國家實驗研究院
National Applied Research Laboratories

NARL Annual Report 2005

Contents

Message from the Chairman

I have served as the Managing Director of NARL since the first day of NARL's establishment in 2003. I am quite familiar with the functions and operations of NARL. In the year of 2005, I am highly impressed by the NARL's performances and achievements under the leadership of Chairman Cheng-I Weng and President Lou-Chuang Lee. I would like to take this opportunity to express my sincere appreciation to them for their dedication and hard work leading NARL to become one of the leading national laboratories in the world.

One of the major missions of NARL is to provide high-quality services to the Taiwan academic community in support of their researches by establishing R&D platforms and fostering the high-tech manpower. In 2005, NARL has grown to an institute comprising of nine national laboratories encompassing various technical fields which the nation focuses its attention. How to integrate the existing capacities and optimize the effectiveness of resources has become the most crucial tasks to be pursued by NARL in recent years. Therefore, we will strive to continuously improve the management system, which would lead NARL to a working environment with common vision and prominent motivation. We will also encourage synergy of the resources including budget, personnel, facility, and expertise, so that NARL can really evolve into a competitive research institute.

I have spent more than forty years of my professional career in the US. I am pleased to come back to my homeland, Taiwan, where I grew up and dedicated to. I am proud of the high-tech achievements of Taiwan and I believe Taiwan can contribute more to the global society via its successful experience in the technology development. Indeed, NARL is a very good starting place for me to share and learn our viewpoint and experience.

Chairman, NARL

Message from the President

I would like to take this opportunity to extend our appreciation to Dr. Cheng-I Weng and Dr. Lou-Chung Lee, former NARL's Chairman and President respectively, for their leadership and contribution to NARL since its establishment in June 2003. In the meantime, we also warmly welcome Dr. Robert Lai, the Chairman of NARL, and all the new members of Board of Directors and Supervisors on board NARL in April, 2006. I believe NARL will be more vital and motivating toward the challenges of the new era under the new management team.

In January 2005, Instrument Technology Research Center (ITRC, former Precision Instrument Development Center) and Science & Technology Policy Research and Information Center (STPI, former Science and Technology Information Center) have been moved to NARL from National Science Council (NSC). With addition of ITRC and STPI, NARL has become an institute consisting of nine national laboratories. We expect ITRC and STPI to enhance their interaction and cooperation with other laboratories through the NARL's platform.

To elevate NARL to a world-recognized national laboratory, NARL has proposed two core research topics, "environment and disaster reduction" and "frontier technology innovation", to demonstrate the most competitive and potential research competences of NARL. In 2005, their implementation plans were initiated by consolidating the diversity of NARL's frontier technologies for innovative researches and establishing an integrated platform for environment and disaster reduction applications. These two core research areas are expected to stimulate the research dynamics of NARL and demonstrate its synergic capabilities throughout the implementation of these projects.

To provide R&D platform and support academic research are the most important missions of NARL. Therefore, one of the crucial efforts in 2005 was to encourage affiliated centers to certify their laboratories with national or even international lab's standards. During the year of 2005, many centers, including National Space Organization, National Center for High-Performance Computing, National Laboratory Animal Center and S&T Policy and information Center, have been awarded by ISO certifications or professional standards. NARL will keep up these efforts as the commitment of providing high-quality services to the academic community.

Finally, I would like to express my extent appreciation to all the NARL's colleagues for your hard work and dedication. Without your contributions, NARL would not be possible to evolve smoothly from a governmental organization into a non-profit organization within such a short period. My appreciation also extends to our users who have given us guidance and advice. NARL will continue to work closely with you to become a leading R&D institute in science and technology arena.

President, NARL

Organization

Board of Directors & Supervisors

Chairman	Robert Lai
Managing Director	Chien-Jen Chen, Lou-Chuang Lee, Shyi-Ming Lin, Ching-Jyh Shieh
Director	Chenming Calvin Hu, Cheng-Yan Kao, Hsiang-Tsung Kung, Chao-Shiuan Liu, Ferng-Ching Lin, Michael M.C. Lai, Wen-Hsiung Li, Shie-Ming Peng, Che-Ho Wei, Maw-Kuen Wu, Chau-Shioung Yen
Executive Supervisor	Guo-Chung Chi
Supervisor	Shaw-Liang Cheng, Wen-Ji Hwang, John Yu

Headquarters

President's Office	Acting President Cheng-Hong Chen
Planning & Evaluation Division	Director Nan-Hung Ting
Business Development Division	Director Guey-Shin Chang
Administration Division	Director Chii-Wen Hung
Accounting & Finance Division	Director Ching-Ping Lu

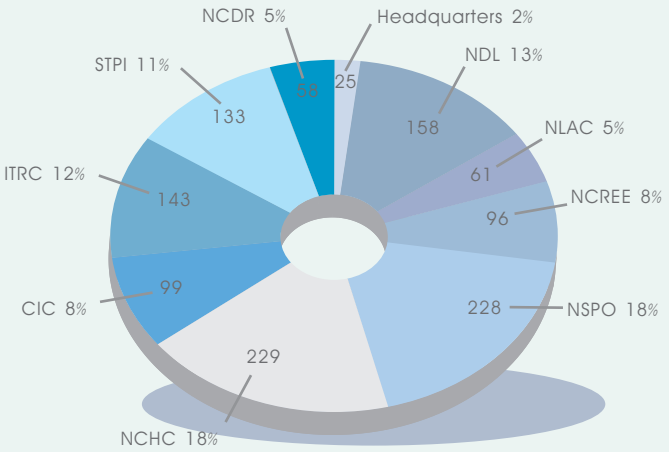
Laboratories

National Nano Device Laboratories (NDL)	Director General Wei-Xin Ni
National Laboratory Animal center (NLAC)	Director General San-Chi Liang
National Center for Research on Earthquake Engineering (NCREE)	Director General Keh-Chyuan Tsai
National Space Organization (NSPO)	Director General Lance Wu
National Center for High-performance Computing (NCHC)	Director General Joe Juang
National Chip Implementation Center (CIC)	Director General Ging-Yang Jou
Instrument Technology Research Center (ITRC)	Director General Chien-Jen Chen
Science & Technology Policy Research and Information Center (STPI)	Director General Chia-Yin Tsai
National Science and Technology Center for Disaster Reduction (NCDR)	Director General Liang-Chun Chen

