversity	86	50	39	19	2	49	2	2	182	431	0	131.2	131.2	0	129	129
Total	487	246	217	62	22	268	4	3	954	2,263	134.3	662.9	797.2	17	771	788

Source: Academia Sinica and NSC project data adapted by the Yearbook working committee

Note: Researcher, Associate Researcher, Assistant Researcher, and Assistant at the Academia Sinica are referred to as Professor, Associate Professor, Assistant Professor, and Assistant in this table, respectively.

5. Forestry, water and soil conservation, and ecology: Forestry, ecology, and forest products, water and soil conservation.
6. Fisheries science: Physiology of aquacultural organisms, aquacultural ecology, aquacultural nutrition, and animal feed research.
7. Animal husbandry and veterinary medicine: Animal husbandry science, veterinary medicine, and animal health research.
8. Food science: Food chemistry, food nutrition, and food microbiology.
9. Biodiversity (including long-term ecological research): Ecological research at the Fushan, Tatachia, and Kenting sites.

Chapter 6 Humanities and Social Sciences

The scope of the humanities consists of Chinese literature, foreign literature, history, philosophy, linguistics, art, anthropology; the scope of the social sciences consists of education, psychology, sociology, law, political science, geography and regional science, economics, and management. Organizations performing humanities and social sciences research include the Academia Sinica and various university departments. See Table II-5 for a breakdown of number, manpower, and funding of humanities and social sciences research projects in FY2003.

The following is an overview of key humanities and social science research areas in FY2003:

1. Chinese literature: "Integrated Project on Ming Dynasty Academic Thought," "Integrated Project on the View of Nature in Chinese Literary Traditions."
2. Foreign literature: "The Hermes Website: A Literary and Culture Studies Website in Taiwan for Research, Learning and Communication."
3. History: "Try to Verify and Identify If Bod During T'ang Period Ever Trying to Join the Chinese Cultural Sphere."
4. Philosophy: "The Public Sphere in Taiwan: A Philosophical and Historical Study."
5. Linguistics: "Discourse and Cognition in Kavalan," "Issues in Atayal, Amis, Puyuma and Thao Morphosyntax," and "A Study of Taiwan Sign Language."

Table II-5 Number, Manpower, and Funding of Academia Sinica- and NSC-sponsored Humanities and Social Sciences Research Projects in FY2003

Field of Research	Researchers										Source of Research Funding (Million NT$)			Research Projects		Total
	Supervisors					Assistants										
	Professors	Associate Professors	Assistant Professors	Lecturers	Other	Project Assistants	Lecturers	Teaching Assistants	Graduate Students	Total	Academia Sinica	National Science Council	Total	Academia Sinica	National Science Council	
Chinese Literature	111	85	62	8	8	13	5	2	276	570	37.4	92.4	129.8	6	240	246
Foreign Literature	41	37	31	2	0	16	0	3	98	228	16.8	47.8	64.6	1	107	108
History	112	77	57	16	20	133	0	0	143	558	556.8	49.5	606.3	134	135	269
Philosophy	25	37	27	2	2	5	0	1	91	190	49.2	28.3	77.5	5	75	80
Linguistics	77	75	67	20	5	64	19	2	244	573	75.7	85.1	160.8	7	183	190
Art	33	49	39	13	1	7	4	1	168	315	0	49.6	49.6	0	116	116
Anthropology	9	7	6	1	5	1	0	0	27	56	0	10.2	10.2	0	26	26
Education	190	176	129	22	11	20	21	27	564	1,160	4.5	171.5	176.0	2	354	356
Psychology	58	64	50	11	12	80	4	4	118	401	116.0	69.3	185.3	26	115	141
Sociology	97	66	90	4	9	72	2	0	259	599	110.7	99.4	210.1	32	188	220
Law	63	59	54	1	1	16	3	1	228	426	41.8	63.6	105.4	8	152	160
Political Science	74	62	66	12	6	38	2	2	218	480	71.8	82.3	154.1	14	182	196
Geography and Regional Science	66	63	78	15	1	24	4	0	261	512	1.6	83.1	84.7	1	180	181
Economics	112	71	88	2	9	114	1	0	188	585	70.6	111.5	182.1	31	213	244
Management	330	356	313	48	9	147	41	12	1,521	2,777	0	434.3	434.3	0	865	865
Total	1,398	1,284	1,157	177	99	749	106	55	4,404	9,428	1,152.9	1,477.9	2,630.8	267	3,131	3,398

Source: Academia Sinica and NSC project data adapted by the Yearbook working committee

Note: Researcher, Associate Researcher, Assistant Researcher, and Assistant at the Academia Sinica are referred to as Professor, Associate Professor, Assistant Professor, and Assistant in this table, respectively.

6. Art: “Research on Chinese Ceramics Excavated from Fustat, Egypt,” “Research on Food Packaging Imagery in Taiwan.”
7. Anthropology: “Migration, Marriage and Fertility: An Analysis of Household Registers in Makung and Baisha During Japanese Colonial Period.”
8. Education: “A Study on the Curriculum Consciousness and Pedagogical Practices of Junior High School Teachers.”
9. Psychology: “Development of Abstract Memory Measures, and Study of the Neurobiological and Psychological Mechanisms Underpinning False Memories.”
10. Sociology: “Newly-affluent Employers, Transnational Movement of Labor, and Identity Politics,” “Characteristics of Urban-rural Personal Networks in Everyday Life: Study of Personal Contact Logs.”
11. Law: “Government Reform in the Era of Globalization: Taiwan’s Agenda and Perspectives.”
12. Political science: “Intellectual History of Political Concepts,” “A Study of the Integration of International and Domestic Factors in the Taipei-Washington-Beijing Triangle.”
13. Geography and regional science: “Exploring Cross-Strait Logistics Development Model for Taiwanese Multinational Corporations.”
14. Economics: “Industry Characteristics, Quality Factors, and the Measurement of Productivity and Efficiency.”
15. Management: In addition to funding “free-form” research projects annually, the NSC’s discipline of management planned and implemented several integrated projects such as the “Integrated Project on Behavioral Finance and Behavioral Accounting” in 2003.

Chapter 7 Science Education

Science education includes the categories of mathematics education, (natural) science education, information science education, and applied science education. See Table II-6 for a breakdown of number, manpower, and funding of NSC-sponsored science education research projects in FY2003.

The following is an overview of science education research areas in FY2003:

1. Mathematics education: Integrated projects including research on adolescents' mathematics concepts, and individual projects including research on mathematics teacher education, student learning, and evaluation.
2. Science education: Science curriculum, learning, and assessment; science instruction and science teachers.
3. Information science education: Application of computer networks in middle school biology, research on virtual teaching of high school life science.
4. Applied science education: Technological science education, medical science education.

Table II-6 Number, Manpower, and Funding of NSC-sponsored Science Education Research Projects in FY2003

Field of Research	Researchers										Source of Research Funding (Million NT$)	Research Projects
	Supervisors					Assistants						
	Professors	Associate Professors	Assistant Professor	Lecturers	Other	Project Assistants	Lecturers	Teaching Assistants	Graduate Students	Total	National Science Council	National Science Council
Mathematics Education	47	64	17	3	0	20	13	34	70	268	57.7	83
Science Education	45	49	11	0	0	14	11	55	152	337	55.3	81
Science Instruction Teacher Training	71	23	38	4	2	10	2	57	97	304	48.7	56
Information Science Education	54	62	25	5	0	20	10	29	277	482	74.0	97
Technical Science	47	69	33	17	7	4	45	13	133	368	59.6	125
Medical Education	33	24	2	10	7	38	1	2	20	137	19.4	29
Environmental Education	20	18	3	1	1	18	13	9	39	122	12.4	27
Gifted Education	7	1	2	0	0	8	2	0	7	27	6.0	7
Popular Science Education	59	39	10	3	21	10	4	7	73	226	109.7	92
E-learning	49	39	11	7	8	41	6	14	162	337	69.6	79
Others	133	148	44	3	14	11	7	14	262	636	374.7	235
Total	565	536	196	53	60	194	114	234	1,292	3,244	887.1	911

Source: NSC project data adapted by the Yearbook working committee

Part III
S&T Domain Projects

Part III S&T Domain Projects

Government S&T projects are divided among 35 fields (see Table III-1). But since these fields have very different developmental goals and environmental frameworks, they have different resource and policy needs as well. In addition, the government has formulated various "National Science and Technology Programs" responding to the nation's major socioeconomic issues; these programs harness the S&T resources of up-, mid-, and down-stream sectors and strive to promote the development of niche industries.

Chapter 1 Information, Communications, and Opto-electronics

Information, communications, and opto-electronics research encompasses the four fields of information, telecommunications, electronics, and opto-electronics.

1. Information

An analysis of the global market and industrial development trends indicates that Taiwan should pursue R&D in the three subareas of information appliances, digital content, and network services. In addition, technological input will be needed in the three most important application service areas connected with the "e-Home": e-Entertainment, e-Learning, and e-Healthcare.
See Fig. III-1 for an overview of information S&T project funding and manpower, FY1999~2003.

1.1 R&D Focal Points:

1.1.1 In the area of information appliances, helping manufacturers quickly stay abreast of global IA market trends and quickly get new products to mass production with the assistance of major system platform firms. Using

Table III-1 Government S&T Development Project Fields in FY2003

Fields		
Electronics	Resources	Fisheries
Information	Energy	Animal husbandry
Telecommunications	Atomic energy	Physics
Automation	Construction and Civil engineering	Chemistry
Machinery	Transportation	Meteorology
Aerospace	Biotechnology	Humanities
Opto-electronics	Food science	Science education
Materials	Medicine	Common technology
Chemical engineering	Pharmaceuticals	Ocean science
Environmental protection	Agriculture	Geology
Textiles	Forestry	e-Business
Infrastructure construction	Biodiversity	

Source: Central government S&T development project review results, FY2003

the Greater China market to draft influential technical standards.

1.1.2 In the area of digital content, initiating international cooperation in market, production, and manpower using Taiwan's advantages of Chinese culture and a diverse society. Employing Taiwan's mature management knowledge and making effective use of China's low-cost production environment to actively participate in the development of the Chinese-language market.

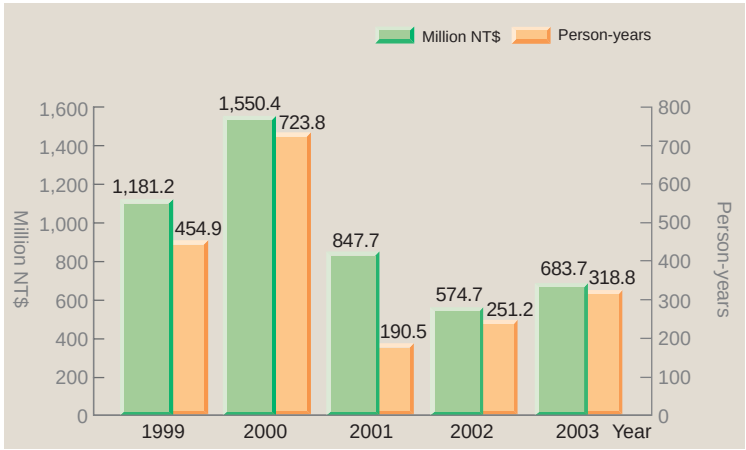


Figure III-1 Information S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

1.1.3 In the area of network services, promoting the deployment of Public UDDI in the status of a neutral third party, and encouraging firms to engage in the development and application of Web services. Manufacturers should actively engage in technological R&D.

1.2 Summary of Research and Results in FY2003:

1.2.1 Mid-term Framework Program for Information – New Digital Learning Environmental Technology Research Project (Department of Industrial Technology (DOIT), MOEA): Completion of a mobile service application development platform, construction of service networks, and development of an e-Book reading platform.

1.2.2 Mid-term Framework Program for Information – Network Multimedia Industry Promotion Plan (Industrial Development Bureau (IDB), MOEA): Establishment of the "Digital Content Industry Promotion Office" and "Digital Content Institute."

1.2.3 Mid-term Framework Program for the Information Field – Software Technology for Advanced Network Applications (IDB): Assistance to seven foreign firms investing and engaging in technological cooperation in Taiwan, establishment of key industrial development systems.

2. Telecommunications

Upon becoming a member of the WTO, the ROC has been obliged to open its domestic telecommunications market and promote telecommunications deregulation in accordance with the WTO Agreement on Basic Telecommunications Services. These efforts will accelerate the completion of a global information and communications infrastructure.

See Fig. III-2 for an overview of telecommunications S&T project funding and manpower, FY2000~2003.

2.1 R&D Focal Points:

2.1.1 Telecommunications firms must strive to establish brands and integrate customer services and strategies in light of users' needs for friendliness, mobility, and intelligence.

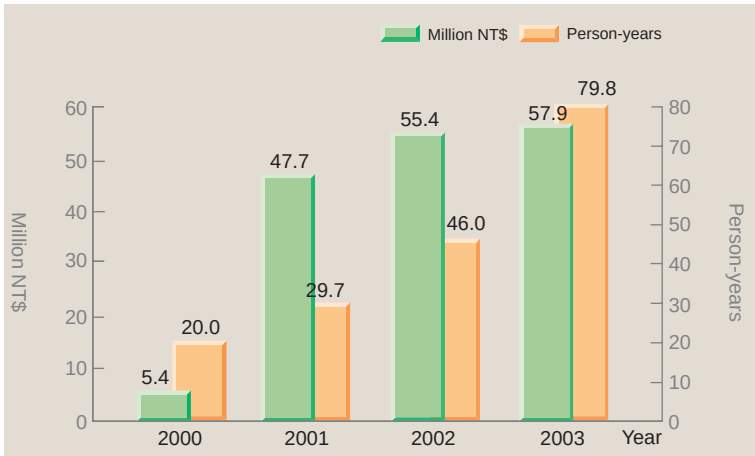


Figure III-2 Telecommunications S&T Project Funding and Manpower, FY2000~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

2.1.2 The government should adopt a more open attitude with regard to improving the environment, establish an international deregulated business environment, and integrate domestic research resources.

2.1.3 The government's policy should be to continue telecommunications deregulation, encourage enterprises to widely establish broadband networks, and transform Taiwan into an information society taking advantage of broadband use, mobility, e-Society, e-Commerce, e-Government, and e-Traffic system.

2.2 Summary of Research and Results in FY2003:

2.2.1 Mid-term Framework Program for the Telecommunications Industry (IDB): Training was provided over 6,826 person-times to engineers working in the industry.

2.2.2 Mid-term Framework Program for Telecommunications – Study of Telecommunication Related Technologies (Office of S&T Advisors, MOTC): Research on new telecommunications network technologies and standards, new telecommunications services, and telecommunications data network security technology.

3. Electronics

The government-led research program on complementary metal-oxide semiconductors (CMOS) laid an outstanding foundation for Taiwan's semiconductor industry. Taiwan is currently ranked fourth in the world in terms of IC manufacturing capability and first in terms of wafer fab capacity. In addition, the country has gradually become a global center of high-tech product manufacturing and services.

See Fig. III-3 for an overview of electronics S&T project funding and manpower, FY1999~2003.

3.1 R&D Focal Points:

Key areas of electronics include semiconductor design and manufacturing technology, nanometer electronics, SiP packaging and testing technology, EDA design platforms, and micro-electromechanical systems.

Work during the current period will focus on the needs of the semiconductor industry, including "system-on-chip" (SoC) technologies.

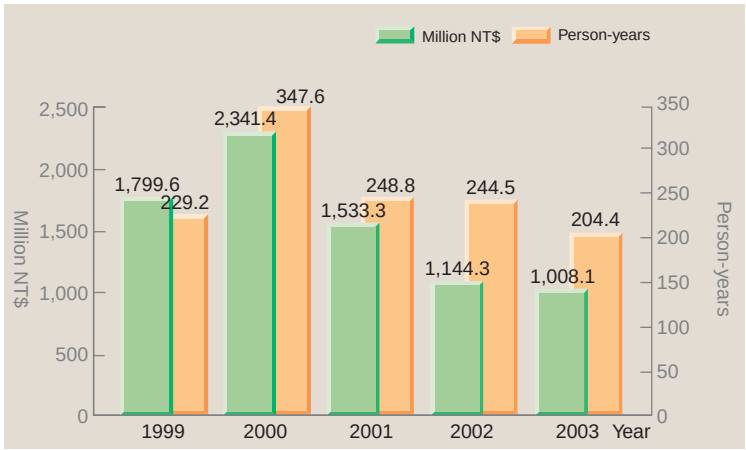


Figure III-3 Electronics S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

In addition, there will be concerted R&D campaigns in such forefront and emerging fields as nanometer electronics and micro-electromechanical systems. The government's ultimate goal is to maintain the electronics industry's competitiveness by dint of superior innovation.

3.2 Summary of Research and Results in FY2003:

3.2.1 Mid-term Framework Program for Development of Electronics Technology (DOIT): Development of key technologies in flat panel displays, nanometer electronics, and chip systems.

3.2.2 Mid-term Framework Program for the Electronics Field (IDB): Formulation of development strategies for the digital video multimedia industry.

4. Opto-electronics

The opto-electronics industry consists of all manufacturers of elements employing opto-electronics technology, and equipment or systems employing opto-electronics elements as key components. The rapid spread of the Internet has been followed by a continuous series of opto-electronics technology breakthroughs and innovations. Key applied technology breakthroughs have been made in such areas as data storage, image displays, opto-electronic semiconductors, micro-optomechanical electronics, optical communications, biomedical opto-electronics, and nanometer opto-electronics.

See Fig. III-4 for an overview of opto-electronics S&T project funding and manpower, FY1999 ~2003.

4.1 R&D Focal Points:

The government's aim in opto-electronics is to maintain the strength of the IC industry – currently the country's largest by value – while fostering the development of emerging industries

geared towards design innovation and the knowledge-based economy, and vigorously developing new and cutting-edge technologies.

4.1.1 The government's policy approach will be to encourage R&D units to devote themselves to advanced basic research and the development of key parts and components and core technologies.