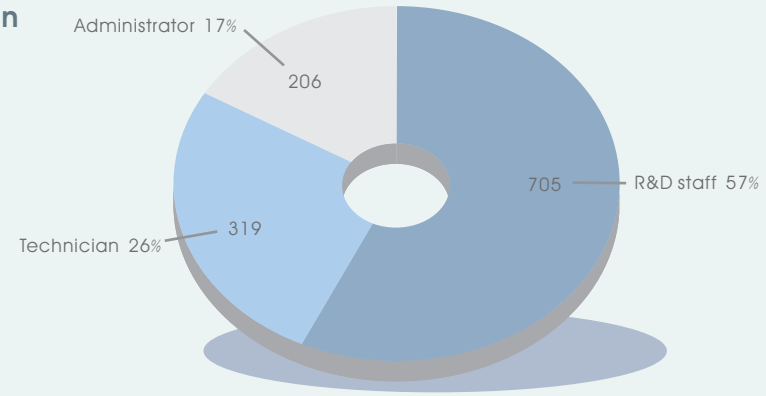
Human Resources

Number of Employees:1230

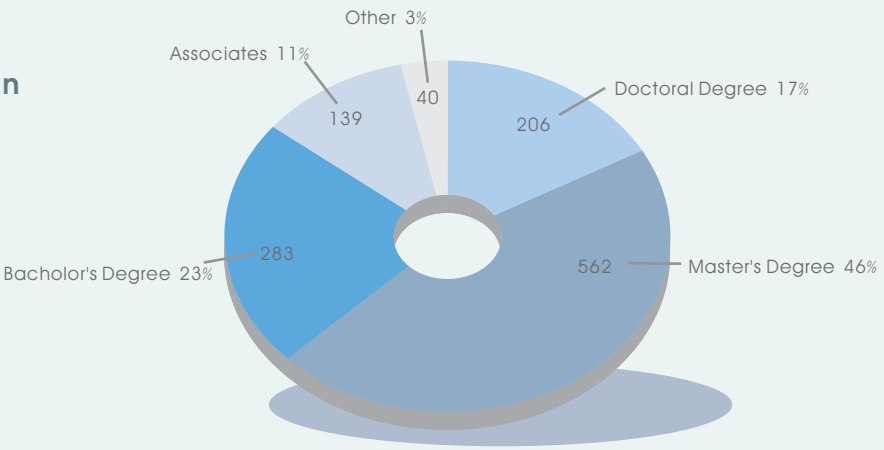
Laboratories



Human Resource Allocation



Education Qualification

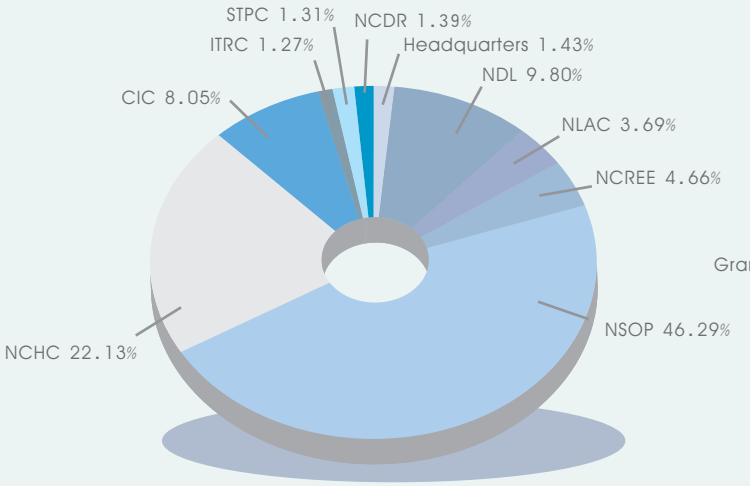


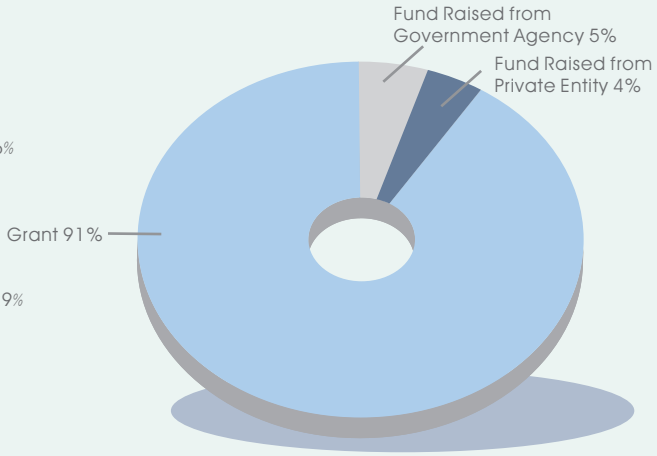
Financial Information

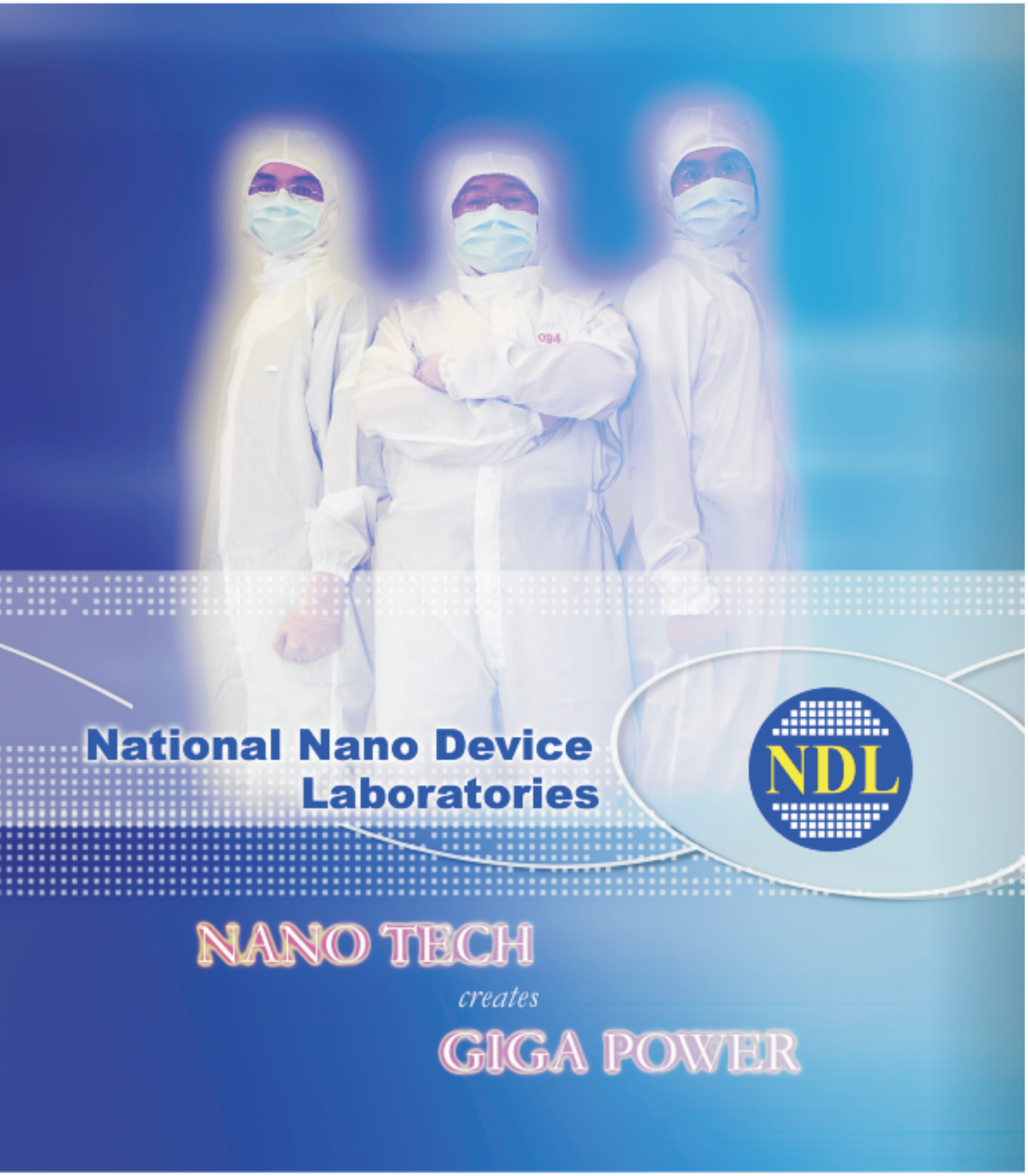
Revenues (FY2005)

Laboratories	($M USD)
Headquarters	2
National Nano Device Laboratories (NDL)	15
National Laboratory Animal center (NLAC)	6
National Center for Research on Earthquake Engineering (NCREE)	7
National Space Organization (NSPO)	70
National Center for High-performance Computing (NCHC)	33
National Chip Implementation Center (CIC)	12
Instrument Technology Research Center (ITRC)	2
Science & Technology Policy Research and Information Center (STPI)	2
National Science and Technology Center for Disaster Reduction (NCDR)	2
Total	151

Rate: $1USD=$33NTD






National Nano Device
Laboratories
NDL
NANO TECH
creates
GIGA POWER

Chronicle

The National Nano Device Laboratories (NDL) was approved by the Executive Yuan to be founded in the name of "National Submicronmeter Device Laboratories" in 1988 and started running in August, 1992.

The goal of NDL is to provide international-level research infrastructure to the academic community in Taiwan and expect to combine the scholars and experts in microelectronic and nanoelectronic field together for research and development in advance semiconductor process technologies and domestic microelectronics, and strengthening the Taiwan's competitiveness in integrated circuit industry. Through the way of open Labs to researchers and graduate students from universities and the way of centralizing resources to maintain and manage the operation of clean rooms, and facilities, NDL led to the advance semiconductor process training and make contributions in well-trained workforce both in quality and quantity that are demanded in semiconductor high-tech industry of Taiwan over the past decade more. Its yearly courses has amounted to more than 5,000 trainees, and more than 1,000 theories have been completed through the utilization of NDL's facilities.

1988

Starting program: "National Submicronmeter Device Laboratories".

Aug. 1992

Starting running the 10-class cleaning room building.

Jun. 1993

Renamed as "National Nano Device Laboratories".

2002

Starting the south branch in Tainan.

Jun. 2003

Under administration of NARL.

Dec. 2004

Moving to new NDL building.

Missions

As the semi conductor technology has entered the phase of nano and quantum era, NDL has set its mission as following:

- To establish a world standard nano devices and material research environment

To process the key technical research of the nano devices; to provide the technical service demanded by the industry; to effectively integrate the lab's valuable resources and to provide a core facility service.

- To train high technical experts in the semiconductor and nano industry

To insure Taiwan's competivity in the world's semiconductor and nano technology market, and related areas, in the next 5 to 10 years.

- To previse the future of nano devices and provide R&D of related materials

To build a platform for prevision of nano devices, to escalate the development of nano technology in the country, and to maximize information exchange through project cooperation among academic and industry field.

Figure1-1 Nano-fabrication and advanced research Labs

Major Accomplishments

Since semiconductor and photonics are the lifelines of Taiwan Economy, NDL provided excellent environment for the consultation of advance nano device technology and foundry service by open Labs since its started running in August, 1992. Over the past years, NDL has trained many elites and elevated the research in Taiwan microelectronics field, which assisted in strengthening of Taiwan's competitiveness in the worldwide chip market.

A.Training in 2005

In recent years, the number of students who have been trained in NDL has increased to 1,200 per year, and the number of the research reports has reached over 1,000. Some of the students continue further study, while others dedicated to reputable companies or research institutes such as TSMC, UMC, and many others.

In 2005, 628 people has completed technology of integrated circuit process class, 637 students finished semiconductor equipment class, 821 students completed clean room training class, 1,917 students were qualified for equipment operation. Moreover, NDL also collaborated with the Semiconductor Institute to recognize the 141 students who out-performed in the field.

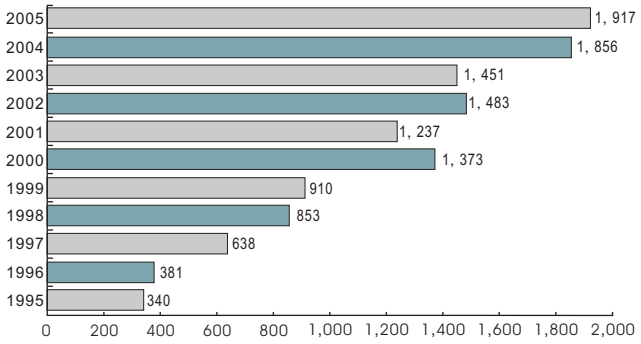


Figure1-2 Number of Trained and Qualified Persons

B.2005 Technology Service

In order to more efficiently and effectively use the resources for maximizing the research capability , NDL operates as an open laboratory in Taiwan with our core equipment facilities and core competence in fabrication technologies of nano devices , while provides various service items , including the training practice of advanced semiconductor and nano devices , technical consulting for fabrication process , and open foundry for both academia and industries.

In 2005 NDL provided foundry services 15,324 case to various universities , and 1,509 cases to industries . Besides , 101 pieces of advanced equipments were opened for academic research to allow graduate students operating by themselves with the total accessing time up to 81,176 hours . During the recent three years , the service revenue has been a level of around 10 million USD/year, and there was about 2.6% increase in 2005 compared to the revenue of 2004.

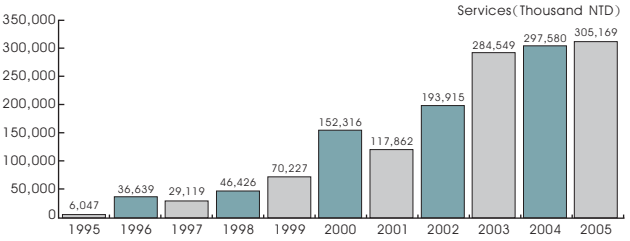


Figure1-3 Service Revenues

C.Advanced Nano Device Research and Technology Development

Based on Si chip process, NDL built a platform for research and development of new-generation nano device technology to meet the demand of its development and workforce which made a great deal of contributions in high technology and economy of Taiwan.

NDL involved 143 and 15 collaborative research projects together with academic community and industry irrespectively in 2005, with 1,200 students joined. 103 papers were published in both domestic and international scientific journals and 136 papers were presented in the leading conferences in the fields. 9 patents got approved and 5 patents were sent for application. The followings are the technology capability, research activities and technology transfer carried out during the period of time.

1.We, for the first time, demonstrated the fabrication of SONOS-type polycrystalline silicon thin-film transistor (poly-Si-TFT) memories with employing high-κ dielectrics, including hafnium oxide, hafnium silicate (Hf-silicate) and zirconium silicate

as the trapping layer with low-thermal budget processing (≤600C). We found that the fabricated memories exhibit good performance in terms of relatively large memory window, high program/erase speed (1ms/10ms), long retention time (>106s for 20% charge loss) and good endurance. More particularly, 2-bit operation has been successfully demonstrated. As a consequence, using high-κ dielectric as the trapping layer does shed the light on implementing the fabrication of the embedded nonvolatile memories on the panel. This work has been announced in 2005 International Electron Device Meeting, San Francisco, USA.

2.We have successfully fabricated 45 nm tri-gate Flash memories with newly-developed nanocrystal technique. This result is very important for the application of the future high-density Flash memories.

3. We report a high Curie-temperature ferroelectricity in a nanostructured film involving mainly silicon (or germanium) and oxygen atoms. The nano structure is comprised of a three-dimensional array of Si (or Ge) nanocrystals embedded in a mesoporous silica matrix. The ferroelectric effect was attributed to electrical dipole layers between nanocrystals and the silica host. The remnant polarization is as large as one-tenth that of typical multi-element perovskite ferroelectrics and is suited for the application of CMOS compatible non-volatile memories.

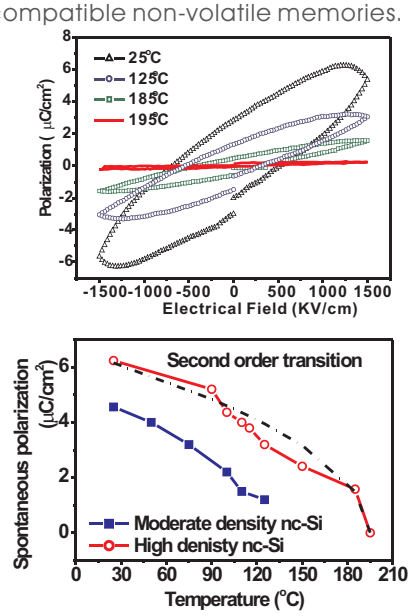


Figure1-4 Si-based Solid-state ferroelectric characteristics

4. We have successfully fabricated a novel single electron FET by incorporating the side electrical gate into SiNx/Si/SiNx nanopillar structure. It is a significant achievement that we produce a 10x10x3 nm3 quantum dot by a VLSI process; moreover, the device sustains a I-V modulated oscillation characteristic at both room temperature and low bias (<1 Volt). We have published the related achievement on Applied Physics Letters.

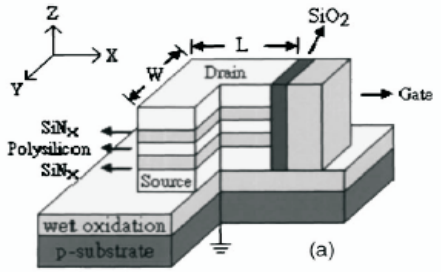


Figure1-5 Schematic drawing of the nanopillars' single-electron transistor.The nanopillars consists of SiNx－3 nm/Si－3 nm /SiNx－3 nm. The side gate is grown vertically at a distance of _9 nm away from the silicon island

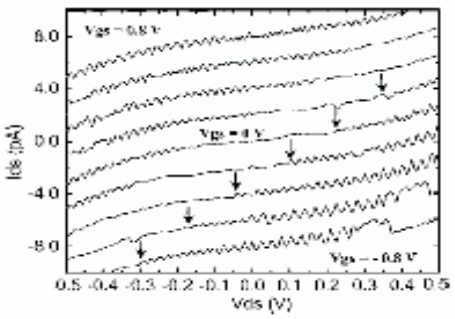


Figure1-6 Drain current Ids as a function of drain-source voltage Vds for fixed Vgs ranging from 0.8 to 0.8 V, in step of 0.2 V

5. Left-handed meta-material (LHM) could have novel optical property with negative refractive index in specific frequency regime. Thus it can break the diffraction limit and use for perfect lens manufacturing. In past all the LHM studies are constrained at microwave region due to difficulty in sample preparation. Right now we have successfully fabricated all kinds of LHM devices with 200 nm dimension. It was observed that the optical behavior of LHM is obvious different with that of Split Ring Resonator (SRR) and Wire Array Grating （WA）. The SRR and WA are the elements which used for composed the LHM device.

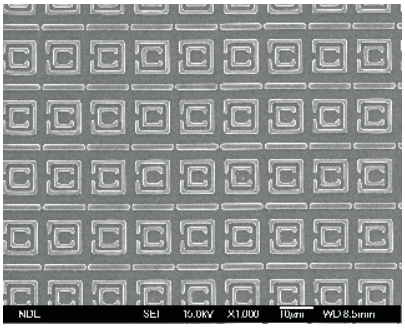


Figure1-7 The magnified LHM structure photography with SEM observation

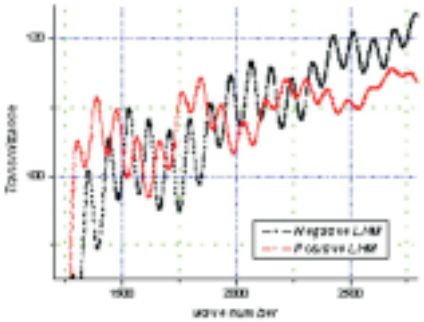


Figure1-8 The Babinet's effect occurred at FTIR measurement by using complementary LHM samples which clearly shows the phase difference at a value of π

6.A Si-based nanomaterial, silicon nanocrystals-embedded mesoporous silica, was integrated in the IC-compatible configuration of metal-oxide-semiconductor, and revealed a high photoresponse of 03-2 A/W (or gain of 1.4-5) at wavelength 275-375 nm. Such an extreme exhibition has great impacts on DVD industries.