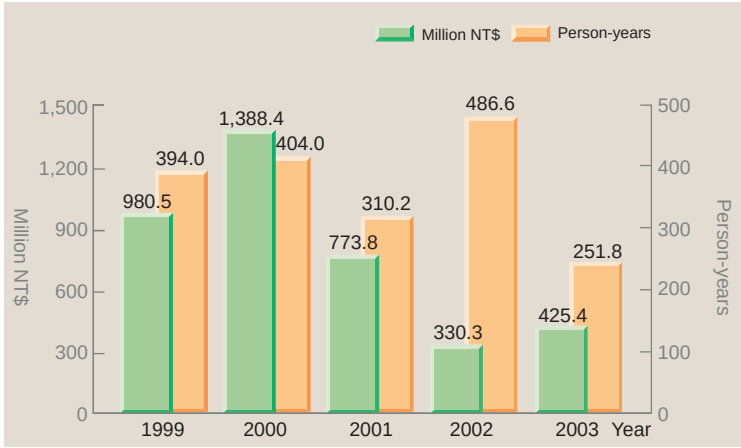


Figure III-4 Opto-electronics S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

4.1.2 With regard to industrial development, the government will encourage the acquisition of advanced technologies from overseas in order to speed up R&D, assist firms to resolve IPR problems, recruit overseas S&T manpower, and play an active role in the drafting of international standards.

4.2 Summary of Research and Results in FY2003:

4.2.1 Mid-term Framework Program for Development of the Opto-electronics Industry (DOIT): Development of optical information systems, opto-electronic semiconductor applications, key optical communications technologies, and personal optical data transmission and display technologies.

4.2.2 Mid-term Framework Program for the Opto-electronics Field (IDB): Assistance to the opto-electronics industry and development of the display industry.

Chapter 2 Machinery and Automation

The field of machinery and automation technology encompasses the three areas of machinery, aerospace, and automation.

1. Machinery

The ROC has earned respect in such areas as cutting machine tools, semiconductor back-end process equipment, precision plastic injection molding, metal processing process and components, VLSI mixed signal testers, automatic optical testing products, and nano- and micro-electromechanical systems technology.

See Fig. III-5 for an overview of machinery S&T project funding and manpower, FY1999~2003.

1.1 R&D Focal Points:

Work in the field of machinery will focus on machinery systems and equipment, encourage progress in up- and down-stream technologies, and priority development of precision machinery, new industrial process equipment, micro-/nanomachinery, secondary metal processing equipment, industrial machinery integration systems, and precision measurement devices.

The MOEA has formulated the following development strategies:

1.1.1 Accelerated implementation of the "International Innovative R&D Base Plan" and promotion of innovation and R&D in the overall industry value chain.

1.1.2 Industrial technology R&D should focus on breakthrough inventions; strengthened R&D of forward-looking technologies at research organizations and schools via technology development programs.

1.1.3 Development of Taiwan as a high value-added Asia-Pacific regional operations and management center: DOIT of the MOEA has initiated CDE projects for the purpose of "centralizing order management in Taiwan, optimizing logistics management globally," which will help companies implement e-Business operations for cash flow, delivery, and

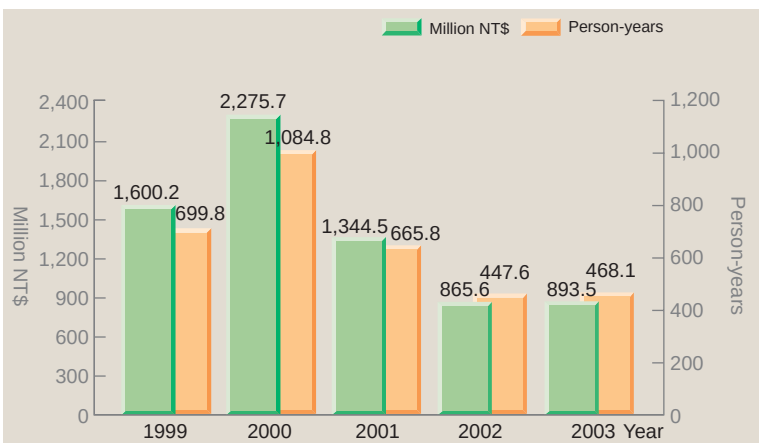


Figure III-5 Machinery S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

engineering collaboration.

1.2 Summary of Research and Results in FY2003:

1.2.1 Mid-term Framework Program for Machinery (DOIT): Development of key technologies for precision machinery, micro-/nanosystem applications, precision measurement of products and processes, and industrial machinery integration.

1.2.2 Mid-term Framework Program for the Machinery Field (IDB): Development of key technologies for new industrial precision machinery systems and integrated industrial machinery systems.

2. Aerospace

Based on the "Strategy for Development of Aviation and Space Industry Technology," the ROC's aerospace technology development efforts will take the form of independent development, international cooperation, and technology transfer. Plans call for the development of commercial aircraft, turbine engine, avionics, and aircraft maintenance technologies during the coming years.

See Fig. III-6 for an overview of aerospace S&T project funding and manpower, FY1999~2003.

2.1 R&D Focal Points:

2.1.1 Emphasis will be placed on the use of existing systems engineering expertise and key aerospace technologies; continued effort will be made to help upgrade conventional industries, while developing systems engineering service and aviation service industries.

2.1.2 Acceleration of the technology transfer timetable via early participation; establishment of industrial R&D capabilities, and encouragement of firms to enter the field of aerospace defense via the release of military products for commercial use.

2.1.3 Technology development will focus on the use of the ROC's superior electronics and computer technology to develop competitive system elements.

2.2 Summary of Research and Results in FY2003:

2.2.1 Mid-term Framework Program for Aerospace (DOIT): Development of key technologies

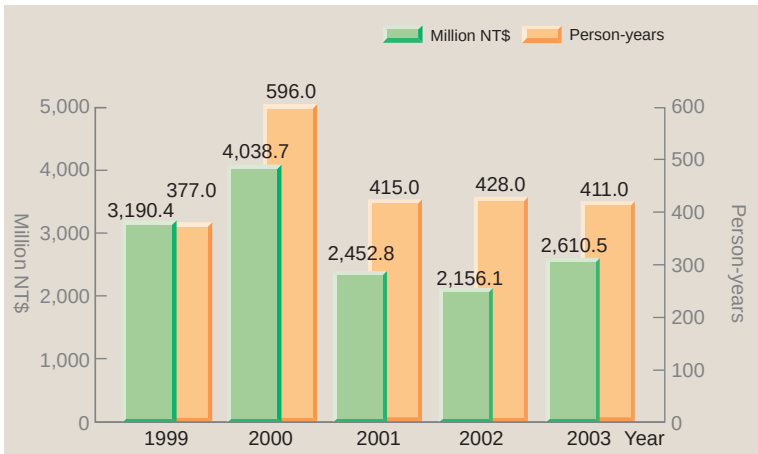


Figure III-6 Aerospace S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

and systems including aircraft structure and key system elements, avionics systems, advanced airborne avionics, and commercial aircraft.

2.2.2 Mid-term Framework Program for the Aerospace Field (IDB): The US firm Crane Aerospace & Electronics Corp. signed a letter of intent with the MOEA concerning investment in an Asian headquarters located in Taiwan.

3. Automation

The government is actively promoting manufacturing automation and systems integration, and strengthening the network communications infrastructure, with the goal of achieving a high level of industrial automation. In addition, the government has been actively promoting agricultural automation since 1991 in conjunction with its industrial automation policy.

See Fig. III-7 for an overview of automation S&T project funding and manpower, FY1999~2003.

3.1 R&D Focal Points:

Development of automation technology will focus on the four areas of "intelligent manufacturing," "manufacturing knowledge integration," "automation and e-Business integration," and "e-Automation."

3.1.1 Apart from assisting the upgrading and transformation of conventional electrical machinery industries, the government should encourage development of the automation technologies needed by the high value-added "Two Trillion and Twin Star" flat panel display industry.

3.1.2 Establishment of an innovative R&D environment and systems for the precision machinery industry in central Taiwan.

3.1.3 Development of key intelligent agricultural automation technologies: Development of nondestructive testing and automated precision management technologies.

3.1.4 Construction automation and e-Business: The re-engineering of construction operating procedures will lay a foundation for the establishment of information management systems, corporate resource planning systems, supply chain systems, and electronic marketplaces.

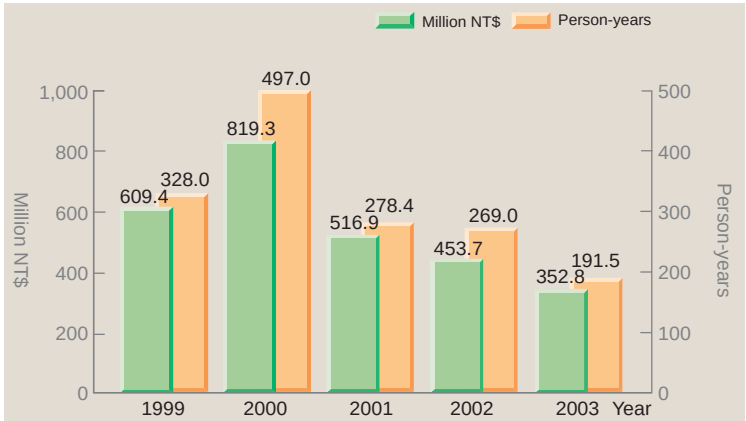


Figure III-7 Automation S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

Promotion of standardized and systematic automated working methods and technologies.

3.2 Summary of Research and Results in FY2003:

3.2.1 Mid-term Framework Program for Automation (DOIT): Development of computer technologies for integration and secondary metal processing automation systems.

3.2.2 Research and Development of Automation Technology (COA): Development of automated production and management technologies for farming, animal husbandry, and fisheries.

3.2.3 Construction Automation and Electronic Commerce (Construction and Planning Agency/ Architecture and Building Research Institute, MOI): Completion of a preliminary feasibility assessment of reclaiming ocean areas, automation and e-Business of structural engineering, establishment of an automated construction information system.

Chapter 3 Materials and Chemical Engineering

Materials and chemical engineering research encompasses the three areas of materials, chemical engineering, and textiles.

1. Materials

From the point of view of the country's overall industrial structure, increased attention to materials and parts and components R&D will increase the added value of related industries. And to boost future industrial competitiveness, it will be necessary to "design in" innovative materials and components to the system's development when creating innovative system products.

See Fig. III-8 for an overview of materials S&T project funding and manpower, FY1999~2003.

1.1 R&D Focal Points:

The focus of industrial technology development efforts will be on the six areas of biomedicine, advanced materials and chemical products, energy and the environment, computers and software, telecommunications systems, micro-electromechanical systems (MEMS), and precision machinery.

1.1.1 Key electronic materials and elements: The government will foster the development of highly-competitive key electronic materials and components industries serving the high value-added electronics industry.

1.1.2 High-performance metals technology: Development of high-performance metal and process technologies needed by the 3C and lightweight vehicle industries.

1.1.3 Civilian-use materials and applications: Development of high-performance fluoride surface materials; development of ultra-high performance surface materials with anti-contamination, high transparency, and anti-reflection properties; and establishment of light-weight polymer composite material technologies.

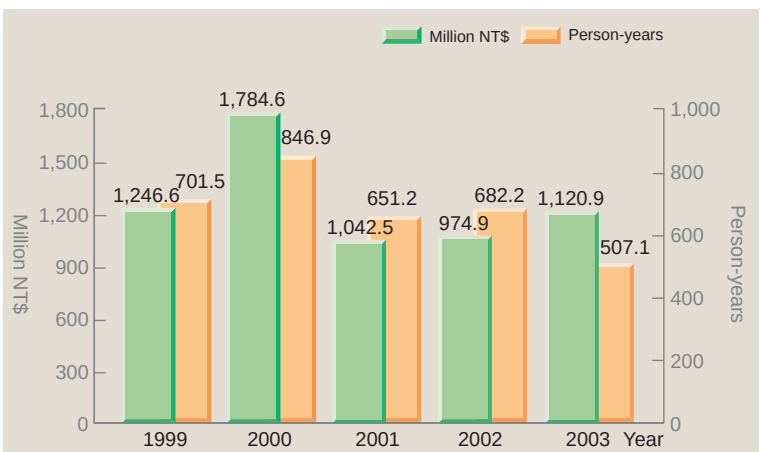


Figure III-8 Materials S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

1.2 Summary of Research and Results in FY2003:

1.2.1 Mid-term Framework Program for Materials Technology Development (DOIT): Research on key electronics materials and elements, high-performance metal materials, and civilian-use materials and applications.

1.2.2 Mid-term Framework Program for the Materials Field (IDB): Development of advanced key materials, high-performance composite materials, and construction materials.

2. Chemical Engineering

The chemical industry is one of Taiwan's mainstay industries, and is intimately linked with citizens' everyday lives. The chemical industry is also able to meet the need of such other industries as electronics, opto-electronics, energy, and environmental protection for functional materials, and thus gives Taiwan a complete up-, mid-, and down-stream industry system.

See Fig. III-9 for an overview of chemical engineering S&T project funding and manpower, FY1999~2003.

2.1 R&D Focal Points:

2.1.1 Grassroots-level R&D aimed at meeting industry needs will have a major impact on the influential synthetic resins industry, which will develop improved aqueous, light-sensitive, and mixed functional resins and new products.

2.1.2 R&D items will include key materials and chemical products for opto-electronics, optical communications, and optical information.

2.1.3 Chemical engineering technology R&D will focus on functional catalysts, nanometer powders, and high-purity chemical products and process technology.

2.2 Summary of Research and Results in FY2003:

2.2.1 Mid-term Framework Program for Chemical Technology (DOIT): Development of precision and functional chemicals, functional chemical products, and tinted inks for printed computers.

2.2.2 Mid-term Framework Program for Guiding Chemical Industrial Technology & Promoting Development of the Chemical Industry (IDB): Assistance for the development of

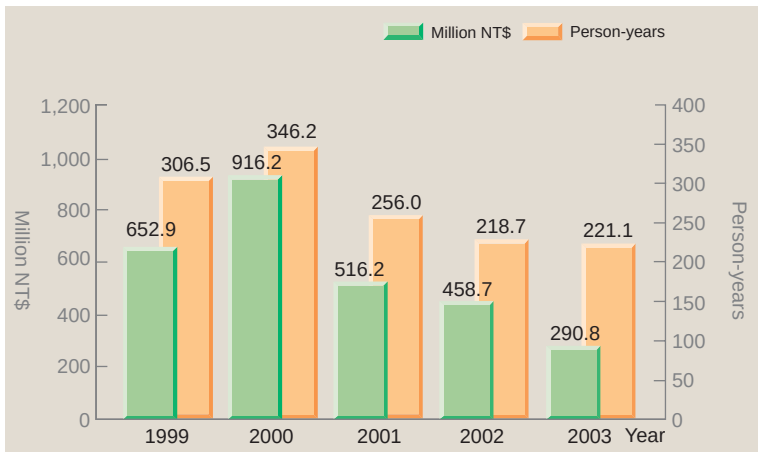


Figure III-9 Chemical Engineering S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

special chemical product industrial technology and electronics/opto-electronics chemical product industrial technology.

3. Textiles

This field includes all textile raw materials, process technology, equipment, labor, enterprises, and markets. The MOEA's "Strategy for Textile Industry Technology Development" and the IDB's "Strategy and Measures for Textile Industry Development" are the most important basis for industrial development and R&D at the current stage.

See Fig. III-10 for an overview of textile S&T project funding and manpower, FY1999~2003.

3.1 R&D Focal Points:

Textile technology development and product design work should aim for the development of differentiated textile products and relatively high value-added ODM and OBM textiles.

3.1.1 R&D efforts on future textile products will focus on functional and fashionable clothing; strengthening of innovative R&D, product design, and assessment.

3.1.2 Product design and technology R&D will focus on miniaturization techniques, integration with other industries, and special uses.

3.1.3 To develop differentiated, high quality products, Taiwan's textile industry must quickly strive to focus on differentiation and production of diverse, low-volume, high-price products.

3.2 Summary of Research and Results in FY2003:

3.2.1 Mid-term Framework Program for Textile Technology (DOIT): Development of fiber manufacturing and application technology, comfortable/healthy textiles, and high-tech textile industrial technologies.

3.2.2 Mid-term Framework Program for the Textile Technology Field (IDB): Assistance to the high-tech textile, textile/fashion design, and exercise/leisure industries.

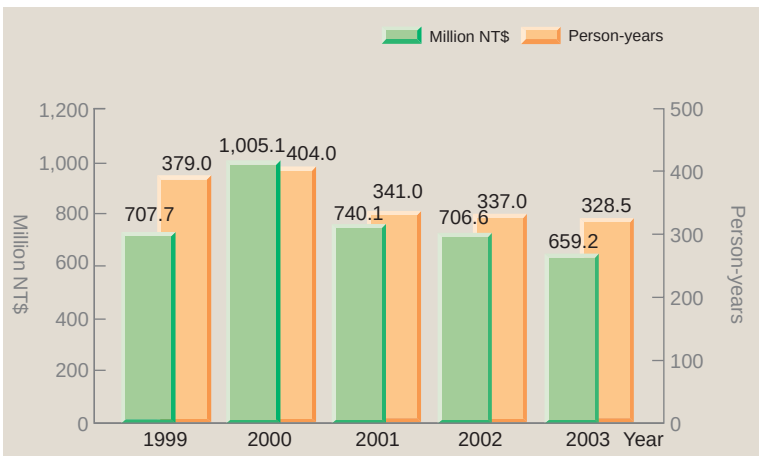


Figure III-10 Textile S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

Chapter 4 Pharmaceuticals

Pharmaceuticals are defined as those substances used to diagnose, treat, prevent, and mitigate disease, or otherwise affect the human body's structure or physiological functions. Since pharmaceuticals are able to directly affect human health, their sale and use are strictly regulated by national health authorities.

See Fig. III-11 for an overview of pharmaceutical S&T project funding and manpower, FY1999~2003.

1. R&D Focal Points:

Future pharmaceutical R&D will focus on up-, mid-, and down-stream integration and division of labor, with the goal of promoting the development of localized drugs. R&D efforts will focus on:

1.1 Emphasis will be placed on the development of new preparation technology in the near term, multi-stage new drug development technology in the mid-term, and new drugs in the long term.