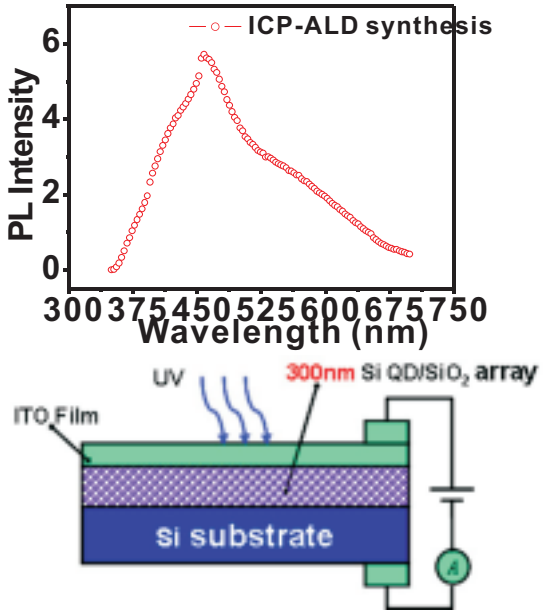


Figure1-9 Photoluminescence spectra of Si-O nanostructures and a schematic layout of ultraviolet-blue light detector containing such a nanomaterial

7.The nanograss arrays that are well aligned over large areas and have high uniformity in length, diameter, and distribution can be prepared through hydrogen plasma dry etching alone. This method may be very attractive for many applications, such as the fabrication of field emission displays and solar cells. We expect that this method can result not only in one-dimensional materials being fabricated but also zero-dimensional materials, such as quantum dots, when thin films are adopted for etching.

In addition, a simple and viable method for nano-scale patterning has been developed by using a combination of conventional photolithography, wet etching and reactive ion etching techniques to fabricate large-area Si nanostructure arrays (< 50 nm) including as dots, pyramidal pedestal, pillars, wires, and cones.

8. The leading manufacture companies of scanning probe microscopy instruments in the world, such as Veeco Co. and NT-MDT Co., have paid much attention on the front-wing (FW) conductive probe invented by NDL because the FW conductive probe can significantly suppress the photoperturbations during the electrical measurements of scanning probe microscopes, and enhance the measurement accuracy. For the time being, the companies are evaluating the possibility of technical transformation of the FW conductive probe. We have also published the related research results in Applied Physics Letters. This paper has been selected for the July 18, 2005 issue of Virtual Journal of Nanoscale Science & Technology at http://www.vjnano.org by AIP.

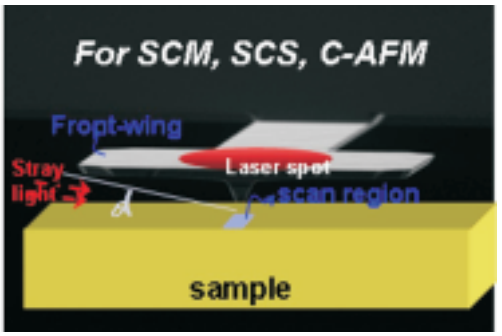


Figure1-10 Schematic diagram of a front-wing conductive probe working on a sample surface

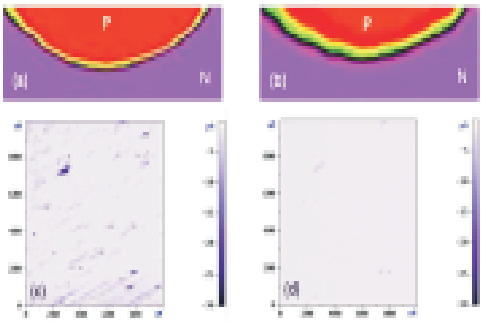


Figure1-11 (a) Photoperturbed SCM image
(b) Nonphotoperturbed SCM image
(c) Photoperturbed C-AFM image
(d) Nonphotoperturbed C-AFM image

9.A wafer mapping toolkit is developed for on-wafer characterization and statistic analysis of microwave devices based on Agilent IC-CAP software. This toolkit has been transfer to Agilent Technologies to get in return the donation of IC design and analysis related softwares worth 480 Million US dollars from Agilent Technologies. These softwares will be opened to academia in Taiwan for the development of high-frequency devices and circuits.

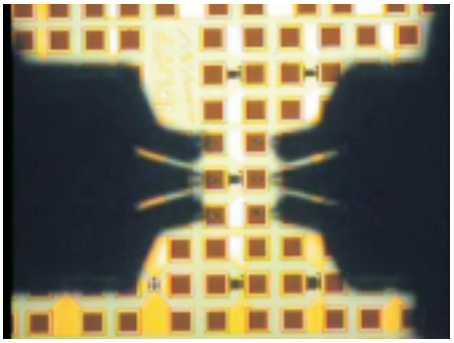


Figure1-12 Photograph of on-wafer microwave device characterization

Vision

As technology evolves, research related to nanoscale has become one of the leading technologies in the future. In order to provide better research infrastructure, NDL will combine its original research capability and innovative nano device technology to be ready for the nano era. NDL will also establish high-quality and high-efficient Lab infrastructure for the production of nano device and relevant material, to be a base of training people, and become the top-one technology research in the world.

- Integrating domestic core facility resources and providing advanced infrastructure for semiconductor and nano device process, maximizing the usage of NDL resources to most of the universities and academic community.
- Providing the practices, consultant and technology service of advance semiconductor and nano device to be the training bridge of academic community and industry.
- Enhancing collaboration projects with academic community and relevant research institutes. Integrating and sharing of research resources to make process more time efficient
  Starting innovative research technologies of nano devices and relevant materials.
- Expanding and strengthening NDL's original core technology in nano device.
  Presenting significant researches in core field that makes a worldwide influence.


國家實驗研究院實驗動物南科分中心動土
National Laboratory
Animal Center
NLAC

Chronicle

National Laboratory Animal Center (NLAC), located in the campus of Academia Sinica, Nankang, Taipei, was established by National Science Council (NSC), Executive Yuan in 1994 and now has come under the National Applied Research Laboratories (NARL) since 2003. NLAC is a non-profit organization and currently has more than 60 formal employees. Under the Director General, there are Vice Directors, the Administration Division, Animal Breeding Division, Research and Development Division and Planning Division. Most of the employees are professional in the biomedical field. Over the past decade, NLAC has played a vital role in laboratory animal history in Taiwan by providing broad scale services and assistances for biomedical researches.

1986

The 3rd National Science and Technology Meeting of NSC proposed to establish a national laboratory animal center.

Dec. 1988

The Executive Yuan approved the funding for the National Laboratory Animal Breeding and Research Center.

1994

National Laboratory Animal Breeding and Research Center began to operate under NSC's supervision.

2004

National Laboratory Animal Breeding and Research Center was renamed as National Laboratory Animal Center under the National Applied Research Laboratories administration.

Missions

The missions of NLAC are as the followings:

- Provide the specific-pathogen free (SPF) laboratory rodents for biomedical researches and development.
- Provide the laboratory animal disease diagnosis and embryo cryopreservation services.
- Establish a nation-wide mice repository of the specific disease models for post-genomic research.
- Provide the training courses on laboratory animal science technology and issue certificates for formal qualification.

Major Accomplishments

A. Laboratory Animal Supply

The high quality SPF laboratory animal production volume in 2005 was 236,004, and the annual sales volume was 168,425. The number of received orders in 2005 was 9,897 from 1,378 customers. And there were 130 organizations including schools, hospitals, research institutes and biotech companies across the nation purchasing NLAC laboratory animals. Since the formal operation beginning from 1994, NLAC has been equipped with the standard laboratory animal breeding facility to produce the high quality SPF laboratory rodents. Among all the strains, SD, Wistar and ICR are popular to be used usually on safty test and toxicology research. In addition to the strains that NLAC currently maintains, in recent years, there is increasing demand by biomedical research for the rare strains of the mice with specific genetic feature.

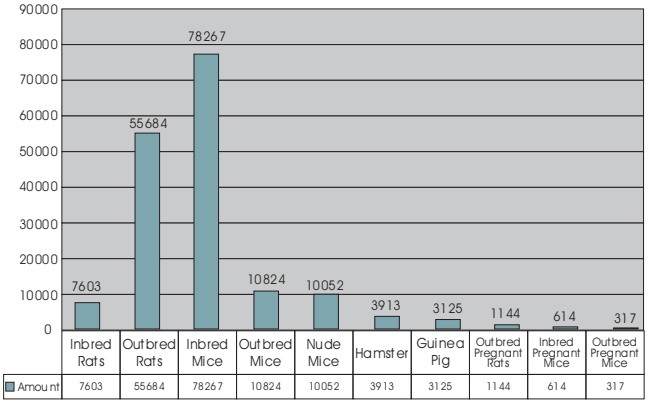


Figure2-1 Animal sales volume in 2005

B. Strains Transferring & Integration of Laboratory Animal Supply System

Based on the cost analysis of 2004, the breeding cost of SD, Wistar and ICR was only 17 percents but the revenue was up to 45 percents. It indicates that these three strains would become profitable if the production volume could scale up. However, the overall animal production in 2004 and

in 2005 has reached the maximum capacity, and it caused tradeoffs between the quality and the quantity of animal production. Besides, serving as a primary laboratory animal source among the biomedical research community, NLAC should increase the variety of animal strains to cover the need on different aspects. Meanwhile, the third "Biology Technology Industry Steering Group Council Meeting" instructed that, the government investment on laboratory animal science should focus on research and development, and help the private companies invest on large scale animal production and animal related services. In other words, NLAC should not compete with private companies in laboratory animal production industry. Therefore, in September, 2005, NLAC decided to transfer SD, Wistar and ICR to BioLASCO by signing a transfer agreement. After the transfer, NLAC imported six strains from the Jackson Laboratory and Charles River Laboratories including NOD.CB17*Prkdc*^{scid}/J, NOD/LtJ, BKS.Cg-*m*+/+*Lepr*^{db}/J, B6.V-*Lep*^{ob}/J and C.B17/Icr-scid etc. With the space and resource being released, NLAC will be able to breed various strains.