1.2 Promotion of international mutual certification systems, establishment of drug brand images, and development of overseas markets.

1.3 Establishment of medical equipment standards systems, planning and deployment of an online drug management system, and continued efforts to formulate a sound legal system governing new biotech products.

1.4 Development of QC and safety assessment methods for Chinese herbal medicines; research on detection techniques, epidemiology, and toxicity assessment for drugs of abuse; establishment of Chinese herbal medicine quality control standards; research on drug composition, toxicology, and pharmacology.

1.5 Establishment of legal consulting mechanisms, continued pro-

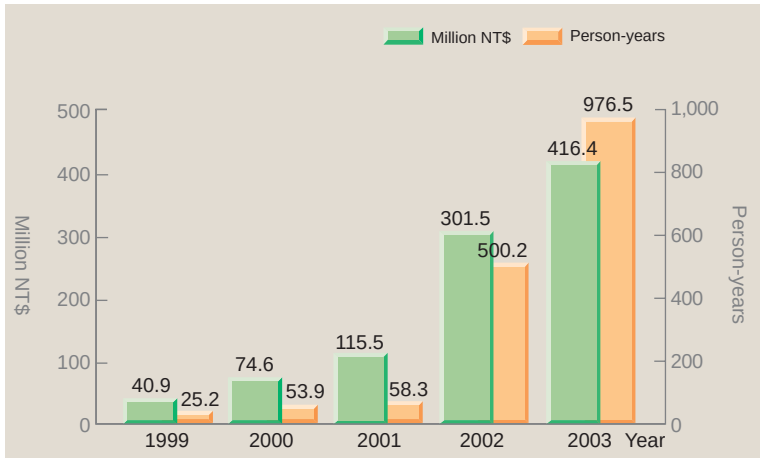


Figure III-11 Pharmaceutical S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

vision of full-course legal consulting services to relevant businesses and R&D units involved in new drug R&D.

2. Summary of Research and Results in FY2003:

2.1 Mid-term Framework Program for Pharmaceutical Development (DOH): Research on drug technology, drug abuse, drug testing, and Chinese herbal medicines.

2.2 Premarket Guidance and Consultation Project for R&D of Biotech Pharmaceutial Products (DOH): Drug testing centers accepted 137 consulting cases; completion and announcement of draft *Application Standards for Investigational New Drugs*, IND conforming to international trends.

2.3 Establishment of a New Drug Clinical Testing System and Operating Mechanisms – Implementation of GLP and GCP; Establishment of Clinical Test Operating Standards and Accompanying Measures (DOH): Implementation of certification for domestic testing organizations, completion of COLA laboratory certification quality documents.

2.4 Mid-term Framework Program for the Pharmaceutical Development Field – Pharmaceutical Industrial Technology Development and Services (IDB): Development of polymer submicron carrier and lipid submicron carrier analysis methods and confirmation of effectiveness.

Chapter 5 Biotechnology

The biotechnology industry is very broad in scope, and includes such areas as biotech drugs, special chemicals, agro-biotechnology, medical testing, food biotechnology, environmental protection biotechnology, and biotech services. Government policies affecting the biotech industry comply with the revised "Action Plan for Strengthening the Biotechnology Industry" – passed by the Executive Yuan in August 1997 – and the conclusions of the Executive Yuan's annual "Industrial Technology SRB Meeting on Industry."

See Fig. III-12 for an overview of biotechnology S&T project funding and manpower, FY1999 ~2003.

1. R&D Focal Points:

While the ROC's basic research in biotechnology has already attained international standards, down-stream corporate R&D capability remains fairly weak. R&D focal points include:

1.1 Development of medical engineering technology, improvement of diagnostic and therapeutic methods, development of medical instruments, and assistance for the improvement of medical equipment safety and reliability.

1.2 The further development and utilization of the country's vaccine research and mass production capability should be a high priority.

1.3 In the field of tissue engineering, specialists in medicine, biology, materials science, and MEMs will work together in interdisciplinary projects aimed at developing tissue engineering and biomimetic materials platform technologies and products.

1.4 Work in the field of biomedical materials and neuroscience will include basic research on glial cells, as well as the development of peripheral nerve regenerative guide devices making use of domestic and foreign research results concerning spinal and peripheral neural injuries. It is hoped

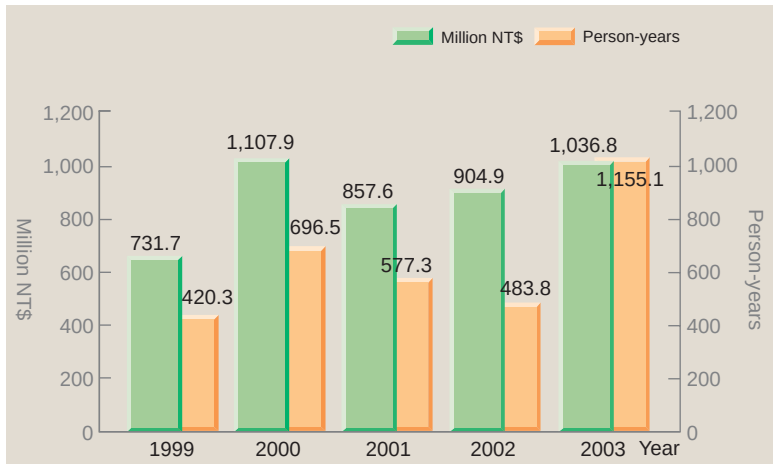


Figure III-12 Biotechnology S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

that this work will lead to the design of improved frameworks for spinal nerve injury regeneration.

1.5 Cell resource collection, preservation, and applications work will include the collection and preservation of cellular resources, the establishment of a "stem cell resource bank," and development of no-serum blood stem cells culture and applications technology.

2. Summary of Research and Results in FY2003:

2.1 National Health Research Institutes Biotechnology Research Projects (DOH): Research on molecular and genetic medicine; completion of chromosome sequencing.

2.2 Mid-term Framework Program for Biology and Biotechnology (DOIT): Collection, preservation, and development of biological resources, tissue regeneration, and development of biomimetic materials technology.

2.3 Mid-term Framework Program for the Biotechnology Field (IDB): Development of tissue regeneration and biomimetic materials technology, collection; preservation, and development of biological resources.

2.4 Mid-term Framework Program for the Biotechnology Field (COA): Breeding of papayas resistant to ringspot virus, tomatoes resistant to mosaic virus, Phalaenopsis orchids with delayed petal aging, and bananas preserving freshness longer after harvest.

Chapter 6 Medicine and Health

Thanks to the government's vigorous planning and promotion, up-stream basic research in medicine and health is already approaching international standards, and mid-stream development capability is gradually achieving a considerable scale. On the other hand, down-stream corporate R&D capabilities still remain inadequate.

See Fig. III-13 for an overview of medical and health S&T project funding and manpower, FY1999~2003.

1. Health S&T

The main framework of health S&T includes public health and health promotion research, health care research, infectious disease control research, cancer research, and geriatric medicine research. The government is actively planning empirical medical research projects intended to resolve the country's medical and public health problems.

1.1 R&D Focal Points:

R&D focal points include monitoring of citizens' health indicators and risk factors, control of major chronic diseases, cancer detection and control, infection control, geriatric medicine, psychiatric medicine, drug abuse research, occupational injuries, and medical policy research.

1.2 Summary of Research and Results in FY2003:

1.2.1 Mid-term Framework Program for Medicine and Health (DOH): Public health and health promotion research, infectious disease control, and medical care S&T research.

1.2.2 Integrated Program on Medicine and Health (DOH): Completion of basic and clinical research on cancer, biotechnology and drug research, medical engineering research.

1.2.3 National Health Research Institutes Medical and Health Research Projects (DOH): Development of five clinical tests, including tests for liver cancer, stomach cancer, and

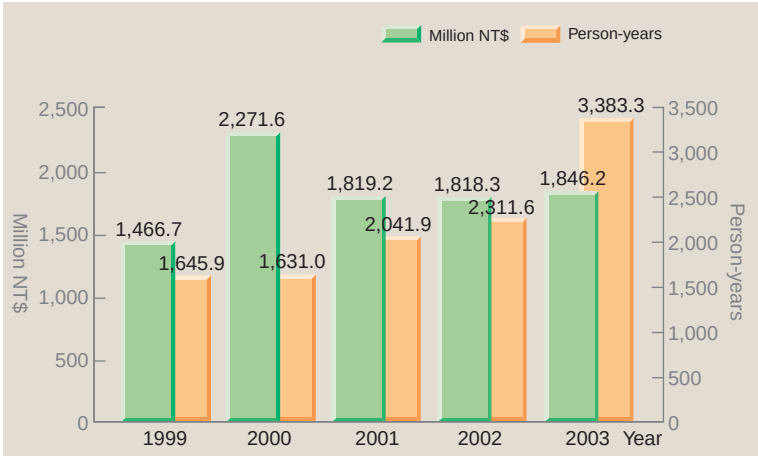


Figure III-13 Medical and Health S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

nasopharyngeal cancer.

1.2.4 Mid-term Framework Program for the Medicine and Health Field – Occupational Hygiene and Medicine Survey (CLA): Monitoring and analysis of occupational injuries/disease and health data, survey of occupational diseases, and occupational epidemiological research.

2. Medical Equipment

As defined in the *Pharmaceutical Affairs Act*, medical equipment consists of "those instruments, apparatus, and tools, and their accessories, parts, and components, used to diagnose, treat, mitigate, and directly prevent human disease, or able to influence the structure and functions of the human body."

2.1 R&D Focal Points:

Medical equipment R&D efforts will focus on the two areas of development of miniaturized diagnostic, treatment, and engineering technologies and development of biomedical testing technology and materials. Alliances will be established to concentrate R&D manpower and resources, and technology acquisition will help accelerate the commercialization of new products.

2.2 Summary of Research and Results in FY2003:

2.2.1 Mid-term Framework Program for Health Care (DOIT): Development of miniaturized diagnostic, treatment, and engineering technologies, as well as medical systems.

2.2.2 Mid-term Framework Program for the Health Care Field – Health Care Equipment Industrial Technology Promotion and Assistance Project (IDB): Development of miniaturized diagnostic, treatment, and engineering technologies, biomedical testing technologies, and materials.

Chapter 7 Agriculture

Agricultural science and technology consists of the four major fields of agriculture, forestry, fisheries, and animal husbandry, plus such associated areas as food processing and plant and animal disease control work.

1. Agriculture

S&T research and development work in the domain of agriculture encompasses plant plant/animal disease control, agricultural policy, agricultural extension, international agricultural cooperation, crop cultivation, horticultural crops, soil productivity, agricultural machinery, and pesticide testing.

See Fig. III-14 for an overview of agriculture S&T project funding and manpower, FY1999~2003.

1.1 R&D Focal Points:

1.1.1 Superior agriculture, improvement of industrial competitiveness, development of environmentally-friendly agriculture, and maintenance of harmony with the ecological environment.

1.1.2 Development of technological, international, rationalized agribusiness production, processing, and sales systems.

1.1.3 Due to the diversity of agriculture, the government must integrate and reinforce policies to achieve its preset goals.

1.1.4 Strengthening of disease monitoring technology, establishment of a stronger disease monitoring system, and better efforts to characterize the spatial and temporal distribution of major plant diseases.

1.2 Summary of COA Research Projects and Results in FY2003:

1.2.1 Crop production technology: International agricultural cooperation, crop breeding, and improvement of production technology.

1.2.2 Agricultural policy: Research on agricultural industries, the resource economy, and agricultural policies and systems.

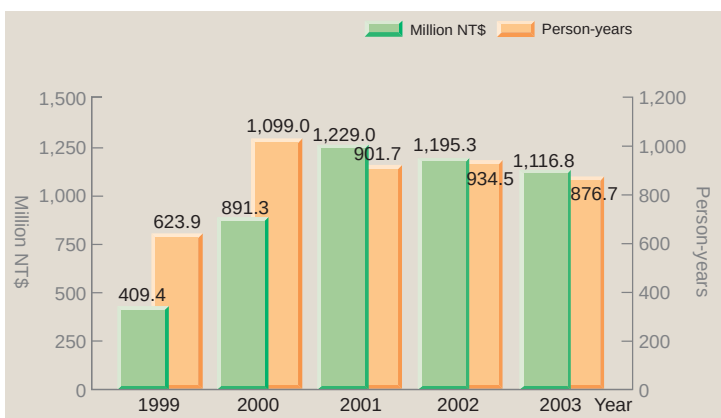


Figure III-14 Agriculture S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

1.2.3 Agricultural extension: Researchers completed a study of how to raise the competitiveness of farmers' organizations and planned how to give farming villages a new, modern look.

1.2.4 Phytosanitary and plant protection research: Researchers monitored plant pests and diseases, and developed or improved plant pests and disease control technologies.

2. Forestry

Forestry research seeks to promote the sustainable management of forest resources. Forestry R&D encompasses sustainable forest management technology research, sustainable forest resource utilization R&D, the development of locally-appropriate soil and water conservation techniques, the development of watershed protection techniques, application of remote sensing technology, and promotion of biodiversity research.

See Fig. III-15 for an overview of forestry S&T project funding and manpower, FY1999~2003.

2.1 R&D Focal Points:

2.1.1 Improvement of forest management methods and conservation/utilization technologies.

2.1.2 Promotion of natural ecology and wild plant and animal resource conservation.

2.1.3 Strengthening of biodiversity research in the Taiwan area.

2.1.4 Remote sensing technology applications research.

2.1.5 Strengthening of water and soil resource utilization research.

2.2 Summary of COA Forestry Mid-term Framework Program Research and Results in FY2003:

2.2.1 Improvement of forest management methods and conservation/utilization technologies: A productivity assessment system was developed for Taiwan's forest plantations.

2.2.2 Forest product processing and utilization R&D: Intensified research efforts focused on physical processing techniques, chemical analysis of wood, and natural rot-prevention techniques.

2.2.3 Water and soil resource utilization research: Researchers assessed water/soil erosion problems in betel palm plantations and evaluated various types of water/soil conservation techniques.

2.2.4 Natural ecology and wild plant and animal resource conservation: Strengthened research

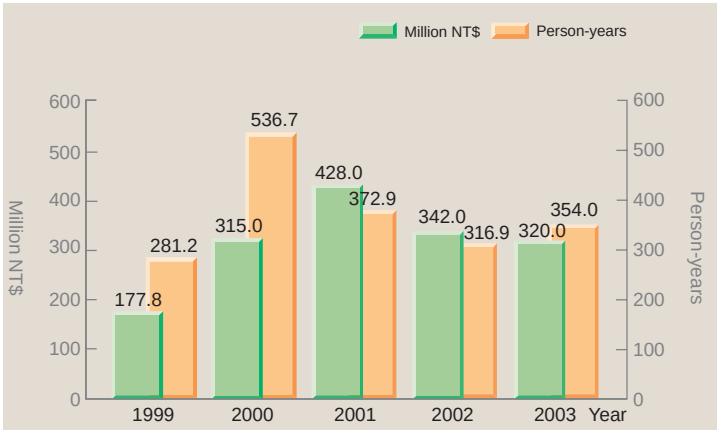


Figure III-15 Forestry S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

on the monitoring and management of nature preserves.

2.2.5 Strengthened research on biodiversity of the Taiwan area: Researchers studies population genetics models and recorded approximately 30,000 sequencing reactions.

2.2.6 Remote sensing applications and research: Researchers compiled a database of wildlife distribution and growth and harvesting of major tree species in the Liwu Stream Forest District.

3. Fisheries

In the face of deregulation and globalization, along with strengthened environmental protection measures and implementation of international responsibility systems, the ROC's fishing industry faces increasing fishing restrictions, cost increases, and slipping fish prices.

See Fig. III-16 for an overview of fisheries S&T project funding and manpower, FY1999~2003.

3.1 R&D Focal Points:

3.1.1 Strengthened biological, ecological, environmental, and quantitative research on far sea fisheries resources.

3.1.2 Adjustment of the fishing industry's structure; provision of fisheries resources in peripheral waters for utilization by the recreational fishing industry.

3.1.3 Strengthened restoration of aquatic resources, development of aquaculture technology, maintenance of order in fishing grounds, and environmental preservation and restoration in fishing grounds.

3.1.4 Strengthened fisheries resource management methods in peripheral waters; species monitoring in marine biodiversity hotspots.

3.1.5 Investigation of the biochemical characteristics of new farmed fish and shellfish, research on the optimal processing and utilization of fish and shellfish, and improvement of freshness preservation after capture and distribution.

3.2 Summary of COA Fisheries Mid-term Framework Program Research and Results in FY2003:

3.2.1 Collection of water temperature, salinity, and density data from 62 monitoring stations in the waters around Taiwan.

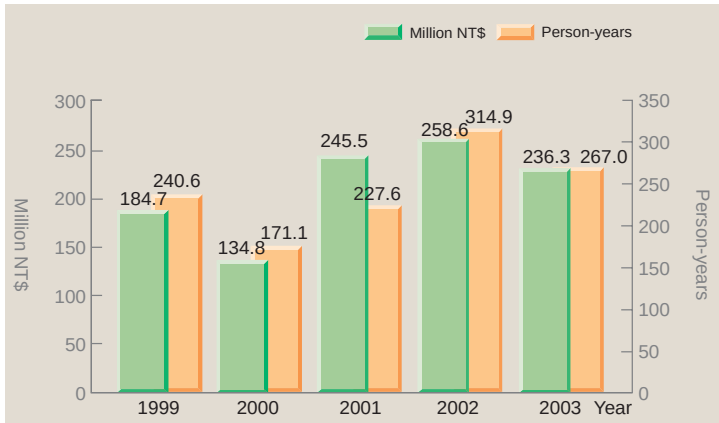


Figure III-16 Fisheries S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

3.2.2 A preliminary analysis was performed of the population structure of albacore in the Indian Ocean and South Atlantic.

3.2.3 Researchers completed a survey of bacterial diseases in 14 types of saltwater fish and shellfish, and identified many types of pathogens.