Strains/Stock	Date	Amount	Source
NOD.CB17*Prkdc*^{scid}/J	2005/11/10	10 pairs	Jackson Lab, USA
NOD/LtJ	2005/12/08	10 pairs	Jackson Lab, USA
BKS.Cg-m+/+*Lepr*^{db}/J	2005/11/10	10 pairs	Jackson Lab, USA
B6.V-*Lep*^{ob}/J	2005/12/08	10 pairs	Jackson Lab, USA
C.B17/Icr-scid	2005/11/03	10 pairs	Charles River, USA
LE Rats (Long-Evans)	2005/11/03	20male	Charles River, USA
BALB/cAnN.Cg-Foxnl^{nu}/Cr	2005/12/14	20male 75female	Charles River, USA

Figure2-2 List of the imported strains in 2005

C.Laboratory Animal Quality Control

In order to ensure the quality standards in animal care and health and to assure that these standards are maintained according to the Specific Pathogen Free (SPF) conditions, NLAC routinely monitors animal health status to help identify health problems. The health monitoring program includes serology, microbiology, parasitology and pathology. In the year 2005, the health monitoring was performed on more than 15,000 items of 767 animals. The genetic monitoring program is also part of the quality control to ensure the genetic stability of the laboratory rodents which determines the valid interpretation of experimental results. Therefore, more and more researchers are now aware of the importance of establishing a rigorous quality control system to validate genetic status. The method adopted by NLAC genetic monitoring is electrophoretic analysis for isozyme markers. In the year 2005, the genetic monitoring was performed on 803 items of 73 animals. In addition, NLAC performs environment monitoring on drinking water and autoclave function, and formalin fumigation. NLAC also provide the external health monitoring service by request from researchers. In the year 2005, the total revenues of the health monitoring service are 1,148,355 NT dollars.

D. Customer Service Quality Promotion

Following the attainment of ISO9001:2000 for "Qualified breeding program and supply system for laboratory rodents", NLAC successfully passed the review assessment in 2005. ISO helped define the standard operation procedures (SOP) including order process, customer satisfaction management, customer complaint handling, and product packing and shipment. The SOPs are strictly followed by production and marketing personnel and are helpful to improve the customer service to a great extent. In 2005, there are 54 cases of customer complaints which are only a half number of 2004. For a further evaluation of the customer service quality, NLAC conducted a customer satisfaction survey in 2005 by sending out 1,204 copies of questionnaires to the regular laboratory animal users, and received 126 valid respondents. The questionnaire was designed to measure customer support, animal quality, order process and deliverance in a range of 1 to 10. The results of the survey are between 8.10 and 8.96, and it shows that the service quality is above the average level.

	Attitude	Profession	Efficiency
Marketing Support	8.82	8.53	8.74
Animal Production Support	8.29	8.33	8.29
Veterinary	8.32	8.32	8.26

Figure2-3 The results of the service quality survey of 2005

E. International Accreditation

The attainment of Chinese National Laboratory Accreditation (CNLA) for Diagnostic Laboratory of Laboratory Rodents in October 2005 is a major achievement of NLAC which shows that the diagnostic technique and the laboratory management are up to the international standards. However, NLAC is not content with the current success. As a leading role in the laboratory animal science field, NLAC must take the responsibility of practicing animal welfare and humane treatment. AAALAC (Association for Assessment and Accreditation of Laboratory Animal Care, International) accreditation is what NLAC endeavors to earn for the next two years for the connection to the international laboratory animal community.

Figure2-4 CNLA awarding ceremony

F.Research and Development Technology

■ Embryo Cryopreservation Technology

The embryo cryopreservation technology has been developed in NLAC for years to help preserve animal strain over a long period of time without occupying much space when the strain is not actively used. Since the viability of the frozen embryo is preserved for future initiation of pregnancy, through embryo thawing technology, it is easy to recover animal population to a large scale from catastrophic losses by disease outbreaks, breeding cessation, or genetic contamination. In 2005, NLAC successfully preserved 8419 frozen embryos from 18 inbred strains. 500 frozen embryos were preserved from BALB/cAnN and BALB/cAJcl respectively, and 534 frozen embryos were produced for QC and embryo transferring. Due to the insufficient space, NLAC continues embryo cryopreservation operation by collaborating with Biomedical Science Institute, Acdemia Sinica, to examine and revise the embryo cryopreservation service procedures. As a result, two frozen embryos were successfully preserved from genetic-engineering mice.

With the successful embryo cryopreservation technology, NLAC intends to provide the external embryo cryopreservation service to help relieve the difficult situation on animal breeding space shortage which is a common problem to most of the research laboratories. The embryo cryopreservation service plans to accept not only the frozen embryo but also the live animal. The live animal should be kept in an isolator for further embryo extraction operation. Thus, the isolator operating skill becomes essential to the embryo cryopreservation service. For preparation, NLAC started the training program for isolator operation and will finish it by the end of 2006.

■ Transgenic Animal Production

One of the NLAC external services in plan is the production of transgenic animals. Since the transgenic technique has become a trend in the biomedical field in recent years, many universities, research institutes and even the biotech companies established their own transgenic core facilities. In the year 2005, NLAC collaborated with Mackay Memorial Hospital to produce the transgenic mice of green fluorescent gene from C57BL/6. For next step, NLAC will continue the collaboration programs with Academia Sinica and National Chung-Kung University to advance the transgenic technology to be mature. Then NLAC will be capable of producing various transgenic animals for scientific research.

■ Germfree Animal Production

The germfree animal production is a unique technology to the laboratory animal field in Taiwan. The baby mice are born through Cesarean Section and then grow up in an isolator where the environment is completely germfree to maintain the mice in germfree status. For years of efforts on germfree technology, now there are 5 germfree strains of mice maintained in isolators for as long as two years. They are C3H/HeNCrNarl, BALB/cByJNarl, C57BL/6JNarl, Tac:(SW) and C/B6 F1 hybrid. Both Tac:(SW) and C/B6 F1 hybrid are used to breed the baby mice. In addition to the germfree mice, NLAC imported germfree SD rats and nude rats and established germfree nude rats after six month breeding in the isolator.

Germfree mice are particularly useful to

genomics research and pharmaceutical test which require higher animal quality standard.

Figure2-5 The Germfree mice are maintained in isolators

Figure2-6 Germfree mice are born through C-Section

G.The Secondary Laboratory Animal Center

Along with the rapid growth of the biomedical technology development in recent years, the demand for laboratory animals is increasing year by year. Being the largest and the most organized laboratory animal provider in Taiwan, NLAC has reached its maximum production capacity in the past two years. Under the large production volume, the overloaded breeding environment could not guarantee the animal quality anymore. In order to solve this strait, building up the secondary laboratory animal center becomes the unavoidable solution to this problem.

After the evaluation in full aspects, Tainan Science Park is the perfect location to build up the secondary laboratory animal center since the completed infrastructure in the park and the STSP Development Plan by NSC strongly encourage the biotech companies to move in. In future, the joint production of the secondary laboratory animal center will not only release the urgent demand for the laboratory animals but also promise the customers high animal quality. In addition, it will disperse the risk of contamination, and avoid the animal stress during long hour transportation.

The secondary laboratory animal center is a 6 floor RC building including a basement floor. The surface size is 9,500 square meters and the total floor surface size is 15,992 square meters. The center is divided to four sections by different functions: the Animal Breeding Section, Research Laboratory Section, Administration Office Section and Control and Supply Section. The construction of the building began on December 22, 2005 and will be completed by May, 2007. There will be a series of operating tests going on through August, 2007 for the preparation of the formal operation.

Figure2-7 The construction ceremony of the Secondary Laboratory Animal Center

Education Outreach

NLAC was committed by Council of Agriculture of Executive Yuan to carry out the training courses on laboratory animal husbandary and care and humane treatment each year. In 2005, two terms of the training courses were held. The first term began from June 24 to June 26 in Biomedical Science Institute, Acdemia Sinica. And the second term began from October 6 to October 8 in the International Conference Hall of National Chung Hsing University. The invited speakers for the training courses are experts and the professionals on laboratory animal science. The topics covers the Animal Protection Law, Standard Laboratory Animal Facility, Laboratory Animal Breed and Care, Management, and Quality Control, Occupational Health and Safety, Nomenclature, and Animal Welfare and Humane Treatment etc. The preliminary purpose is not only to train the laboratory animal people but also to educate the users the legitimate application of laboratory animals, especially the 3Rs principle: Replacement, Reduction and Refinement .

Figure2-8 The first term of laboratory animal management training course

Vision

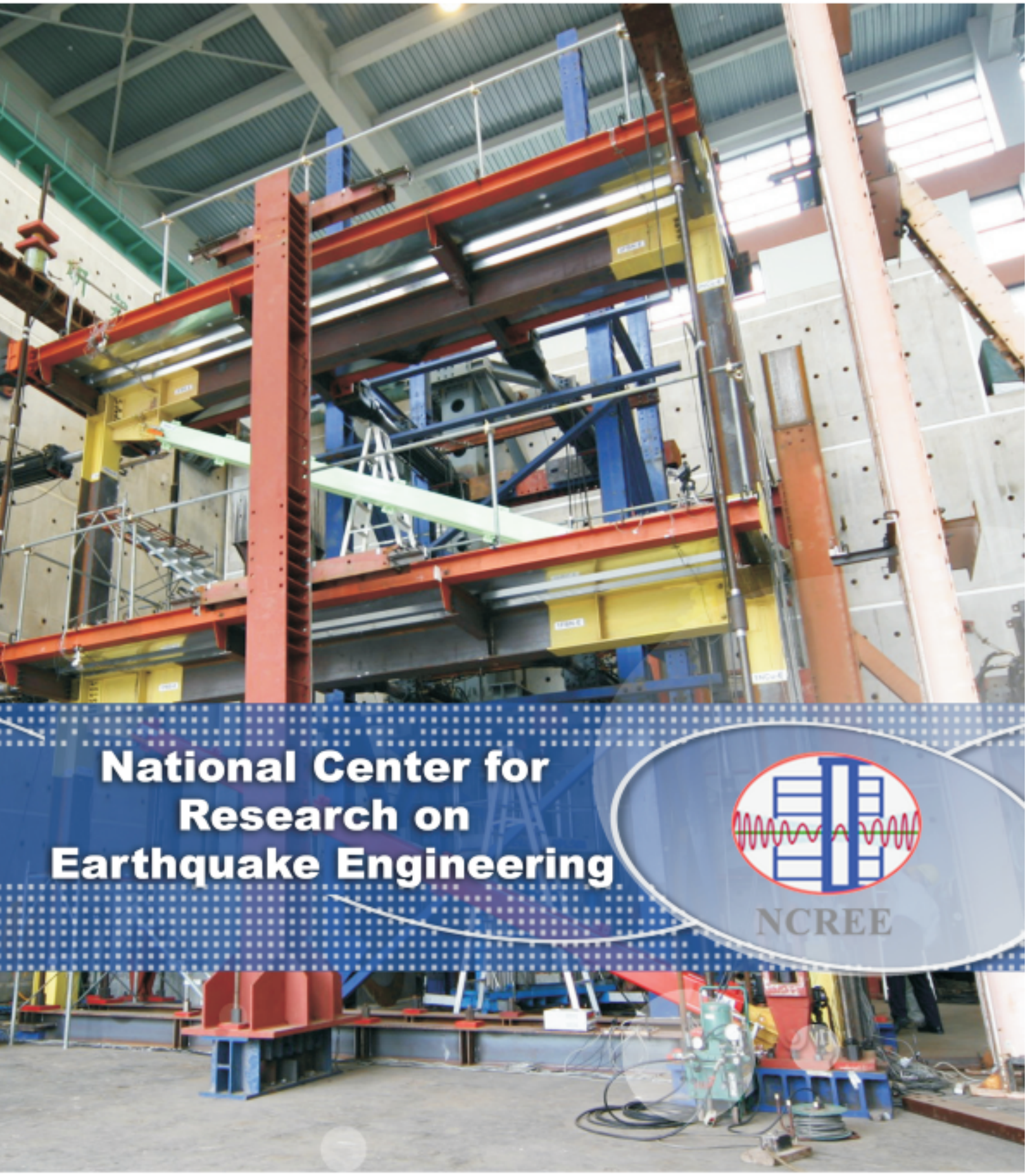
After the reorganization renovation in 2004, NLAC became one of the research laboratories under NARL. Through the organizational switch, NLAC intended to pursue a better performance and management strategy by ameliorating the employees' work attitude to help improve the work efficiency . Therefore, NLAC recruited an accountant to establish a cost analysis system to calculate the actuarial cost and earnings and to evaluate the production and sales policy and management. This system will also be applied to the future operation of the secondary laboratory animal center when it operates in 2007.

Upon the completion of the secondary laboratory center, there will be larger space available to breed various strains. There will also be training programs given periodically on laboratory animal care and management. From the other aspect, the secondary laboratory animal center will take the advantage of its location to complete the laboratory animal resource network across the nation, and to balance the bio-resource distribution between north and south for the need of the biomedical research development in the southern Taiwan. Moreover, it will have opportunities to collaborate with the surrounding biotech companies in the Park to encourage private enterprise to invest on a large scale of laboratory animal supply system for the integration of the laboratory animal resources.

The laboratory animal breeding is a high risk industry. It requests the personnel to operate by absolutely following the standard operation procedure to guarantee the animal quality. NLAC has been conducting a series of training programs on a regular basis to strengthen the employee's capability and ensure their qualification. As a result, NLAC attained ISO 9001:2000 certification in 2004 and CNLA accreditation in 2005 to demostrate the remarkable achievements on management and quality control through years of efforts. Now, NLAC is aiming the goal at attaining AAALAC accreditation for reaching the international standard.

NLAC now is in the transition period of making a new direction for future development. To move toward the center orientation according to the government policy, NLAC will endeavor to:

- Establish a service mechanism for industrial research and development as the fundamental construction to Tainan Science Park.
- Build up an international standard laboratory animal test facility to provide the industrial companies with high quality hardware and software resources for animal experiments.
- Increase the variety of animal strains.
- Further the interaction and possibility of cooperation with southern research institutes by collaborating with the surrounding industrial companies and schools.
- Create an environment and a system to train laboratory animal personnel on both basic and advanced levels.


National Center for
Research on
Earthquake Engineering
NCREE

Chronicle

To promote the research and development of earthquake disaster-prevention technology, the National Center for Research on Earthquake Engineering (NCREE) was established in 1990 at the National Taiwan University by the National Science Council of the Executive Yuan of Taiwan. The Center was to set up, through large-scale or actual-size static/dynamic experiments, a world-class seismic simulation laboratory research and development on earthquake engineering technologies. To facilitate its operational flexibility, the National Science Council of Taiwan founded in 2003 the National Applied Research Laboratories, a non-profit organization, of which NCREE was one of its eight labs.

Oct. 1989

Approval by the Executive Yuan to set up a preparatory office for the National Center for Research on Earthquake Engineering.

Mar. 1990

Official establishment of the National Center for Research on Earthquake Engineering, which was supervised and managed by National Taiwan University under a project contract with the National Science Council of Taiwan.

Apr. 1992

Establishment of a seismic experimental park in the campus of the National Ilan Institute of Agriculture and Technology free of charge.

Aug. 1993

Initiation of the construction project for the main building and the large-scale structural laboratory.

Jul. 1997

Completion of the construction project for the tri-axial seismic shaking table facilities.

Nov. 1997

Moving into the newly constructed main building.

Nov. 1998

Inauguration ceremony for the newly constructed building and the large-scale structural laboratory.

Jan. 2003

Becoming a nonprofit organization, and a member laboratory of the National Applied Research Laboratories.

Nov. 2004

Signing memorandum of understanding with Kyoto University to promote research collaboration.

Missions

With the aim to stimulate theoretical and applied research on earthquake engineering, NCREE unites researchers and engineers to solve important issues in seismic engineering via numerical and/or experimental methods in an innovative manner. As such, the missions of NCREE include:

- Planning, integration, promotion and implementation of multidisciplinary research projects on earthquake engineering.
- Improvement of experimental technology in large-scale structural laboratories, as well as providing services and execution of related experiments.
- Collection, distribution, and promotion of research information and findings in the fields of earthquake engineering.
- Revision of region-dependent seismic design codes suitable for civil infrastructure systems and engineered structures in Taiwan, and development of innovative construction methods.
- Earthquake-induced loss assessment through computational simulation.
- Miscellaneous duties such as earthquake reconnaissance and international collaborations.