3.2.4 Testing methods were developed for various types of pesticides in aquatic products, including testing techniques with relatively low equipment and manpower demands.

3.2.5 Remote sensing technology was used to measure resource abundance and probe the fishing grounds environment, enabling better data on fishing and ocean conditions.

4. Animal Husbandry

The livestock industry has been exposed to global competition since Taiwan became a member of the WTO in January 2002.

See Fig. III-17 for an overview of animal husbandry S&T project funding and manpower, FY1999~2003.

4.1 R&D Focal Points:

4.1.1 Strengthened research on ways of reducing production and sales costs, development of high-quality, superior-value livestock and poultry products with local features.

4.1.2 Strengthened R&D of testing techniques for drug residue in livestock and poultry products, reduction of antibiotic use.

4.1.3 Development of GM microbial agents for use in animal feeds as alternatives to antibiotics.

4.1.4 Development of animal disease control techniques, improvement of animal sanitation and health standards, and improvement of animal industry competitiveness.

4.1.5 Development of animal disease inspection and diagnostic technology, and strengthened veterinary medicine research and development.

4.2 Summary of COA Research Projects and Results in FY2003:

4.2.1 Animal Industry Research: An ongoing research project investigated genes promoting boar fertility and developed and applied a testing biochip; development of rapid testing techniques for GM animal feed.

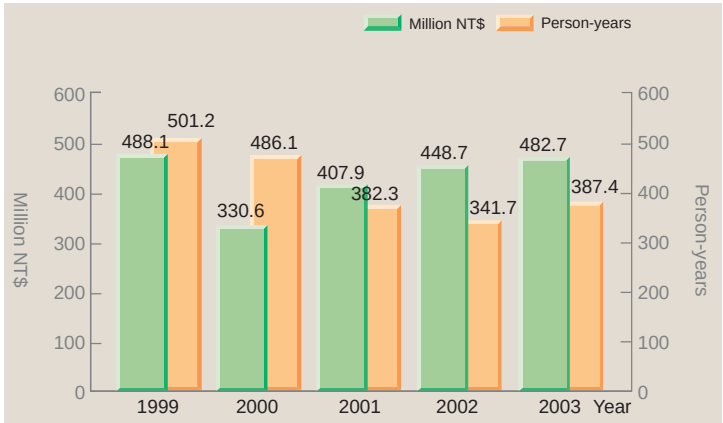


Figure III-17 Animal Husbandry S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

4.2.2 Phytosanitary and Animal Protection Research: Development of foot and mouth disease control techniques and new hog cholera control methods.

5. Food Science

The scope of food science R&D encompasses food processing/manufacturing and peripheral industrial technologies, including food preparation, packaging, distribution, and inspection technology, and food machinery and integration technology.

See Fig. III-18 for an overview of food science S&T project funding and manpower, FY1999 ~2003.

5.1 R&D Focal Points:

5.1.1 Functional health foods: Chinese herbal medicines will be used in the development of health foods; use will be made of local edible plant materials and marine resources in highly competitive products offering multiple benefits.

5.1.2 Vegetarian foods: Development of vegetarian foods possessing cultural and culinary strengths can promote the emergence of a promising industry.

5.1.3 Food machinery industry: System design work will be assisted by food specialists in an effort to promote the development of the food machinery industry.

5.2 Summary of Research and Results in FY2003:

5.2.1 Care Project for Food Technology Development (COA): Development of traditional Chinese-style foods, high-quality food service meals, and instant food products.

5.2.2 Mid-term Framework Program for Innovative Processing and Ingredient Technologies in the Food Industry (DOIT): Development of food processing packaging technologies, development of continuous microwave frying/drying process technology for instant noodles.

5.2.3 Mid-term Framework Program for the Foods Field (IDB): Food industry technology development and assistance work, food GMP technology assistance and extension.

5.2.4 Mid-term Framework Program for Foods (DOH): Development of ten testing methods for GM foods, research on food technologies, and development of health foods.

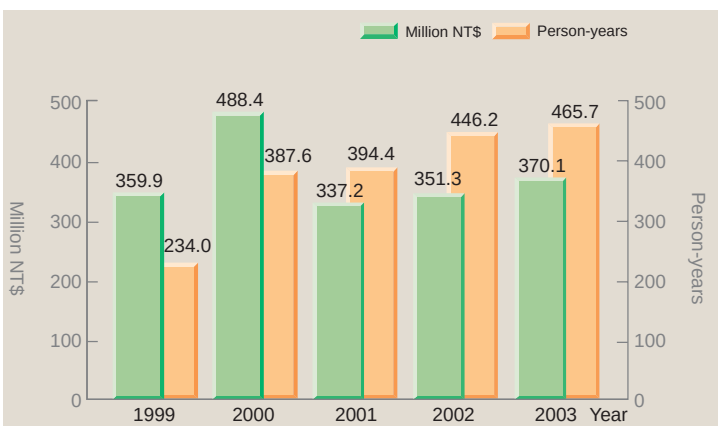


Figure III-18 Food Science S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

Chapter 8 Earth Science

Earth science encompasses the three areas of meteorology, geology, and ocean science.

1. Meteorology

What we call the "weather" is a general term for various physical and chemical phenomena occurring in the atmosphere. From the point of view of practical public service, meteorological technology plays roles in the five areas of weather observation, forecasting, applications, information, and education.

See Fig. III-19 for an overview of meteorology S&T project funding and manpower, FY1999~2003.

1.1 R&D Focal Points:

Future meteorological R&D will focus on the modernization of weather observation, improvement of forecasting, and diversification of services. In particular, the development of short-term climate forecasting techniques will play a vitally important role in connection with such economically-important aspects as water resource utilization, electrical power allocation, and pest and disease control. The field of meteorology will rely on interdisciplinary integration to offer effective climatic information applications and diversified services.

1.2 Summary of Central Weather Bureau Meteorological Research and Results in FY2003:

1.2.1 Meteorological observation: Weather stations were established in the Kinmen and Matsu areas, and 20 new automatic stations were added in eastern Taiwan.

1.2.2 Weather forecasting: Researchers studied long-term weather forecasting processes, climate analysis, and numerical climate forecasting models.

1.2.3 Weather information: Planning, analysis, and basic design tasks for a climate and climate monitoring database.

1.2.4 Meteorological applications: Completion of ground surface and local area climate and hydrological meteorology applications research.

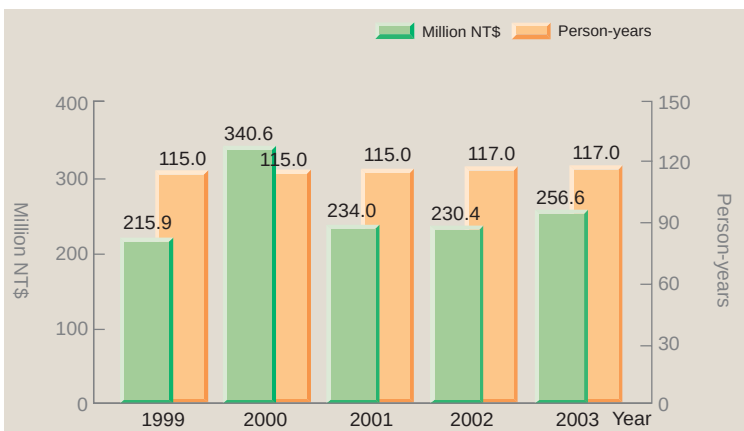


Figure III-19 Meteorology S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

2. Geology

To reduce loss of life and property damage due to catastrophic earthquakes,

the government has systematically implemented active fault survey work, the monitoring of active faults already associated with seismic activity, and earthquake risk assessment research. See Fig. III-20 for an overview of geology S&T project funding and manpower, FY1999~2003.

2.1 R&D Focal Points:

2.1.1 Crustal deformation gauges would be used to monitor crustal response and stress shifts, and possibly detect releases of energy signifying impending major earthquakes.

2.1.2 Environmental geochemistry research will study correlations between the chemical composition of water and gases and the occurrence of earthquakes to discover possible signs presaging earthquakes.

2.1.3 The "Earthquake and Active Fault Research Program" will improve the functions of monitoring wells and perform integrated research projects.

2.1.4 Earthquake detection and warning efforts will emphasize the drafting and implementation of real-time strong earthquake warning applications.

2.2 Summary of Research and Results in FY2003:

2.2.1 Fault Activity Monitoring and Earthquake Potential Evaluation (Central Geological Survey): Researchers established fault activity monitoring stations and studied correlations between environmental geochemistry and terrestrial fault activity in Taiwan.

2.2.2 Study of Groundwater Anomalies Associated with Earthquakes (Water Resources Agency): Researchers collected data from advanced nations regarding changes in groundwater level, water temperature, and water chemistry before and after earthquakes.

2.2.3 Taiwan Strong Monitoring Instrumentation Program (Phase 2) – The Implementation of a Rapid Earthquake Reporting System (Central Weather Bureau): Establishment of a real-time seismic monitoring network, strong earthquake rapid reporting system, and GPS landform change observation network.

3. Ocean Science

The MOTC has included "coastal tourism and recreation" and "navigation safety" within its main service scope, and considers the integration of safety and recreation to be an important part of its mission.

See Fig. III-21 for an overview of ocean science S&T project funding and

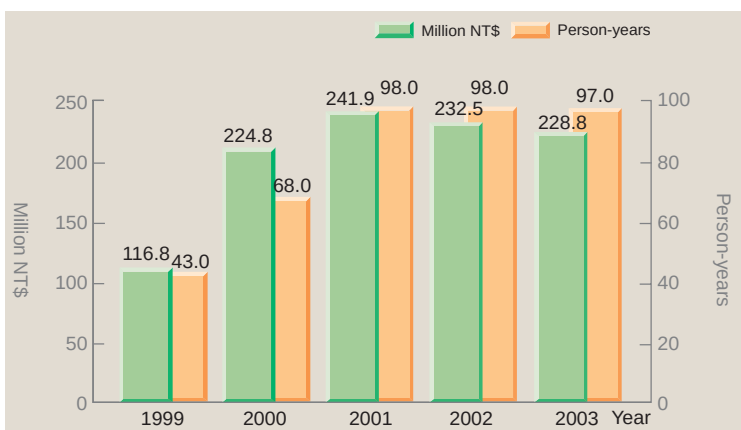


Figure III-20 Geology S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

manpower, FY1999~2003.

3.1 R&D Focal Points:

3.1.1 The country considers tourism to be an important strategic industry.

3.1.2 Continued efforts will be made to deploy and maintain a long-term sea state observation network; this network will be used to investigate the marine environment and develop localized numerical forecasting models.

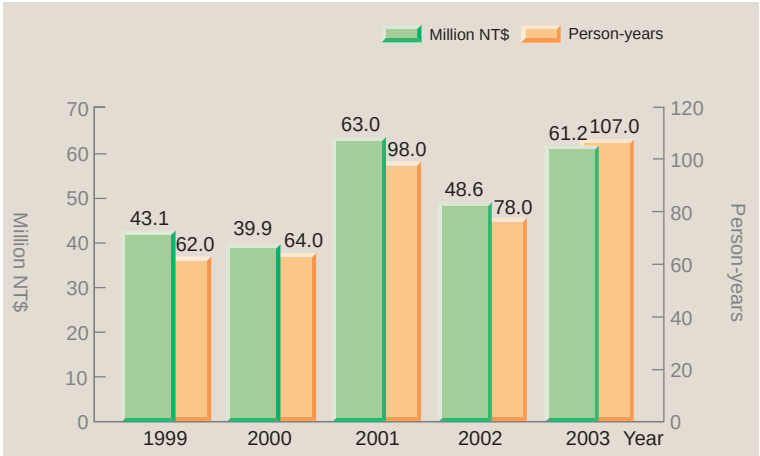


Figure III-21 Ocean Science S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

3.1.3 Establishment of an integrated real-time observation and forecasting information network.

3.1.4 Research on marine resource development, within the goal of achieving safe, effective, and sustainable resource utilization through the use of new marine technology.

3.2 Summary of Research and Results in FY2003:

3.2.1 Taiwan Coastal Recreation and Navigation Safety Information Research (Office of S&T Advisors, MOTC): Establishment of geographical information systems useful in the development of coastal recreation of resources and disaster mitigation work.

3.2.2 Mid-term Framework Program for Ocean Science and Technology Development (The Institute of Transportation, MOTC): Wave monitoring and forecasting, harbor structure safety research, breakwater top scouring.

Chapter 9 Energy, Resources, and Environmental Protection

Energy, resources, and environmental protection S&T encompasses the four areas of atomic energy, energy, resources, and environmental protection (including chemistry).

1. Atomic Energy

In compliance with the government's re-engineering campaign and the S&T policies and the Atomic Energy Council's strategy guidance, the ROC's atomic energy S&T program focuses on the three areas of nuclear safety, environment and energy, and radiation applications. Particular attention is paid to civilian applications of atomic energy and basic R&D.

See Fig. III-22 for an overview of atomic energy S&T project funding and manpower, FY1999~2003.

1.1 R&D Focal Points:

1.1.1 Strengthening of nuclear safety controls, radiation protection, radioactive materials management, and environmental radiation monitoring.

1.1.2 Drafting of key R&D issues connected with the promulgation of the *Ionizing Radiation Protection Law*, *Nuclear Materials and Radioactive Waste Management Law*, and other regulatory legislation.

1.1.3 R&D of improved operating technologies for cyclotron accelerators, radiation sources, and other core facilities.

1.1.4 Continued advanced technology research on fuel cells, solar cells, plasma and clean processes, and Incinerator fusion environmental protection.

1.2 Summary of AEC Research Projects and Results in FY2003:

1.2.1 Research of Nuclear Safety Technology: Improvement of nuclear power plant severe accident handling capability, applications of nuclear safety assessment techniques.

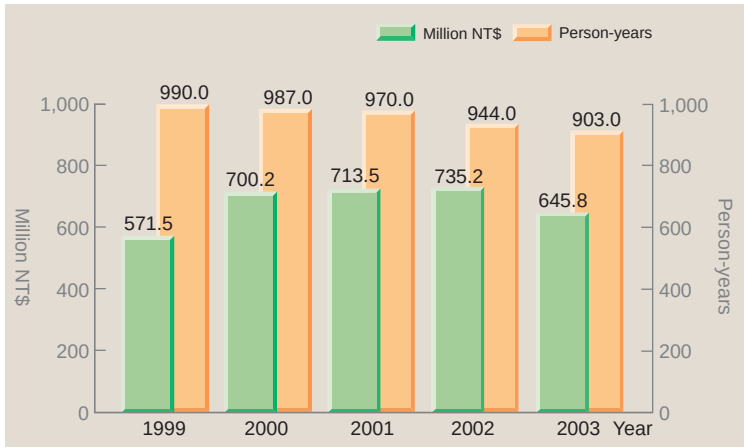


Figure III-22 Atomic Energy S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 funding and manpower has been converted to a single-year basis.

1.2.2 Environmental and energy research: Development of high efficiency solidification technology for radioactive waste.

1.2.3 Radiation applications research: Development of the Parkinson's disease imaging agent "TRODAT-1" (^{99m}Tc).

2. Energy

As laid out by the "National Energy Conference Conclusions Action Plan" and the "National Science and Technology Development Plan," the nation's energy development vision will emphasize renewable energy, new energy uses, and energy conservation.

See Fig. III-23 for an overview of energy S&T project funding and manpower, FY1999~2003.

2.1 R&D Focal Points:

2.1.1 Drafting of strategies and measures to promote the development of a clean energy equipment manufacturing industry.

2.1.2 Establishment of domestic clean energy equipment testing and certification standards and capabilities, promotion of product and technology upgrading.

2.1.3 Strengthened promotion of renewable energy demonstrations, establishment of relevant technologies, and drafting of relevant legislation.

2.1.4 Establishment of common intelligent household appliance wireless control network communications modules.

2.2 Summary of Research and Results in FY2003:

2.2.1 Mid-term Framework Program for Electrical Machinery and Technology (DOIT): Research on clean air conditioning industrial technology.

2.2.2 Mid-term Framework Program for the Energy Field (IDB): Planning of a testing platform and environment for high-performance batteries.

2.2.3 Renewable Energy Development and Utilization (Bureau of Energy, MOEA): Development of solar cooling/air conditioning systems.

2.2.4 Innovative Energy Conversion Technologies (Bureau of Energy, MOEA): Development

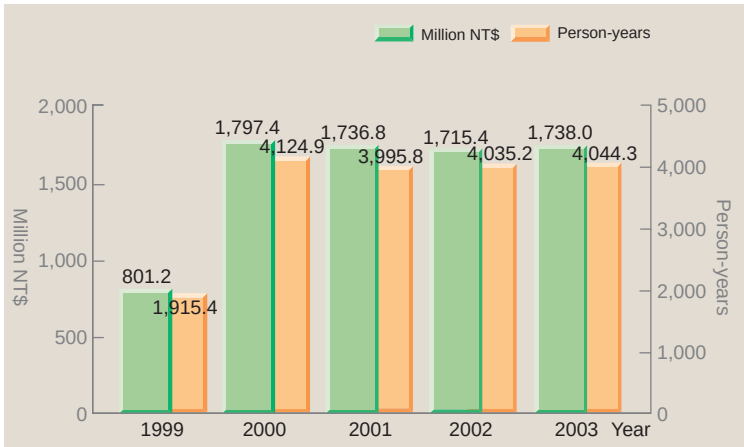


Figure III-23 Energy S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

of a 1-kW fuel cell system using hydrogen as fuel.

2.2.5 Energy Conservation Technology (Bureau of Energy, MOEA): Completion of a direct-flow variable-frequency air-conditioning unit using the new refrigerant R-410A.

2.2.6 Energy Efficiency Management and Technical Services (Bureau of Energy, MOEA): Implementation of an energy consumer audit system.

2.2.7 Research on Cutting-edge Energy Technology and Knowledge Management (Bureau of Energy, MOEA): Research on nanometerenergy conservation technologies.

3. Resources

In a world of limited resources, the sustainable development and utilization of resources can strongly impact national development and national competitiveness. Resources R&D chiefly consists of the three areas of water resources, renewable resources, and sand/gravel/mineral resources.

See Fig. III-24 for an overview of resources S&T project funding and manpower, FY1999~2003.

3.1 R&D Focal Points:

3.1.1 Development of flood and drought prevention and mitigation technologies, river and waterway restoration methods, and water resource conservation technologies.

3.1.2 Development of sustainable resource technologies involving seawater, recycled process water, rare metals, and mineral resources.

3.1.3 Assistance and extension projects to promote the efficient use of industrial water; promotion of sand/gravel/mineral resource S&T development.

3.1.4 R&D of high-uniformity photoexcitation dry washing and high-performance nanometer process ozone water photoresist washing technologies.

3.2 Summary of Research and Results in FY2003:

3.2.1 Mid-term Framework Program for the Resources Field – Sustainable Resource Technology Development Project (DOIT): Development of seawater resource development and utilization approaches.

3.2.2 Mid-term Framework Program for the Resources Field – Efficiency Pro-

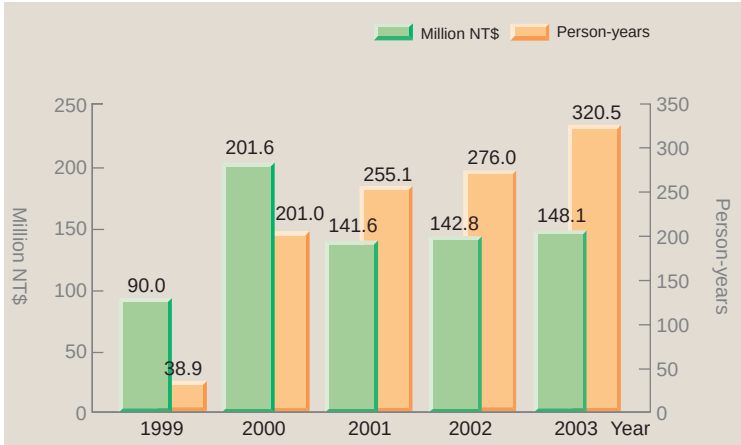


Figure III-24 Resources S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

motion and Consulting Project for Industrial Usage (IDB): Thirty companies in six industries were able to raise their recycling rate by 10~35%, depending on the industry type.

3.2.3 Mid-term Framework Program for Water Disaster Mitigation (Water Resources Agency, MOEA): Implementation of a drought mitigation decision-making support system.

3.2.4 Mid-term Framework Program for Water Conservation in Management (Water Resources Agency, MOEA): Compilation of basic data on optimally designed beach and coastal protection structures for use in northern and central Taiwan.

4. Environmental Protection

In line with the "Challenge 2008 – National Development Plan," the government has taken sustainable development as its strategic goal, and seeks to strengthen ecological conservation and environmental protection, in an effort to boost international national competitiveness, create employment opportunities, maintain quality of life, and promote economic development.

See Fig. III-25 for an overview of the environmental protection S&T project funding and manpower, FY1999~2003.

4.1 R&D Focal Points:

4.1.1 The government will continue to implement the Mid-term Framework Program for Sustainable Development, with an emphasis on interdisciplinary research and sustainability.

4.1.2 Resolution of urgent environmental protection and industrial safety issues connected with nanotechnology industry R&D and production.

4.1.3 Expansion of research under the "Plan of Green Building and Residential Environment Technology Project" in line with the country's sustainable development policy goals concerning environmental buildings.

4.1.4 Continued research on how airborne pollutants entering the Taiwan area from outside affect air quality, clouds, and rain.

4.1.5 Development of models and technology for assessing noise and vibration caused by Taiwan's high-speed rail system.

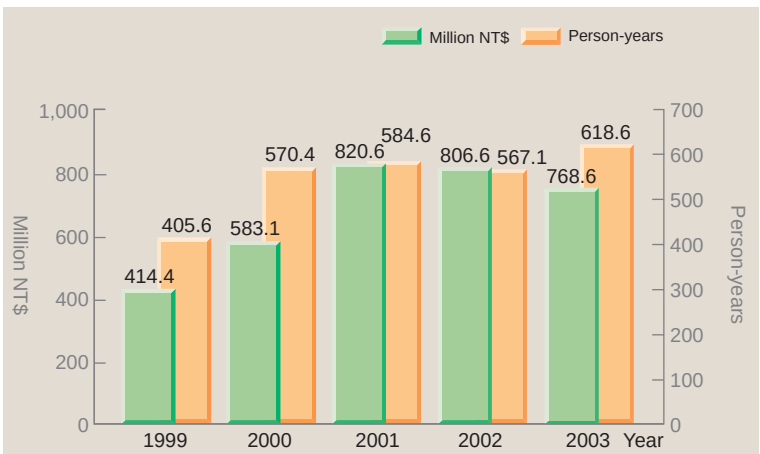


Figure III-25 Environmental Protection S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

4.2 Summary of Research and Results in FY2003:

4.2.1 Mid-term Framework Program for Environmental Protection (DOIT): Development of waste recycling and processing technology.

4.2.2 Industrial Safety and Environmental Protection Assistance and Promotion Plan (IDB): Completion of an industrial sustainable development promotion strategy.

4.2.3 Environmental Technology Development Project (COA): Research on livestock farm waste reduction and recycling.

4.2.4 Green Building and Living Environment Technology Plan (Architecture and Building Research Institute, MOI): Green building technology research and development.

4.2.5 Study on Cumulative Environmental Impacts Assessment Standards and Integration with Geographic Information System (EPA): Establishment of a query management system for environmental impact assessment cases.

4.2.6 Survey of the Environmental Distribution of Toxic Chemicals (EPA): Completion of mercury content testing of 120 river bottom mud specimens and 41 biological specimens.

4.2.7 Planning and Establishment of Management Technologies for Environmental Use Microbial Agents (EPA): Drafting of review mechanisms for microbial preparations used as environmental agents in Taiwan.

4.2.8 Environmental Monitoring and Information Management Technology Research (EPA): Research on dust storms in China and the characteristics of particulate matter from background monitoring stations.

4.2.9 Mid-term Plan for Development of Environmental Testing Technologies (EPA): Research on the diameters of particulate pollutants from various types of emission channels.

4.2.10 Mid-term Framework Plan for Sustainable Development and Advanced Environmental S&T (EPA): Investigation of the relationship between WTO trade rules and major MEAs.

4.2.11 Waste Disposal Technology Development Research (EPA): Environmental management of hazardous industrial waste solidification and treatment plants and solid waste landfills.

4.2.12 Research on Noise and Vibration from the High Speed Rail System; Research on Motor Vehicle Noise Control Technology and control measures (EPA): Research on intermittent noise and impact noise from the high-speed rail system.

4.2.13 Mid-term Framework Program for Chemistry – Research on Analytical Techniques for Assessing Workplace Exposure Hazards (CLA): Research on domestic occupational diseases caused by exposure to chemicals.

Chapter 10 Construction, Civil Engineering, and Transportation

Construction, civil engineering, and transportation S&T encompasses the two areas of construction/civil engineering and transportation.

1. Construction and Civil Engineering

See Fig. III-26 for an overview of construction and civil engineering S&T project funding and manpower, FY1999~2003.

1.1 R&D Focal Points:

1.1.1 Strengthened research on fire safety techniques for high-rise buildings.

1.1.2 Promotion of the concepts of disaster mitigation and sustainability in technologies and applications.

1.1.3 Efforts to improve historic site and building preservation technologies and practical applications.

1.1.4 Strengthened research on innovative civil engineering working methods, new applications of high-tech materials, and computerized construction management.

1.2 Summary of Research and Results in FY2003:

1.2.1 Six-Year Project for Development and Application of Building Fire Safety Technology (Architecture and Building Research Institute, MOI): Research on strategies and legal systems, augmentation of fire safety laboratory equipment.

1.2.2 Mid-term Framework Program for Hazard/Disaster Mitigation Technology in Urban Areas and Buildings (Architecture and Building Research Institute, MOI): Disaster mitigation research and development, government assistance for local urban disaster mitigation demonstration projects.

1.2.3 Plan for Seismic Disaster Prevention of Buildings (Architecture and Building Research Institute, MOI): Strengthened research on brick

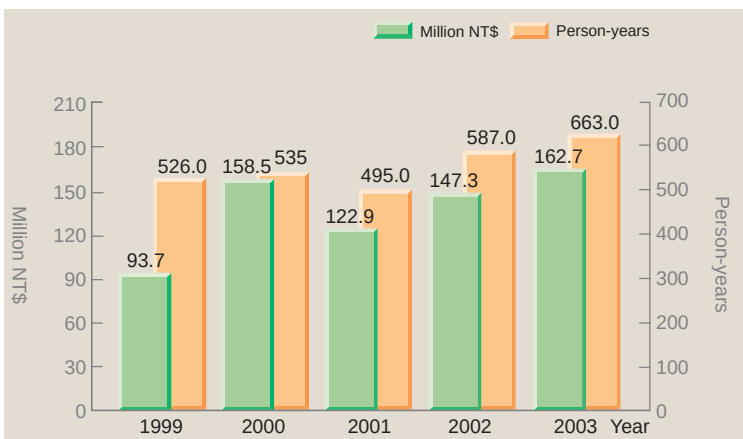


Figure III-26 Construction and Civil Engineering S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

building seismic resistance diagnosis and reinforcing strategies.

1.2.4 Mid-term Framework Program on the Preservation and Restoration of Historical Sites and Buildings (Architecture and Building Research Institute, MOI): Research on structural restoration and the preservation environment.

1.2.5 Mid-term Framework Program for National Public Construction Technology – Studying and Monitoring Sustainable Development (Public Construction Commission): "Sustainable Taiwan" public construction technologies and strategies.

1.2.6 Mid-term Framework Program for Tunnel Engineering – Establishment of a Rock Mass Classification System and Tunnel Engineering Database (Public Construction Commission): Establishment of a rock mass classification and tunnel support system for Taiwan.

1.2.7 Transportation and Civil Engineering Construction S&T Program (Technology Advisory Office, MOTC): Research on optimal working methods to prevent embankment landslides along mountain roads.

1.2.8 Mid-term Framework Program for the Transportation Technology Field (Institute of Transportation, MOTC): Research on the functional design of harbor structures.

2. Transportation

Transportation S&T projects are primarily aimed at the rail vehicle industry, automotive industry, electric vehicle industry, shipbuilding industry, and bicycle industry.

See Fig. III-27 for an overview of transportation S&T project funding and manpower, FY1999~2003.

2.1 R&D Focal Points:

2.1.1 Establishment of testing and technical standards for the high-speed rail system; establishment of a signal maintenance outsourcing system.

2.1.2 The government is assisting the automotive industry by strengthening the global response capability of Taiwan's parts and components suppliers, promoting industry-academic technical interchange, and promoting vehicle engineering manpower training.

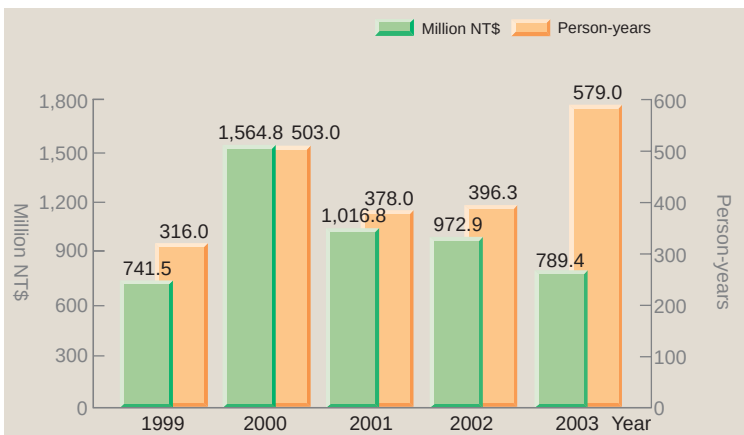


Figure III-27 Transportation S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

2.1.3 Assistance for the elec-

tric vehicle industry will take the form of collection of up-to-date industry and technology news from around the world.

2.1.4 Assistance for the shipbuilding industry will include the use of an industry e-bulletin to establish ship products information exchange standards for Taiwan.

2.1.5 Assistance for the bicycle industry will include the development of new bicycles types and transmission system designs, and the establishment of marketing industry information platforms.

2.2 Summary of Research and Results in FY2003:

2.2.1 Mid-term Framework Program for Transportation (DOIT): Development of compound power, chassis, and vehicle electronics networks.

2.2.2 Four-year Transportation Technology Development Program (IDB): Establishment of national standards for rail vehicles, and formulation of laws and regulations governing light rail systems.

2.2.3 Mid-term Framework Program for Intelligent Transportation Systems (Office of S&T Advisors, MOTC): Research and development of a dynamic information system for buses, and implementation of a moving vehicle safety device and demonstration project.

2.2.4 Mid-term Framework Program for Transportation Technology (Office of S&T Advisors, MOTC): Formulation of draft technical standards for mass transit system construction.

2.2.5 Mid-term Program for the Transportation Technology Field (The Institute of Transportation, MOTC): Research, development, and operation of a domestic NTCIP integrated communications platform.

Chapter 11 e-Business

e-Business S&T encompasses the networking of industry, commerce, agriculture, and construction. The main goal of this field is to enhance the competitiveness of manufacturing, commerce, service industries, farming, and fisheries through the application of computer networks.

e-Business S&T projects received NT$1.09 billion in funding and involved 532.7 person-years of labor in FY2003.

1. R&D Focal Points:

1.1 Establishment of an information environment: Researchers will make continued efforts to develop operating models employing information technology and reflecting the trend toward a global division of labor and global operations. e-Business technology and standards will be developed and adopted, putting the network applications environment on a sound footing.

1.2 Automation and e-Business for manufacturing industries: Ongoing efforts will be made to help manufacturers to implement corporate e-Business projects; planning and implementation of a corporate e-Business assessment system.

1.3 e-Commerce: The government will strive to develop infrastructure, create a trustworthy e-Commerce environment, upgrade corporate e-Business capabilities, coordinate industry integration, develop e-Commerce application integration mechanisms for industry supply chains and demand chains, and foster knowledge innovation and the establishment of industry knowledge value networks.

1.4 Promotion of SME e-Business: The government will join forces with industry associations to promote online marketing by SMEs and establish industry e-Business service teams, train e-Business manpower at SMEs, and promote unified SME supply chains.

1.5 Agricultural automation and e-Business: The government will strive to integrate agricultural industry value chains and achieve value chain synergy, integrate recreational farming resources, develop boutique agriculture, promote agricultural knowledge management applications, and boost agriculture's competitive advantage.

2. Summary of Research and Results in FY2003:

2.1 Establishment of an Information Environment (DOIT): Establishment of an internationally-compatible information environment applicable to Taiwan's industries, particularly key industries.

2.2 Automation and e-Business Promotion Project for Manufacturing Industries (IDB): Deployment of high-efficiency supply chain management networks, development of

e-Business standards for manufacturing industries.

2.3 e-Commerce (Department of Commerce, MOEA): The Department of Commerce helped 28 merchants to adopt e-Commerce systems and 13 logistics companies to adopt e-Logistics systems.

2.4 e-Talent Training and e-Learning Web Site for SMEs (Small & Medium Enterprise Administration (SMEA), MOEA): The SMEA helped SMEs develop e-Commerce environments, and established 26 industry e-Business service teams.

2.5 Agricultural Automation and Computerization (COA): Development of relevant agricultural product production-sales information service applications, establishment of a production-marketing team information service network.

Chapter 12 Common Technology

Common technology R&D was divided into the subareas of "management, assistance, and subsidies," "National Measurement Laboratory, PIDC, Institute of Occupational Safety and Health," and "information and services" in FY2003. The following is an overview of projects in each area:

See Fig. III-28 for an overview of common technology S&T project funding and manpower, FY1999~2003.

1. Management, Assistance, and Subsidies

1.1 R&D Focal Points:

The government will strengthen deliberation of budgetary estimates for S&T projects and establish a performance assessment system; promote industrial development via the three approaches of "technological upgrading," "innovative R&D," and "development of global operations"; work towards the ultimate goal of creating a "Green Silicon Island" with superior production, living, and ecological conditions; perform overall assessments of different aspects of business and draft specific measures meeting corporate needs; implement the e-Taiwan Construction Plan and promote development of relevant information services; and continue to expand and integrate biotechnology and medical patent databases and Chinese herbal medicine databases.

1.2 Summary of Research and Results in FY2003:

1.2.1 Medicine and Health S&T Management Service Project (DOH): Formulation of a medical and health S&T strategy plan and implementation of an evaluation plan.

1.2.2 Program for Evaluation and Management of Technology Projects (IDB): Establishment of budgetary estimate deliberation procedures and a review system for assistance resources.

1.2.3 Industrial Revitalization Promotion Plan (IDB): Assistance for technology develop-

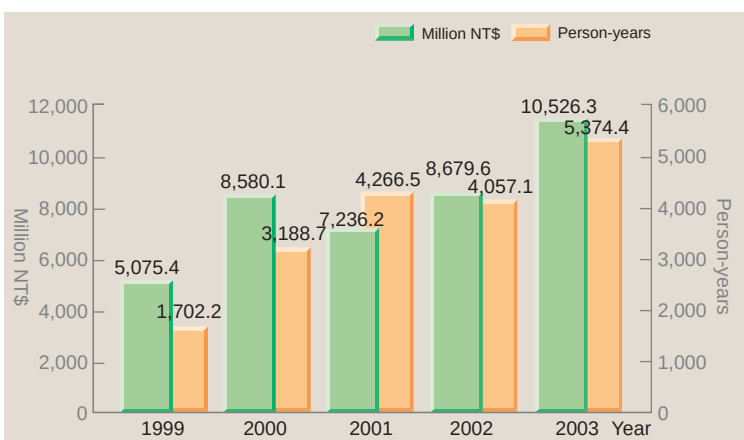


Figure III-28 Common Technology S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

ment in conventional industries, improvement of business management quality.

1.2.4 Industrial Innovation Capability Improvement Plan (IDB): The IDB is promoting the development of innovative design, industrial R&D cooperation, innovative consumer industries, a citizens' creativity movement, and technology transaction market mechanisms.