Major Accomplishments

A. Research

1. Development of performance-based seismic design methods to enhance earthquake resilience of new civil structures

NCREE assisted the Construction and Planning Agency of the Ministry of the Interior to review implementation program for seismic evaluation and retrofit of buildings and to plan promotion clause for seismic evaluation and retrofit of private buildings. NCREE invited scholars and professionals as well as

representatives from the industry and the authorities concerned to jointly establish "Research and Development Council on Seismic Design Provision," to develop new seismic-design codes and solve existing problems of the codes. The Committee was to discuss on a regular basis existing problems of the Codes, so as to propose suggestions on the revision of existing codes. The Committee would provide explanation of the seismic design codes regarding their analysis procedures, acceptable standards, demands, goals, performance levels, as well as possible earthquake damage. The Committee was also to provide the clauses and the design examples of design guideline (draft) for steel structure.

2. Development of structural diagnosis technologies and retrofit schemes in accordance with the urgent needs to upgrade earthquake resilience of existing civil structures

To facilitate the seismic evaluation and retrofit plan for elementary and junior high school buildings initiated by the Ministry of Education, NCREE conducted in-situ pushover experiments in Xin-Cheng Junior High School of Hualian County, and Ko-Hu Elementary School of Yunlin County (Figure3-1) to verify NCREE-proposed seismic performance evaluation methods. These evaluation methods were then applied to conduct simplified seismic performance survey for some ten thousand elementary and junior high school buildings in Taiwan, the results of which were compiled as a data bank for future reference for retrofit planning. NCREE also held many workshops for practicing professionals to promote standard seismic performance evaluation procedures and new retrofit technology. In addition, NCREE completed the evaluation of 11 fire-fighting buildings of Taipei city in terms of basic seismic performance requirements using comprehensive evaluation models, and proposed feasible retrofit schemes. As for bridge safety, NCREE developed an analysis approach for cable measurement utilizing fiber Bragg grating sensor, and was used to monitor the cables on Gi-lu cable-stayed bridge. (Figure 3-2) Studies were also made on wireless sensor technology for measuring natural frequencies and mode shape of cables and Study of the influence of conduit on the tensile force of steel wires. In addition, a series of seismic tests were conducted upon bridge bearing components to improve their seismic performance.

RC pure frame of school building	School building retrofitted with brick wing walls	School building retrofitted with RC wing walls

Figure 3-1 School building seismic ability on-spot inspection at Ko-hu Elementary School of Yunlin County

Figure 3-2 Verification of the repair of Gi-Lu Cable-stayed bridge in Nantou County after earthquake damage

3. Development of TELES decision support system to match the needs for earthquake emergency response and risk management

To assist in disaster preparedness, emergency response, and rescue plans, NCREE complied a data base of the pipe system of the Gas Company of the Greater Taipei together with its earthquake disaster simulation, using Taiwan Earthquake Loss Estimation System (TELES) to build a Geographic Information System (GIS) data base of major highways, bridges, and school buildings in Taiwan. These were also used to revise soil-liquefaction susceptibility category map to provide a community-based soil-liquefaction susceptibility map. This information can be used for future estimation of disastrous soil liquefaction potential and the earthquake-induced settlement. NCREE also completed the TELES World Wide Web and Seismic Disaster Simulation by combining GIS and the Internet technology (Figure 3-3). The general public can easily simulate an earthquake disaster via the website mentioned above. Such knowledge is of great importance to the general public in terms of their after-shock emergency response, and the seismic prevention education is thus reinforced.

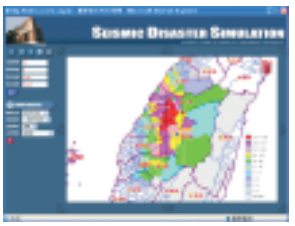


Figure 3-3 TELES World Wide Web

4.Development of innovative seismic technologies to deliver sustainable structural system

To effectively integrate the academic resources available nationwide, NCREE initiated three disaster-prevention projects funded by National Science Council of Taiwan:" strategies for seismic protective design of high-tech industrial factories" , "Seismic performance research of post-tensioned buildings" and "structural control and system identification". This research is aimed at identifying the seismic vulnerability and proposing the corresponding retrofit methods for the high-tech factories in Taiwan. The proposed methods should also be applicable to the new construction of the factories. Analytical and experimental verification of the proposed methods have been conducted. Regarding seismic performance researches on post-tensioned buildings program, full scale specimen experiments and numerical analyses including the RCS moment resisting frames, the RC beam-to-column connection sub-assemblies with slab, CFT beam-to-column connection sub-assemblies and shear wall subjected to post-tensions have been studied(Figure 3-4). Experimental results show that they really possess a key feature of re-centering a structural system back to its original position, after earthquakes and improve seismic performance of buildings. In addition, the sub-structural pseudo-dynamic tests of a 2-story buckle restrained braced frame or steel plate shear wall frame are completed, respectively.（Figure 3-5）. In the research of the structural control and system identification, the nonlinear shaking table test of the benchmark structure and construction of the corresponding data bank are completed. The data bank will be made available to the subprograms for the subsequent system identification researches. Also, the international cooperation test of the development of the wireless sensing system is finished.

Figure 3-4 Seismic performance research of post-tensioned buildings

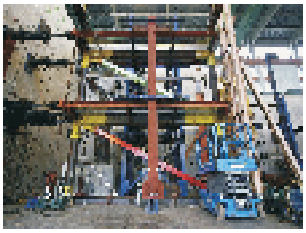


Figure 3-5 Double-Cored Double-Tubed Buckling Restrained Brace

5.Establishment of world-class experimental environment in support of continual improvement of experimental and numerical simulation capability

The "tri-axial earthquake simulator testing system" and "seismic energy dissipation device testing system" have been approved. NCREE made efforts to upgrade its laboratory to become networked with international research institutions; during the past year NCREE also collaborated with Canada in completing a hardware/software integration of the actuator controller and data acquisition systems, to do a networked international collaborative pseudo-dynamic experiment with a bridge system composed of 4 double-skinned concrete filled tube piers. NCREE made great efforts to the development and application of numerical simulation technology by making GISA3D, a pre-processing system for structural analysis, and planning the software framework of the next generation of PISA3D and VISA3D.（Figure 3-6）In addition, NCREE also collaborated with industries in developing 3D graphing technology for structural analysis, as a foundation of graphically demonstrating nonlinear structural analysis results ImPro, software for automatic tracking of moving targets and image based displacement measurement, was also developed and applied on the detection of in-plane displacement in shaking table collapse experiments.

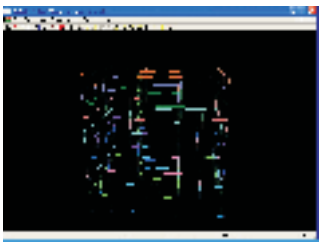


Figure 3-6 non-linear static and dynamic 3-D structural analysis software development

6.Establishment of earthquake engineering knowledge bank for sharing and promotion of research findings

NCREE conducted collaborative investigation with the Construction and Planning Agency of the Ministry of the Interior in the "Development of Knowledge Taxonomy and Knowledge-Interoperation Standards for Construction Industry" to establish a knowledge management website for seismic design and hazard mitigation, in which through a framework of theme maps basic and

advanced knowledge and accompanying search engine are provided for professional engineers, and general knowledge on disaster prevention is provided for teachers, students and general public. Last year, NCREE collected boring log data of 26 TSMIP stations, increasing the previously surveyed stations to a total number of 292. Among these, 19 stations had a boring depth of more than 50 meters or deeper. Geological information was updated and released on the Internet for national or international academic usage. As for the building of strong-motion knowledge bank, the search engine of Taiwan structural strong-motion monitoring database has been established; users can search for structural strong-motion monitoring records and related analyses from the Central Weather Bureau by specifying an earthquake event or choosing a specific station.

7. Integration of earthquake engineering and earth science to facilitate the transformation of basic research into practical applications

Based on the de-aggregation analysis of seismic hazard, the potential earthquake sources are identified and considered as the criteria for collecting the basic design ground motion database from the TSMIP strong motion array operated by the Central Weather Bureau. The indices defining the smoothed design spectrum of multiple records are computed and tabulated to allow for efficient selection of appropriate records. The procedure and software for generating spectrum-compatible time history are also provided for engineering practices. For the project on monitoring the micro earthquake activities using seismometers and geochemical isotope gases, a dense micro-tremor measurements with spatial spacing about 150-300 meters was performed in the Hsin-Chu Science Park and its surrounding proximity. According to the paleoearthquake investigation of the Shin-Chen fault and the seismicity of the Shintsu area, a time-predictable characteristic earthquake model of the Shin-Chen fault is generated and used to calculate the earthquake occurrence probability and hazard potential for the period of next 30 years. We can trace the surface distribution of the Hsin Cheng fault based on the principal that the anomalous soil gas concentrations can usually be found at fault zones. Consequently, we have successfully set up an automatic soil gas station to continuously monitor the activity of the fault in the area.In order to study the soil behavior, such as liquefaction and soil-structure interaction, nine shaking tests have been conducted on the Vietnam sand specimen in the biaxial laminar shear box on the shaking table at NCREE since August 2002 while two of them were completed in 2005. The results can serve as the database for the studies of liquefaction potential evaluation.