1.2.5 High-efficiency Industrial Park Development Management System Deployment Project (IDB): The IDB completed a review of industrial park development policies and performed development planning.

1.2.6 Small and Medium Enterprise Quality Management Upgrade Project (SMEA): Establishment of quality management systematization procedures meeting international standards.

1.2.7 Application of Knowledge Management for Small & Medium Enterprises (SMEA): Planning and deployment of a knowledge management utilization in sharing platform.

1.2.8 Policy Planning on e-Taiwan, Biodiversity, and Open Source Software (STAG): Taiwan had over 3.04 million broadband users as of the end of 2003. The government established the "Taiwan Biodiversity Information Network" and assisted companies to develop five new products based on open source software.

1.2.9 Expanded Recruiting of Overseas S&T Manpower Project (Industrial Development and Investment Center, MOEA): Companies were given assistance in recruiting 599 S&T personnel from overseas.

1.2.10 Project on Biotechnology Patent Protection (Intellectual Property Office, MOEA): Compilation of Chinese herbal medicine patent information and plant research data.

2. National Measurement Laboratory, PIDC, Institute of Occupational Safety and Health

2.1 R&D Focal Points:

Relevant efforts will include the development of calibration standards needed for health care, implementation of a calibration tracking system for radiotherapy, joint GPS observations employing multiple-frequency and multiple-channel receivers, development of labor safety technology and guidelines meeting international standards, and strengthening of industrial accident prevention.

2.2 Summary of Research and Results in FY2003:

2.2.1 Establishment of National Standards for Ionizing Radiation (Bureau of Standards, Metrology and Inspection (BSMI), MOEA): Development of primary standards for ^{60}Co water absorbent quantity.

2.2.2 Maintenance and Enhancement of National Time and Frequency Standards (BSMI): Research on the improvement and maintenance of time and frequency standards at the National Measurement Laboratory.

2.2.3 Labor Safety Research (CLA): Research on machinery safety, chemical safety, and construction safety.

2.2.4 Program for Disseminating Research Achievements on Occupational Safety and Health (CLA): Completion of a Chinese and English website for the Health and Safety Digital Museum.

3. Information and Services

3.1 R&D Focal Points:

Efforts in this area seek to stay abreast of industrial development information, help government to draft industrial technology development strategies, promote international technological cooperation to acquire advanced foreign technologies, and continue to produce research reports concerning industrial technology development policies.

3.2 Summary of Research and Results in FY2003:

3.2.1 Mid-term Framework Program for Common Technology (DOIT): The DOIT collected and analyzed industry and product market information for the three major areas of machinery/metals, electronics/computers, and chemical/sundry products.

3.2.2 National Information Services (NSC): Major undertakings included “high-performance computing service and extension research,” “research supporting S&T policy and establishment of a knowledge base,” “establishment of national database and integration service mechanisms,” “industrial research,” and “dissemination of results and extension,” etc.

Chapter 13 National Science and Technology Programs

The nine "National Science and Technology Programs" underway in FY2003 respectively addressed the topics of hazards mitigation, telecommunications, agricultural biotechnology, biotechnology and pharmaceuticals, genomic medicine, digital archives, chip systems, nanoscience and nanotechnology, and e-Learning. The following is an overview of projects in each area:

See Fig. III-29 for an overview of national science and technology program funding and manpower, FY1999~2003.

1. National Science and Technology Program for Hazards Mitigation

The National Science and Technology Program for Hazards Mitigation is currently in its second phase (FY2002~2006). In consideration of the practical needs of disaster relief work in Taiwan, the program places emphasis on "realization of applications" and "strengthening extension."

1.1 R&D Focal Points:

Focal points include the strengthened integration of disaster prevention and relief resources and promotion of R&D; establishment of operating mechanisms for research/relief organizations for disaster prevention, establishment and integration of disaster mitigation databases, strengthening of research on the control of manmade disasters, and investigation of the socioeconomic aspects of disaster prevention and relief.

1.2 Summary of Research and Results in FY2003:

1.2.1 Researchers established correlations between flood losses, frequency of flooding, flooding depth, land use zoning, and commercial use; this research was used to establish a model for assessing flood damage.

1.2.2 Hydrological and meteorological data

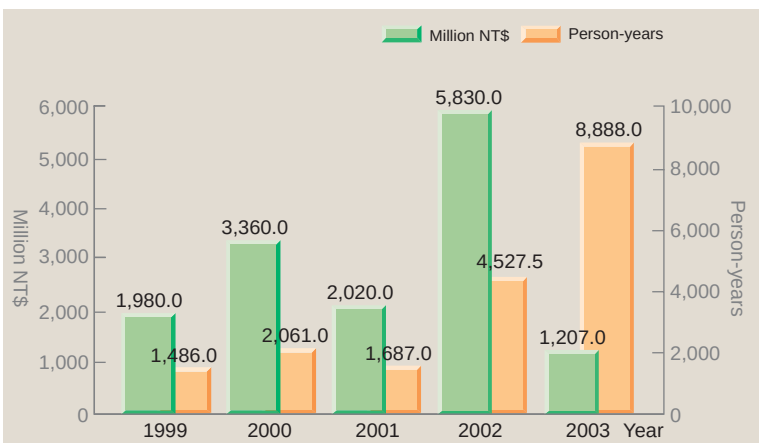


Figure III-29 National Science and Technology Program Funding and Manpower, FY1999~2003

Source: National science and technology program office statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

was used to derive correlations between real-time rainfall monitoring data and flooding hazard, and develop a flood prevention decision-making support core system.

1.2.3 Researchers produced sixteen maps (25,000 : 1 scale) of areas in central Taiwan affected by the 921 earthquake, including Taichung City and County, Changhua County, and Nantou County.

1.2.4 A research project investigated the mechanism of localized road embankment landslides and performed the qualitative assessment of landslide probability along existing roads.

1.2.5 Researchers developed a localized water level forecasting model integrating water level observations throughout Taiwan and numerical simulation results.

2. National Science and Technology Program for Telecommunications

Thanks to the level of participation on the part of government and industry, the first phase of this program has begun to yield tangible results. For instance, the annual output value of communications equipment in Taiwan grew by an average of 17% annually from 1999 to 2003.

2.1 R&D Focal Points:

Current wireless communications R&D is focused on mobile communications technology. In this area, the program looks forward to developing third-generation mobile communications (3G) cell phone technology and key components. In the area of broadband networks, the program will focus on urban broadband network technologies and develop Gigabit Ethernet and FTTx/PON technology. In the area of applications and services, the program seeks to develop extensive applications- and service-oriented telecommunications service systems technologies.

2.2 Summary of Research and Results in FY2003:

2.2.1 Wireless communications: Establishment of GPRS base station and core network systems, development of IP phone servers/gateway technology and improved IP phone technology.

2.2.2 Broadband Internet: Development of network gateway access technology, complete IP-based access gateways, and private virtual networks.

2.2.3 Efforts to promote communications industry investment and invigorate the industry environment included encouraging IPOs to make purchases in Taiwan.

2.2.4 Education and training undertakings included arrangement of advanced courses, extension of educational improvement results, and implementation of short-term courses and industry-academic technology cooperation.

2.2.5 Research was performed on 3G mobile communications and broadband Internet services.

3. National Science and Technology Program for Agricultural Biotechnology

In the genomic research program added to the National Science and Technology Program for Agricultural Biotechnology in May 2001, the COA is planning plant and animal genomic research projects, integrating government research resources and industry R&D capabilities, and

creating an effective nationwide plant and animal genomic research network.

3.1 R&D Focal Points:

The program office's coordinating function will include the formation of strategic alliances with projects under other national science and technology programs. Project control work includes the implementation of technology transfer mechanisms, attention of researchers' right to confidentiality, and encouragement of R&D personnel to quickly apply for IPR protection.

3.2 Summary of Research and Results in FY2003:

3.2.1 Production of transgenic hogs via the transplantation of nuclear material from somatic cells.

3.2.2 Development of a multifunctional bacterial culture method, rapid bacterial strain evaluation technique, and bacterial composting technology.

3.2.3 Transfer of the gene for the enzyme chitinase.

3.2.4 Research and development of template-repeated polymerase chain reaction (TR-PCR) technology.

3.2.5 Establish testing methods for GM ingredients of foods.

4. National Science and Technology Program for Biotechnology and Pharmaceuticals

The purpose of this program is to establish a comprehensive R&D system, integrate the drug R&D resources of various government agencies, recruit research manpower and promote active participation, foster up-, mid-, and down-stream cooperation and division of labor, and realize results as industrial applications.

4.1 R&D Focal Points:

This program will strive to shepherd leading compounds to the preclinical testing stage. Most of the program's research projects are currently still at the cell line screening stage, but it is expected that many will progress to *in vivo* testing. R&D of Chinese herbal medicines is proving difficult; the program is therefore encouraging implementation of advance clinical tests as a means of speeding up the R&D process.

4.2 Summary of Research and Results in FY2003:

4.2.1 Development of biochips capable of detecting liver cancer, lung cancer, and the hepatitis C virus.

4.2.2 Researchers received help to perform drug efficacy screening, record experiment results, and establish databases; more than 4,000 samples have been obtained.

4.2.3 A research project has isolated active compounds from the leaves of hybrid whiteback, *Vittaria anguste-elongata*, Taiwan yellow cypress and local feather coral.

4.2.4 More than 400 compounds possessing biological activity have been synthesized to date.

5. National Digital Archives Program

The primary goals of this program include the digitization of the nation's important artifacts and collections, the establishment of a national-level digital archives database, and the use of national digital archives to promote cultural, social, industrial, and economic development.

5.1 R&D Focal Points:

This program will develop an open-access national digital archives system and relevant technical standards, foster an open digital content market, and promote the quality and quantity of applications in education, academic research, commerce, industry, everyday life, and entertainment.

5.2 Summary of Research and Results in FY2003:

5.2.1 A total of 46TB of digital archive files have been produced to date, including animation, video, voice, and images.

5.2 2 The program uses resource identification codes as management tools, has developed missing character processing elements for webpages, and employs joint digital archive catalog platform technology.

5.2.3 The program will develop core technologies including database technology, multimedia processing technology, language processing technology, and core IPR and privacy management mechanisms.

6. National Research Program for Genomic Medicine

The National Research Program for Genomic Medicine is using proteomics and bioinformatics techniques developed by the information industry to understand gene functions and pathogenic mechanisms. To avoid problems farther in the future, the program is also performing in-depth research on the ethical, legal, and social implications of genomic S&T.

6.1 R&D Focal Points:

Research on the genome can help discover disease-causing genes, find methods of preventing, diagnosing, and treating illness, and understand the relationship between the environment and evolution. The program is focusing on the human genome to develop prevention, diagnosis, and treatment methods for diseases commonly seen in Taiwan.

6.2 Summary of Research and Results in FY2003:

6.2.1 Core facilities: The government has provided funding for the establishment of 18 core facilities performing genetic analysis and related research.

6.2.2 Research projects: A total of 104 individual projects and 13 integrated projects have passed review thus far.

6.2.3 DOH projects: The DOH has sponsored research projects on genes connected with lung cancer in Taiwan and clinical applications, and genomic studies of Chinese herbal medicines.

6.2.4 MOEA-sponsored technology development projects: A project working to establish a human liver protein profile derived a total 14,578 GI, including 3,730 unique GI.

7. Si-Soft National System-on-Chip Program

The government hopes that Taiwan's future industries will rely on design, innovation, and value for their competitive advantage. Efforts are therefore being made to foster the emerging intellectual property (IP), design, software, and systems industries.

7.1 R&D Focal Points:

This program will help Taiwan establish plentiful silicon IP and integrated electronic design automation software (EDA) over the next three to five years. The program hopes to harness the strengths of industry, government, academia, and the research community, and will emphasize both breadth and depth.

7.2 Summary of Research and Results in FY2003:

7.2.1 Human Resources: Students have attended advance in-school courses 3,359 person-times and others have attended manpower training 500 person-times.

7.2.2 Innovative Product Design Plan: Researchers completed 11 leading-edge product development project and six projects at domestic and foreign R&D centers.

7.2.3 Innovative Platform Development: Researchers completed two platform service projects and two IP gathering projects.

7.2.4 Innovative IP Development: Six leading-edge IP projects were completed.

7.2.5 Emerging Industry Technology Development Program: The IDB sponsored ten projects on pioneering new products.

8. National Science and Technology Program for Nanoscience and Nanotechnology

The National Science and Technology Program for Nanoscience and Nanotechnology seeks to bring together the strengths of industry, academia, and the research community for the sake of developing the nanotechnology platform technologies needed for academic excellence and industrial applications. At the same time, the program is also striving to accelerate the training of nanotechnology manpower and laying a sturdy foundation for nanotechnology research and development in Taiwan.

8.1 R&D Focal Points:

The "academic excellence" projects under this program will boost the country's innovation and drive in the field of nanoscience. For their part, the "Industrialization Nanotechnology Program" will establish the platform technologies needed for progress in nanotechnology, while strengthening knowledge useful in industrial applications. An international-class joint nanotechnology laboratory will be established to provide nanometer testing/process services via knowledge networks.

8.2 Summary of Research and Results in FY2003:

8.2.1 Academic Excellence Program: Technology was developed for the growth of multiple poly-crystalline carbon nanofibers using a single catalyst.

8.2.2 Industrialization Nanotechnology Program: An upper gate P- and N-type carbon nano-tubule field-effect transistor (CNT FET) process compatible with existing IC processes was developed.

8.2.3 Core Facilities Program: Five projects were approved, including the "Core Industrial Facilities" laboratory overhaul project.

8.2.4 Education Program: The "K-12 Nanotechnology Manpower Training Teacher Workshop" was held.

9. National Science and Technology Program for e-Learning

The goal of the National Science and Technology Program for e-Learning is to use government policy guidance to promote nationwide e-Learning, narrow the digital divide, and raise the country's overall competitiveness in the knowledge-based economy age.

9.1 R&D Focal Points:

The implementation of the "narrowing the digital divide" subproject will devise ways of closing the e-Learning gap. The leading indicators e-Learning technology R&D subproject will employ ITRI's industrial S&T, the medical sector's medicine and health care knowledge, and NCHC's grid computing R&D results to develop language e-Learning technology with cognitive and emulative functions.

9.2 Summary of Research and Results in FY2003:

9.2.1 National Science and Technology Program for e-Learning – Basic Research: Work includes the development of open source educational software, basic research, and e-Learning content research.

9.2.2 e-Learning Industry Promotion and Development Project: The "Network Science Park for e-Learning" formally began operations in August 2003.

9.2.3 Five-year e-Learning Technology Development Project: Developed platform technology for a mobile learning carrier.

9.2.4 Art and Culture e-Learning Development Project: Planned and established national-level e-Learning mechanisms for artistic and cultural information.

Chapter 14 Infrastructure Construction Projects

The main goal of the Infrastructure Construction S&T Project is to foster the development of multiple-application core laboratories, acquire testing and process facilities and equipment, and establish pilot plants. These facilities will provide the support needed for innovative, forward-looking projects to develop key technologies. They will enhance multiple engineering expertise in such fields as electronics, information, opto-electronics, materials, and chemical engineering, etc., while encouraging "interdisciplinary integrated" R&D projects.

Infrastructure construction S&T projects received NT$1.32 billion in funding and involved 584.9 person-years of labor in FY2003.

1. R&D Focal Points:

1.1 Communications and opto-electronics: The program will establish the R&D environment and key technologies needed for the development of the communications, video, opto-electronics, and electronics information industries.

1.2 Precision machinery and micro-electromechanical engineering: Major developmental goals includes energy-conserving and environmentally friendly green cutting technologies. This will include the development of high-speed metal processing machines driven by linear motors.

1.3 Materials and chemical engineering: The program will strive to develop many new technologies, including nanomaterials platforms.

1.4 Biotechnology and medicine: Establishment of genomic and biomedical information laboratories, development of gene expression chip design and analysis technologies.

1.5 Sustainable development: The program calls for the establishment of core technological platforms needed for clean industrial production.

2. Summary of DOIT Infrastructure Construction S&T Research Projects and Results in FY2003:

2.1 Communications and Opto-electronics Infrastructure Construction Project: Establishment of a flat panel display laboratory and development of low-temperature polysilicon/glass substrate TFT technology.

2.2 Precision Machinery and MEMS Area Infrastructure Construction Project: Development of advanced manufacturing technology, clean precision machinery, and nanometer machinery and technologies.

2.3 Materials and Chemical Engineering Infrastructure Construction Project: Development of nanotechnology powder technology, development of high-HTP chiral dopants.

2.4 Biotechnology and Medicine Infrastructure Construction Project: Establishment of genome

and biomedical information laboratories, development of a nucleic acid fragment microarray biochip mass production capability.

2.5 Sustainable Development Infrastructure Construction Project: Establishment of a clean production technology laboratory, development of clean production assessment standards for the wiping process.

Chapter 15 Other Fields

This chapter includes the two items of humanities and social sciences, and science education.

1. Humanities and Social Sciences

The ROC's OEM production model is now under severe pressure from rapidly industrializing developing nations. Responding to regional economic trends and the state of cooperation/competition across the Taiwan Straits, the government must formulate far-reaching goals and development strategies if the country is to achieve a new era of success.

See Fig. III-30 for an overview of humanities and social sciences project funding and manpower, FY1999~2003.

1.1 R&D Focal Points:

1.1.1 Promotion of accelerated industrial upgrading and transformation, reviving Taiwan's competitive advantage.

1.1.2 Formulation of future directions for domestic manufacturing industries, assessment of the impacts of manufacturing industries and possible influencing factors, and formulation or discovery of response strategies.

1.1.3 Assistance to corporations performing integration of global resources and assets; formulation of a superior industrial development environment favorable to R&D innovation.

1.2 The following is an overview of the content of the IDB's Project for Social Sciences and Philosophy and its results:

1.2.1 Building a knowledge-based economy, creating added value: The project is using observations and predictions concerning China and Taiwan and the global environment to steer companies' and government's plans and response strategies.

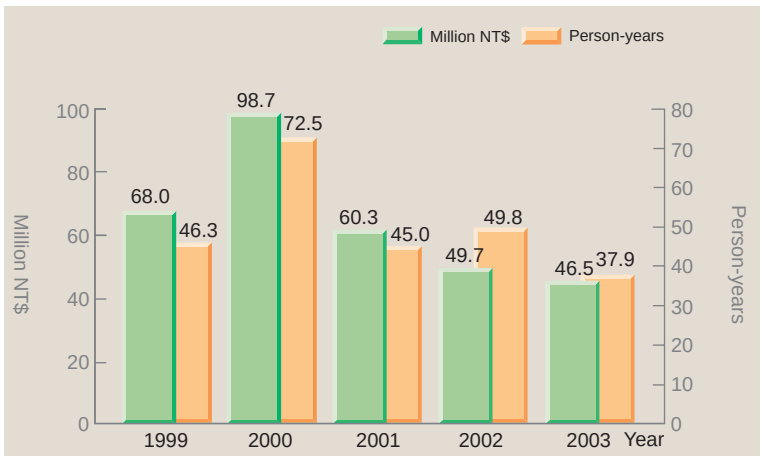


Figure III-30 Humanities and Social Sciences S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

1.2.2 Stimulating industrial revival, achieving government/private sector consensus: Panel discussions involving industry, government, academia, and the research community have been held to discuss the current situation and manufacturers' means of participation, while establishing communication channels between government and the private sector.

1.2.3 Supporting private R&D investment, boosting the country's R&D capability: The use of government money to fund commissioned research at private organizations has made policy formulation fairer, more objective, and more democratic.

2. Science Education

Science education projects focus on the training of manpower for strategic industries and improvement of the qualifications of S&T personnel; this research and implementation work emphasizes inter-departmental, inter-collegiate, inter-university, and international goal-oriented integrated teaching projects.

See Fig. III-31 for an overview of science education S&T project funding and manpower, FY1999~2003.

2.1 R&D Focal Points:

2.1.1 Training of personnel with practical industry experience; training of specialists in such areas as biotechnology laws and regulations, intellectual property rights, technology transfer, and investment assessment.

2.1.2 Integration of research and teaching resources, establishment of specialized electro-mechanical co-op education programs at universities.

2.1.3 Use of industry-academic strategic alliances to improve domestic aerospace S&T education; coordination of industry-academic co-op instruction.

2.1.4 Deepening of basic integrated training for manufacturing personnel.

2.1.5 Use of laws and regulations, administrative orders, and investment to promote green buildings, healthy materials, and energy-saving equipment throughout the educational system.

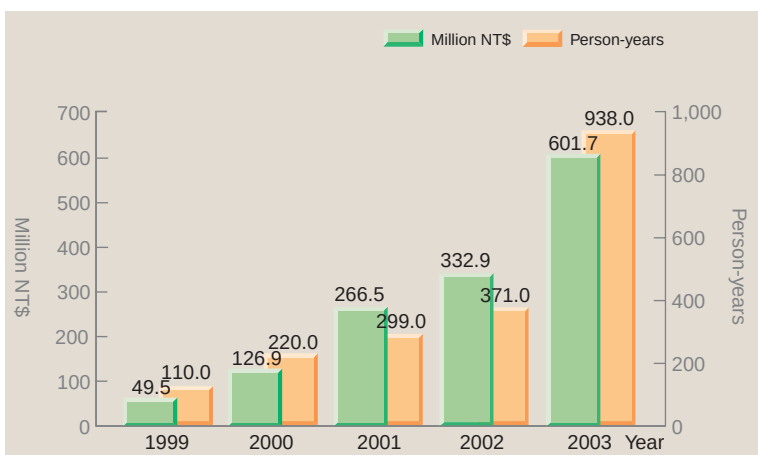


Figure III-31 Science Education S&T Project Funding and Manpower, FY1999~2003

Source: Government agency statistics
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

2.1.6 Continued addition of new interdisciplinary subjects and courses.

2.2 Summary of MOE S&T Projects and Results in FY2003:

2.2.1 Biotechnology Education Upgrading Program: Implemented via strategic alliances, this program seeks to improve interscholastic biotechnology instruction.

2.2.2 Education Reform Program on Precision Mechatronics Technology: This program seeks to establish relevant laboratories and courses; support has been given for the establishment of nine teaching resource centers, including a precision machine-tool resource center.

2.2.3 Aerospace Education Improvement Program: This program has promoted laboratory resource sharing, sharing of equipment between allied schools, and support for 28 specialized laboratories.

2.2.4 Integrated Manufacturing Education Improvement and Development Program: Twenty-seven programs were evaluated as class A, and another 27 evaluated as class B.

2.2.5 Fourth-Phase Plan to Enhance Education in the Humanities and Social Sciences: This program provides support for instruction in science, technology, and society (STS) and promotes design of integrated curricula addressing diverse cultural and contemporary issues; there have been a total of 12 inter-school cooperative projects under this program.

2.2.6 Plan for Creative Educational Development: 2004 Creativity Education Exposition and the issuance of the W*hite Paper on Creative Education – Establishing a Republic of Creativity for Taiwan* (English version).

2.2.7 Program to Strengthen School Environmental Education and Campus Environmental Management – MOE Environmental Protection Task Force: This program used computer technology to develop a nationwide implementation platform.

2.2.8 Science Education Improvement Program: Implementation of interdisciplinary instruction in basic science.

2.2.9 Program for Cultivating Information Technology Human Resources in Higher Education: Planning of embedded software courses, establishment of an embedded software promotion alliance.

Part IV
Supporting Measures for S&T Development

Part IV Supporting Measures for S&T Development

Apart from promoting academic and applied S&T research and development, the government has also fostered S&T development through such supporting measures as the educating, training, recruiting, and rewarding of S&T personnel; improvement of the research environment; technology transfer and diffusion; the establishment of an intellectual property rights system; and the encouragement of private sector research and development. All of these measures will play essential roles in the development of S&T.

Chapter 1 Educating, Training, Recruiting, and Rewarding of S&T Personnel

1. The government has adopted the following three approaches to the education and training of S&T talent: Education in colleges and universities, advanced studies in the ROC and overseas for personnel selected by government agencies, and training by vocational and professional training institutions. As for graduates of colleges and universities, a total of 1,265 persons received an S&T-related (natural sciences, engineering, medicine, agriculture) Ph.D. degree, 17,682 received an M.S. degree, 86,835 received a B.S. degree, and 65,309 received a technical associate degree during the 2002 academic year. See Table IV-1 for statistics concerning the numbers of S&T personnel sent by the government for further education and training in Taiwan and abroad, and the ROC's chief technical manpower training systems and their accomplishments in FY2003.
2. The government has adopted simultaneously long- and short-term approaches to the recruiting of S&T manpower. See Table IV-2 for a list of the various types of recruiting programs and their results, and Fig. IV-1 for statistics concerning the numbers of émigré personnel recruited to return to Taiwan.
3. The government offers a variety of grants and awards aimed at encouraging S&T personnel to engage in academic research, technology development, and invention. See Table IV-3 for an overview of the various grants and award measures, and their results, in FY2003.

Table IV-1 Government-sponsored Advanced Educating & Training for S&T Personnel, Manpower System and Results in FY2003

Institute	Item	Person-times
Ministry of Education	Government Scholarship for Overseas	108
Industrial Development Bureau	Human Resources in Industrial Technology	39,422
Department of Health	Medical Oncology Training Programs	4
(National Health Research	M.D./P.D. and D.D.S/Ph.D. Pre-doctoral Fellowship	5
Institutes)	Postdoctoral Fellowship Awards	4
	Medical, Surgical & Gynecological Oncology Training Programs	4
National Science Council	S&T Personnel Selected for Research and Advanced Study Locally and Abroad	182
	Postdoctoral Research Subsidies for Specific-topic Projects	10
Employment and Vocational	Vocational Training	762,000
Training Administration,	Skill Testing	238,839
Council of Labor Affairs		(Skill Certificates issued)

Source: Statistics from government agencies

Table IV-2 Government S&T Personnel Recruitment Systems and Results in FY2003

Institute	Item	Person-times
Academia Sinica	Recruitment of Post Doctoral Researchers, Overseas Consultants, Experts and Scholars	11
National Science Council	Recruiting S&T Personnel	101
	Recruiting Post-doctoral Research Personnel	884
	Recruitment of Research Scholars with Subsidies	20
	Inviting Important S&T Researchers from Mainland China for Short-term Visits	12
	Recruiting S&T Researchers from Mainland China for Research Works	100
	Funding of Trips to Mainland China for the Purpose of Short-term Scientific and Technological Research by Specialists and Scholars	120
	Specialists Visiting from Mainland China for S&T Activities	505

Source: Data from various government agencies

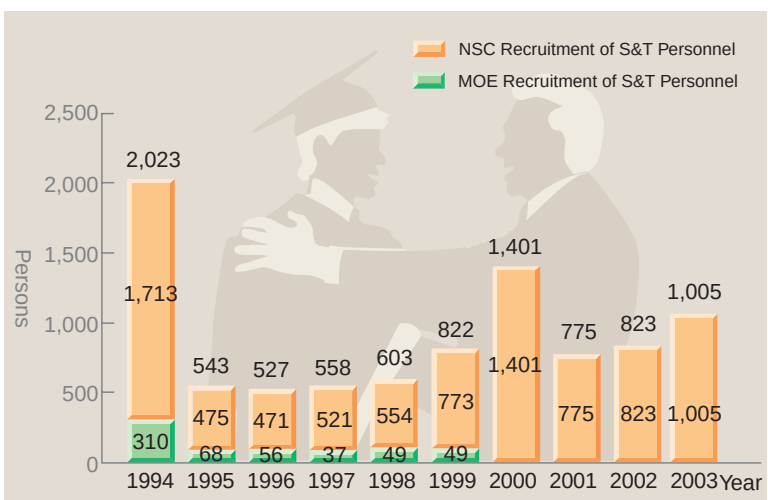


Figure IV-1 Number of Personnel Recruited by Ministry of Education and National Science Council, FY1994~2003

Source: NSC, MOE

Notes: 1. The MOE has ceased recruiting since FY2000.

2. FY2000 was during the period from July1, 1999 to Dec. 31, 2000.

Table IV-3 Government S&T Personnel Awards Systems and Results in FY2003

Institute	Item	Persons
Academia Sinica	Academia Sinica Award for Young Scholars	14
Executive Yuan	The Outstanding Scientific & Technological Worker Awards	9
Ministry of Education	Academy Award	9
	National Chair Award	10
National Science Council	Outstanding Research Award	98
	Ta-You Wu Memorial Award	25
Department of Health	Research Award	14
Atomic Energy Council	Atomic Energy Professional Medal	-
	Superior Contracted Research Projects Award	5
	Radioactive Materials Management Distinguished Performance Award	11
	Performance Award of Radiation Protection Inspection	6
	Research and Development Achievement Award	12
Presidential Science Steering Committee	Presidential Science Prize	3
Council of Agriculture	Superior Agricultural Personnel Award	8

Source: Data from various government agencies

Chapter 2 The S&T Research Environment

The government has established or is establishing the Hsinchu Science Park (HSP), Chunan Science Park, Tungluo Science Park, Hsinchu Biomedical Park, Lungtan Science Park, the Southern Taiwan Science Park (STSP), and Central Taiwan Science Park Administration. The establishment of northern, central, and southern Science Parks and their satellite sites will facilitate the diffusion of industrial technology throughout Taiwan, leading the ROC into the ranks of the technologically-advanced developed nations.

1. Science Parks

The HSP is home to the six major industries of integrated circuits, computers and peripherals, communications, opto-electronics, precision machinery, and biotechnology. A total of 369 firms were operating in the HSP as of 2003.

The HSP Administration provides annual "Grants for Innovative Technology R&D Projects" and " Innovative Product Awards" to encourage firms to engage in innovative R&D. "Accomplishment Awards" were first offered in 2003 to reward park firms for exceptional R&D achievements.

See Fig. IV-2 for an overview of the number of projects, total funding, and amount of grants and awards, 1994~2003.

Thirty-four more firms were approved to establish plants in the STSP in 2003, yielding a cumulative total of 127 firms. The STSP will give first priority to the development of integrated circuits, opto-electronics, and biotechnology industry clusters. In addition, the MOTC has announced that it will establish its telecommunications technology center at the Luchu site; this site plans to acquire more firms in the communications industry and become a center of the telecommunications industry.

The government implemented the "Central Taiwan Science Park Establishment Feasibility Study" in 2001 and selected a suitable main site for such a science park. The Executive Yuan subsequently approved the *Central Taiwan Science Park Administration Provisional Organizational Rules and Organizational Table* in March 2003.

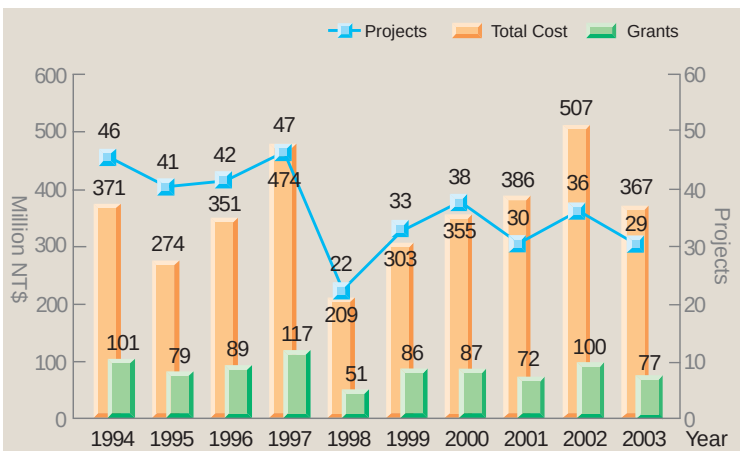


Figure IV-2 HSP Innovative R&D Grants, 1994~2003

Source: HSP Administration

The Central Taiwan Science Park had approved the admission of 34 firms and two incubation centers as of the end of December 2003. Approved investment totaled NT$426 billion at that time. This science park will focus its efforts on attracting firms in the opto-electronics, precision machinery, and nanotechnology industries.

2. Common Research Facilities

To ensure that the country's outstanding S&T research and development personnel enjoy a superior, stable working environment, the government provides a variety of common research facilities:

2.1 The Precision Instrument Development Center (PIDC) is implementing R&D projects intended to consolidate its core areas of nanotechnology, opto-electronics remote sensing technology, vacuum and thin film technology, and precision optics technology.

2.2 To augment and fully utilize costly scientific instruments at universities and colleges, and create an outstanding instrument use environment, the NSC is implementing the "Major Instrument Common Use Service Subsidy Program."

2.3 The National Nano Device Laboratories (NDL) has a mission of providing an advanced research environment for academic researchers and promoting forward-looking R&D on nanometer elements and materials technology.

2.4 The National Laboratory Animal Center (NLAC) provides high-quality experimental animals to domestic research organizations and is improving experimental animal research standards.

2.5 The National Center for Research on Earthquake Engineering (NCREE) is engaged in basic and applied research in seismic engineering. NCREE uses theory and experiment to resolve domestic seismic engineering problems, integrates domestic academic resources, and develops new seismic engineering technologies.

2.6 The National Center for High-performance Computing (NCHC) is the sole open-access, national-level high-performance computing and network center in Taiwan. It is engaged in relevant high-performance computing and network R&D, applications development, and promotion work.

2.7 The National Synchrotron Radiation Research Center (NSRRC) is an advanced synchrotron radiation facility with a state-of-the-art research environment.

2.8 The National Space Program Office (NSPO) is in charge of "Long-term planning of the ROC space technology development," including satellite projects, academic research, and industrial development.

2.9 The National Chip Implementation Center (CIC) was established for the purpose of upgrading domestic chip design standards and training practical chip design manpower. Services are provided to universities and colleges, industry, and research organizations.

2.10 The National Measurement Laboratory (NML) is the country's highest calibration laboratory. It is responsible for establishing and maintaining the highest national standards of weights and measures, and provides calibration services to industry.

2.11 An architectural experiment facility is being established for the purpose of architectural research, particularly localized research addressing architectural laws and regulations and performance standards.

3. Science and Technology Information

The Executive Yuan lists the "e-Taiwan Construction Plan" as one of ten major undertakings in the "Challenge 2008 – National Development Plan." The goals of the e-Taiwan Construction Plan are broadband access for six million subscribers, e-Society, e-Government, e-Traffic system, and e-Commerce.

Apart from the Science and Technology Information Center (STIC), government agencies such as the MOEA, MOI, and DOH are also compiling S&T databases. In addition, research institutions and non-profit organizations such as the Academia Sinica, Chung Hua Institution for Economic Research, Taiwan Institute of Economic Research, ITRI, the Food Industry Research and Development Center, the Institute for Information Industry, and China External Trade Development Council, are also engaged in processing domestic S&T data. Databases are generally dispersed at present, but the country is moving in the direction of an integrated information supply system.

The nation's leading Internet backbone systems include the MOE's Taiwan Academic Network (TANet), the Chunghwa Telecom Data Communication Subsidiary's HiNet, and the Digital United Inc.'s SEEDNet. These three systems are linked to each other to form Taiwan's Internet backbone. In addition, the National Center for High-performance Computing provides high-speed computing equipment and high-speed network backbone equipment; with a bandwidth of 20Gb/s, this system constitutes Taiwan's main research network backbone.

4. Measures Encouraging Private Research and Development

Since 2001 the MOEA has implemented such measures as the "Preliminary R&D Federation Program," "R&D on Service Industry," "Incentives for Domestic Corporations Wishing to Establish R&D Centers in Taiwan," and "Incentives for Foreign Corporations Wishing to Establish R&D Centers in Taiwan." These measures have helped domestic industries respond to global competition by shifting from an investment orientation to an innovation orientation, while establishing a diversified R&D capability.

After drafting the *Incentive Schemes for Enterprises to Develop Industrial Technologies* in 1999, the MOEA implemented the "Industrial Technology Development Program," "Small Business Innovation Research," and "IT Application Promotion Project"; see Fig. IV-3 for the funding of

these three projects. See Table IV-4 for statistics concerning pioneering product development projects, including numbers of approved projects in different industries and their funding.

Industry-university Cooperative Research Projects are carried out by academic research organizations with joint funding from the NSC and the corporate sector. The ultimate goal of these projects is to patent new products and technologies and perform technology transfer.

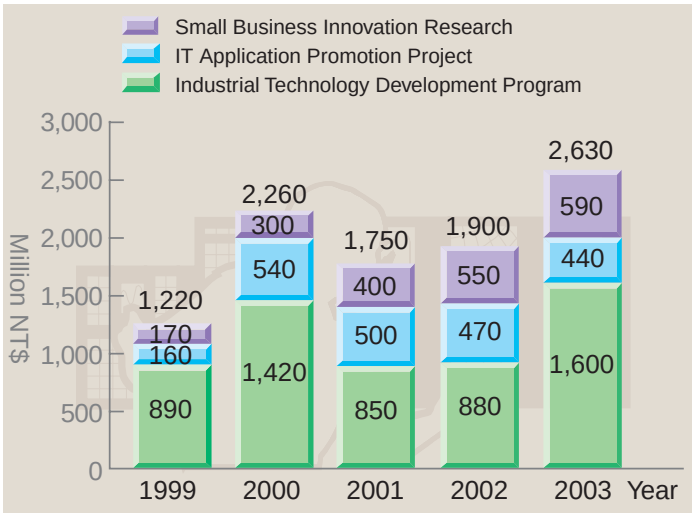


Figure IV-3 MOEA Funding of Industrial TDP Projects, FY1999~2003

Source: MOEA

Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

Table IV-4 The Regulation Governing Assistance in the Development of Leading New Products Program by Total Budget, FY1999~2003

Unit: Million NT$

Industry	1999		2000		2001		2002		2003		Total	
	Project	Funding	Project	Funding	Project	Funding	Project	Funding	Project	Funding	Project	Funding
Information Technology	9	1,114.3	8	772.3	8	577.8	6	317.1	9	343.3	40	3,124.8
Communications	14	1,743.5	13	1,358.5	9	1,035.6	6	1,205.7	9	961.7	51	6,305.0
Consumer Electronics	8	876.7	8	1,092.5	7	957.4	15	1,637.3	9	297.9	47	4,861.7
Aerospace	2	300.0	1	57.0	2	1,481.1	0	0	0	0	5	1,838.2
Medical Health Care			1	65.0	3	199.4	2	106.4	6	248.3	12	619.1
Pollution Prevention							1	61.1	0	0	1	61.1
Advanced Material	5	541.5	7	595.9	8	874.8	5	509.7	1	70.0	26	2,591.8
Semi-conductors	3	217.0	2	450.8	3	306.9	2	117.1	7	256.2	17	1,348.0
Specialty Chemical	7	807.6	6	494.3	8	621.5	6	501.1	4	100.6	31	2,525.3
Pharmaceutical Production	6	460.5	3	180.8	4	340.9	2	183.4	13	88.6	28	1,254.2
Precision Instruments and Automation	12	727.2	19	1,611.8	7	677.4	9	1,409.4	2	474.5	49	4,900.4
Total	66	6,788.3	68	6,678.9	59	7,072.8	54	6,048.3	60	2,841.3	307	29,429.6

Source: Industrial Development Bureau, MOEA

Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

Chapter 3 Technology Diffusion, Intellectual Property Rights, and Standards

1. Technology Transfer and Diffusion

There were 130 MOEA's Technology Development Programs, 1,725 patent applications, 801 approved patents, 5,158 research reports, 2,502 academic papers, 51 technology acquisition cases, and 644 investment promotion cases in 2003. These results indicate that the government's efforts to encourage the private sector to perform applied R&D have induced an increasing amount of R&D on the part of businesses. See Table IV-5 for the results of MOEA technology transfers, FY1999~2003.

In addition, the NSC is also promoting technology extension, including technology transfer and copyright authorization cases, and is activity encouraging industry-academic cooperative projects, in an effort to accelerate the diffusion of technology to the private sector. See Table IV-6 for the results of NSC technology transfer cases, FY1999~ 2003.

2. Intellectual Property Rights

The Intellectual Property Office, MOEA, is responsible for the registration, management, and protection of patents, trademarks, copyrights, and business secrets. It is continuing to adopt improved review systems and simplified operating procedures in an effort to strengthen the protection of intellectual property rights. See Table IV-7 for patent application and approval statistics, 1999~2003.

There were 28,483 trademark change, transfer, authorization, and mortgage cases; 2,368 trademark objection, judgment, and revocation cases; 63,150 trademark registration application cases; and 21,051 trademark registration extension cases in 2003.

3. Standards and Measures

Standards and measures are part of the infrastructure needed for the country's economic and social development. Responding to international development trends and domestic needs, the government has continued to review, draft, and revise laws and regulations governing standards and measures at appropriate times. This work includes the adjustment of national standards and recognition of the CNS Mark Quality Management system in accordance with WTO/TBT Protocol and APEC/SCSC requirements. See Table IV-8 for metrology project funding statistics, FY1999~2003.

Table IV-5 MOEA Technology Transfer Results, FY1999~2003

Year	Item	University-Industry-Research cooperation	Transfer of results	Results of technology transfer
2003	Communications and opto-electronics	76	100	176
	Machinery and aerospace	230	77	307
	Materials and chemical engineering	313	176	489
	Biotech and pharmaceuticals	30	19	49
	Common area	29	27	56
2002	Communications and opto-electronics	54	99	153
	Machinery and aerospace	177	65	242
	Materials and chemical engineering	174	74	248
	Biotech and pharmaceuticals	33	20	53
	Common area	75	8	83
2001	Communications and opto-electronics	49	70	119
	Machinery and aerospace	158	48	206
	Materials and chemical engineering	173	60	233
	Biotech and pharmaceuticals	35	7	42
	Common area	13	11	24
2000	Communications and opto-electronics	80	62	142
	Machinery and aerospace	252	66	318
	Materials and chemical engineering	296	55	351
	Biotech and pharmaceuticals	76	18	94
	Common area	18	1	19
1999	Communications and opto-electronics	117	65	182
	Machinery and aerospace	216	51	267
	Materials and chemical engineering	258	44	302
	Biotech and pharmaceuticals	58	11	69
	Common area	4	0	4

Source: MOEA

Table IV-6 Completed NSC Technology Transfer Cases, FY1999~2003

Item	FY1999	FY2000	FY2001	FY2002	FY2003
Technology transfers (cases)	25	44	40	45	90
Early-stage technology transfer (cases)	0	0	0	447	843
Royalties (NT$1 million)	15.6	32.5	49.9	54.3	122.0
NSC Income (NT$1 million)	5.3	11.3	11.8	11.4	21.4

Source: NSC
Note: FY2000 was during the period from July 1, 1999 to Dec. 31,2000.

Table IV-7 Patents Application and Approval Statistics, 1999~2003

Item	1999		2000		2001		2002		2003	
	Applied	Granted	Applied	Granted	Applied	Granted	Applied	Granted	Applied	Granted
Invention	22,161	11,280	28,451	17,503	33,392	21,966	31,616	23,769	35,734	25,294
New Utility Model	21,481	14,298	23,728	18,067	25,370	18,218	21,750	16,407	21,832	22,195
New Design	8,279	3,566	9,052	6,671	9,098	7,537	8,036	5,845	7,946	6,176
Total	51,921	29,144	61,231	42,241	67,860	47,721	61,402	46,021	65,512	53,665

Source: MOEA

Table IV-8 Metrology Project Funding, FY1999~2003

Unit: Million NT$

Project name	FY1999	FY2000	FY2001	FY2002	FY2003
Governing Weights and Measures and Verification Conducted by Designated Organizations	124	177	137	135	158

Source: Bureau of Standards, Metrology and Inspection, MOEA
Note: FY2000 was during the period from July 1, 1999 to Dec. 31, 2000.

Chapter 4 International S&T Cooperation

The ROC engages in academic and technological interchange mainly through bilateral S&T cooperation agreements or through the items of cooperation drafted at economic or technological cooperation conferences. Interchange activities include reciprocal exchanges of S&T personnel, the holding of bilateral conferences, joint research projects, and S&T information sharing activities.

The following are among the main results of international cooperation in FY2003:

1. The Academia Sinica signed an academic cooperation agreement with Harvard University and established an ROC committee of the International Council of Scientific Unions (ICSU) to bear responsibility for liaison between domestic academic associations, including the Academia Sinica, and international scientific organizations.
2. The MOI participated in the "Collaborative Program to Advance Structural Fire Resistance" at the invitation of the International Council for Research and Innovation in Building and Construction's Fire Resistance Commission (CIB W14).
3. The MOE supported the activities of international cultural and educational organizations and sponsored academic cooperation between domestic and foreign universities and colleges.
4. The Institute of Transportation, MOTC, became a member of the US Transportation Research Bureau (TRB) and US Intelligent Transportation System Association (ITS America).
5. The DOH and the National Health Research Institutes have conducted various international academic activities, and have funded international academic seminars held by domestic medical centers, medical associations, and non-profit organizations.
6. The AEC is in regular contact with the United Nations' International Atomic Energy Agency (IAEA) regarding nuclear safeguards, and also participates in the international cooperation activities of the Organisation for Economic Co-operation and Development (OECD) Nuclear Energy Agency (NEA). The AEC also maintains friendly ties with nuclear energy agencies and organizations in 19 countries, including the US, France, Germany, and Japan.
7. The NSC continues to implement bilateral international technology cooperation, and is forging increasingly strong ties with the US, Canada, France, Britain, Germany, the Netherlands, Denmark, and the nations of Eastern Europe. The NSC also participates in the relevant activities of APEC, the EU, and various major international S&T organizations.
8. The COA is promoting the sharing of agricultural technology and acquisition of key technologies in connection with the US, Canada, Japan, Germany, France, Australia, and the Netherlands.
9. See Table IV-9 regarding the MOEA's acquisition of foreign technology.

Table IV-9 MOEA Acquisition of Foreign Technology in FY2003

Project Name	Technology source
International Technology Interchange and Technology Cooperation Project	US, Japan, Korea, Europe, USSR
Third-generation Wireless Communications System Software Technology Acquisition Project	US, India
Establishment of SD Verification Lab. Technology Development Program	Japan
Collaborative Research Project on Information Security Technology between ITRI and Carnegie Mellon University	US
Collaborative Research Project between CCL, ITRI and Massachusetts Institute of Technology	US
Advanced Technologies in Optical Metro/Access Network Platform	US
Project to Assist the Acquisition of Japanese Technology by SMEs	Japan
International Biotechnology Discovery and Acquisition Project	US, Britain, etc.
Supercritical Carbon Dioxide Washing Equipment Acquisition Project	Austria
New Drug Development Technology Acquisition Project	US
Project to Promote Value-added Innovation Services	US

Source: MOEA

APPENDICES

Figure Appendix

Special Reports

Figure A-1 Breakdown of Funding for SARS Research Projects by Area in FY2003 2
Figure B-1 Broadband User Targets for the Broadband Access Project, 2001~2007 10

Part I S&T Policies and Development Performance

Figure I-1 Organizational Framework for S&T Development in the ROC 14
Figure I-2 Schematic View of the Division of Labor between Executing and Implementing Organizations 16
Figure I-3 S&T Project Planning and Assessment System 17
Figure I-4 Annual S&T Project Review and Control Framework 18
Figure I-5 Development of the ROC's S&T Framework and Evolution of Policies 19
Figure I-6 Schematic Diagram for the Timetable of "National Science and Technology Development Programs" and the *White Paper on Science and Technology* 30
Figure I-7 Distribution of Government S&T Research Activities Funding in FY2003 by Agency 32
Figure I-8 Distribution of Government S&T Research Activities Funding by Type of Research, FY2001~2003 32
Figure I-9 Government S&T Research Activities Manpower by Type of Research, FY2001~2003 33
Figure I-10 Manpower of Government Agency S&T Research Activities Projects in FY2003 by Agency 33
Figure I-11 Number of ROC Papers Cited in *SCI* 34
Figure I-12 Number of ROC Papers Cited in *EI* 34

Part II Academic Research

Figure II-1 Funding Provided by the NSC and Academia Sinica for Research Projects in Various Areas, FY1999~2003 37
Figure II-2 Number of NSC- and Academia Sinica-funded Research Projects in Various Areas, FY1999~2003 38
Figure II-3 Manpower of NSC- and Academia Sinica-funded Research Projects by Area of Research, FY1999~2003 38
Figure II-4 Number of Full-time University Professors in Natural Sciences, Engineering, Medicine, Agriculture, Humanities and Social Sciences, 1999~2003 38
Figure II-5 Number of Full-time University Associate Professors in Natural Sciences, Engineering, Medicine, Agriculture, Humanities and Social Sciences, 1999~2003 ... 38

Part III S&T Domain Projects

Figure III-1 Information S&T Project Funding and Manpower, FY1999~2003 54
Figure III-2 Telecommunications S&T Project Funding and Manpower, FY2000~2003 55
Figure III-3 Electronics S&T Project Funding and Manpower, FY1999~2003 56
Figure III-4 Opto-electronics S&T Project Funding and Manpower, FY1999~2003 57
Figure III-5 Machinery S&T Project Funding and Manpower, FY1999~2003 58
Figure III-6 Aerospace S&T Project Funding and Manpower, FY1999~2003 59
Figure III-7 Automation S&T Project Funding and Manpower, FY1999~2003 60
Figure III-8 Materials S&T Project Funding and Manpower, FY1999~2003 62
Figure III-9 Chemical Engineering S&T Project Funding and Manpower, FY1999~2003 63
Figure III-10 Textile S&T Project Funding and Manpower, FY1999~2003 64
Figure III-11 Pharmaceutical S&T Project Funding and Manpower, FY1999~2003 65
Figure III-12 Biotechnology S&T Project Funding and Manpower, FY1999~2003 67
Figure III-13 Medical and Health S&T Project Funding and Manpower, FY1999~2003 69
Figure III-14 Agriculture S&T Project Funding and Manpower, FY1999~2003 71
Figure III-15 Forestry S&T Project Funding and Manpower, FY1999~2003 72
Figure III-16 Fisheries S&T Project Funding and Manpower, FY1999~2003 73
Figure III-17 Animal Husbandry S&T Project Funding and Manpower, FY1999~2003 74
Figure III-18 Food Science S&T Project Funding and Manpower, FY1999~2003 75
Figure III-19 Meteorology S&T Project Funding and Manpower, FY1999~2003 76
Figure III-20 Geology S&T Project Funding and Manpower, FY1999~2003 77
Figure III-21 Ocean Science S&T Project Funding and Manpower, FY1999~2003 78
Figure III-22 Atomic Energy S&T Project Funding and Manpower, FY1999~2003 79
Figure III-23 Energy S&T Project Funding and Manpower, FY1999~2003 80
Figure III-24 Resources S&T Project Funding and Manpower, FY1999~2003 81
Figure III-25 Environmental Protection S&T Project Funding and Manpower, FY1999~2003 82
Figure III-26 Construction and Civil Engineering S&T Project Funding and Manpower, FY1999~2003 84
Figure III-27 Transportation S&T Project Funding and Manpower, FY1999~2003 85
Figure III-28 Common Technology S&T Project Funding and Manpower, FY1999~2003 89
Figure III-29 National Science and Technology Program Funding and Manpower, FY1999~2003 92
Figure III-30 Humanities and Social Sciences S&T Project Funding and Manpower, FY1999~2003 100
Figure III-31 Science Education S&T Project Funding and Manpower, FY1999~2003 101

Part IV Supporting Measures for S&T Development

Figure IV-1 Number of Personnel Recruited by Ministry of Education and National Science Council, FY1994~2003 104
Figure IV-2 HSP Innovative R&D Grants, 1994~2003 106
Figure IV-3 MOEA Funding of Industrial TDP Projects, FY1999~2003 109

Table Appendix

Special Reports

Table B-1 Information Policy Focal Points in Several Leading Nations 8
Table B-2 Annual Subproject Targets, 2002~2007 9

Part I S&T Policies and Development Performance

Table I-1 National Science and Technology Program Periods, Total Funding, and Participating Agencies 24
Table I-2 Sci-Tech Spending Plan for Government Agencies, 2003~2006 30
Table I-3 S&T Research Activities Funding by Agency, FY1999~2003 31
Table I-4 US Patents Granted and Rank 35

Part II Academic Research

Table II-1 Number, Manpower, and Funding of Academia Sinica- and NSC-sponsored Natural Science Research Projects in FY2003 39
Table II-2 Number, Manpower, and Funding of Academia Sinica- and NSC-sponsored Engineering Research Projects in FY2003 41
Table II-3 Number, Manpower, and Funding of Academia Sinica- and NSC-sponsored Medical Research Projects in FY2003 45
Table II-4 Number, Manpower, and Funding of Academia Sinica- and NSC-sponsored Agricultural Research Projects in FY2003 47
Table II-5 Number, Manpower, and Funding of Academia Sinica- and NSC-sponsored Humanities and Social Sciences Research Projects in FY2003 49
Table II-6 Number, Manpower, and Funding of NSC-sponsored Science Education Research Projects in FY2003 51

Part III S&T Domain Projects

Table III-1 Government S&T Development Project Fields in FY2003 53

Part IV Supporting Measures for S&T Development

Table IV-1 Government-sponsored Advanced Educating & Training for S&T Personnel, Manpower Systems and Results in FY2003 104
Table IV-2 Government S&T Personnel Recruitment Systems and Results in FY2003 104
Table IV-3 Government S&T Personnel Awards Systems and Results in FY2003 105
Table IV-4 The Regulation Governing Assistance in the Development of Leading New Products Program by Total Budget, FY1999~2003 109
Table IV-5 MOEA Technology Transfer Results, FY1999~2003 111
Table IV-6 Completed NSC Technology Transfer Cases, FY1999~2003 111

Table IV-7 Patents Application and Granted Statistics, 1999~2003 111
Table IV-8 Metrology Project Funding, 1999~2003 112
Table IV-9 MOEA Acquisition of Foreign Technology in FY2003 114

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