B. Patents

Table 3-1 Patents Approved

Patent Name	Country
Method for Strengthening Reinforced Concrete Columns using Polygonal Tube	ROC
Steel Beam-to-Column Connection with External Clamping Diaphragms and Stiffeners	ROC
Corner Stiffening Device for Concrete-Filled Tube (CFT) Column	ROC
Earthquake-Resisting Control System for High-Rise Building	ROC
Two-Dimensional Test Container with Flexible Boundary	ROC
Double-Cored Double-Tubed Buckling Restrained Brace	ROC
Seismic Brace With a Removable Restraining Member Disposed Around a Middle Portion an Elongated Central Brace Unit	ROC, Japan
Method for Strengthening or Repairing an Existing Reinforced Concrete Structural Element	ROC
Method for Strengthening Structural Element using Steel Stiffeners and Fibrous Composite	ROC
Earthquake-Resisting and Energy-Dispersing Structural Assembly, and Method for Installing the Same	ROC
Cable-Typed Optical Fiber Sensor Device and its Manufacturing Method	ROC
Seismic Isolation Bearing Assembly with a Frame Unit	ROC
Seismic Isolation Bearing Assembly with a Frame Unit for Supporting a Machine Body Thereon	USA

Table 3-2 Patents Pending

Patent Name	Country
Seismic Isolation Bearing Assembly with a Frame Unit for Supporting a Machine Body Thereon	ROC, Japan
Application of Sensor Device in Geotechnical and River Monitoring System	ROC
Method and Application of Optical Fiber Dial Gauge in Highway Monitoring System of Over speed and Overload	ROC
Anchorage System for Structural Reinforcement of Fiber Reinforced Plastic Materials and the Like	ROC

Patent Name	Country
A MEMS Based, Wireless Pressure Sensors for Civil Engineering Applications	ROC, USA, Japan, PRC
Seismic brace with a removable restraining member disposed around a middle portion an elongated central brace unit	USA
Method for Strengthening or Repairing an Existing Reinforced Concrete Structural Element	USA
Earthquake-Resisting and Energy-Dispersing Structural Assembly, and Method for Installing the Same	Canada

Education Outreach

1.The 5th IDEERS Student Competition competition among students in the making of earthquake-resistant miniature building frames

College students from UK, Japan, USA, and Hong Kong, as well as foreign high school students in Taiwan were all invited to join the competition to enhance earthquake awareness and fundamental knowledge of earthquake engineering.

2.Graduate Students Symposia

Symposia were held to provide opportunities for Taiwanese and international graduate students to exchange their knowledge in earthquake engineering research

3.International Training Program for Seismic Design of Structures

ITP invited 32 practicing engineers and researchers from 15 countries in Southeast Asia and Latin America to improve seismic design practice in developing countries, and thereby created a new channel to strengthen Taiwan's diplomatic connections.

4.The "School-Building Seismic Evaluation Contest" was held in coordination with the in-situ test of Ko-hu Elementary School from July to August. Guests from civil engineering and architecture related fields were invited to build structural-analysis models for prediction of seismic responses and static push over capacity curve, etc., and to compare them with test results. As a result, engineers and students were able to gain a better and insightful understanding of how to enhance seismic capability of school buildings.

5.NCREE sponsored together with the National Museum of Natural Science the event of "Earthquake Week," a series of educational activities, which are comprised of "Shaking Spaghetti Room Contest," "Buildings and Earthquake," "the Story of Soil Liquefaction", and "Experience of Earthquake Magnitude and Intensity". These activities were open to the general public of all ages as a chance to learn about earthquake science and seismic engineering.

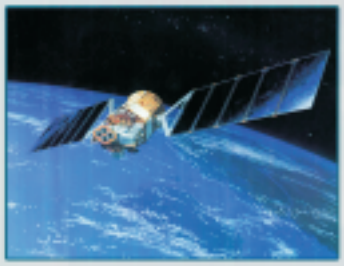
6.International Conferences and National Workshops

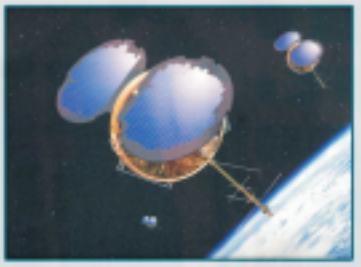
International conferences included 2005 Across-the-Strait Academic Conference on Disaster Reduction, Workshop for Investigating Seismic Performance of Post-tensioned Structural Systems, International Conference on Advanced Steel Structures, NCREE-hosted national workshops included Taiwan Earthquake Loss Estimation System (TELES) 2005, Symposium on Soil Liquefaction Potential and Hazard Evaluation for the Structures of Transportation System, Symposium on the Potential, Risk, and Prediction of Earthquake-induced Landslides, Workshop on Seismic Evaluation and Retrofit of School Buildings, Workshop on Simple Seismic Survey for Buildings of Senior High Schools, Colleges and Universities in Taipei City, 2005 Workshop on Simple Seismic Survey for Buildings of Primary and Secondary schools in Taiwan, Conference on Multiple Scale and Interaction Mechanics, Conference on Seismic Technology of Structures.

Vision

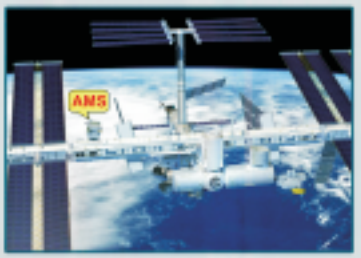
To comply with the national needs of pre-earthquake preparedness, emergency response, and post-earthquake recovery, NCREE will continue to take advantage of its outstanding experimental facilities, world-class technical capability and unparalleled earthquake-related databases to bring together domestic researchers and to encourage international collaborations. It is hope that we could minimize earthquake related damage via technological innovation and consolidation. Throughout continual efforts, it is our hope that NCREE will become a world-famous and first-rate international research center in the near future.

National Space Organization





NSPO



Chronicle

The national space program of Taiwan was initiated in October of 1991 after the approval of the fifteen-year "Long-term Planning of the ROC Space Technology Development" (The First Phase Space Program). National Space Program Office Program Office(NSPO) was established by the National Science Council (NSC) of the Executive Yuan as an implementing agency to execute the first phase space program. The program, from 1991 to 2006, is commissioned to establish organization and technology to facilitate the national space program development in Taiwan, build up human resources required for space programs, and develop three satellite programs set up .

To continue the development of Taiwan space program, NSC formed a planning board in April of 1999 to formulate strategy and direction for the second phase space program. To smooth the transition between the two phases, second phase space program is scheduled to span from 2004 to 2018. After numerous discussion and revisions, the strategy and direction were finally approved by the NSC committee in the December of 2002.

NSPO has evolved into a non-profit organization under the National Applied Research Laboratory (NARL) of NSC in June of 2003 and renamed as National Space Organization in March 2005. NSPO will place its effort on the successful completion of the planned mission for the First Phase Space Program and development of the programs for the Second Phase Space Program.

Missions

Main mission of the first phase space program is to establish domestic capability of satellite development, launch three scientific satellites and perform space science research.

Main mission of the second phase space program is to extent the capabilities and applications of the space technology:

- to promote space related technology by integrating capabilities from industries, universities, research institutes and government;
- to establish space industry in Taiwan, including capability of satellite-related applications and facilities;
- to carry out satellite projects for science research and space-related business opportunities; and
- to make NSPO the heart of Taiwan space related technology integration and development.

2005 is the transition year between the first and second phase space program, major programs include:

1.FORMOSAT-2 Program

The primary mission of FORMOSAT-2 program is to develop a remote sensing satellite for earth and upper atmospheric lightning phenomenon observation. The remote sensing mission is to take earth images for civilian needs. The images are intended for the environment and resources monitoring throughout the Taiwan main island, the offshore remote islands, Taiwan Strait, and its surrounding ocean. FORMOSAT-2 may also obtain similar images over other regions of the world for international cooperation. The phenomena of upper atmospheric lightning will be investigated using an imager payload, which will be the first scientific instrument in the world to observe this phenomenon from a satellite.

2.FORMOSAT-3 Program

The FORMOSAT-3 program is also known as Constellation Observing System for Meteorology, Ionosphere and Climate, or FORMOSAT/COSMIC for

short. It is an international collaboration project between Taiwan and the US with joint efforts of Taiwan's National Space Organization (NSPO) and University Corporation for Atmospheric Research (UCAR) of the US. The goal of the project is to launch six micro-satellites and develop advanced technology for the real-time monitoring of the global climate, the long-term climate change research, interactive ionosphere monitoring, global space weather forecast, and earth gravity research.

3.Sounding Rocket Program

The primary goal of the sounding rocket program is to provide a reliable platform for applications of various Domestic Research Institutes to probe physical phenomena emerging on upper atmosphere and ionosphere above Taiwan region. The secondary goal of this program is to provide a sub-orbit environment for spacecraft component verification. The last goal is to make a sound and firm foundation for indigenous development of launch vehicle.

4.Satellite System Development Program

Satellite system development program focus on establishing NSPO heritage spacecraft platform and capabilities of providing satellite for national needs and driving international space programs.

5.Space Technology Development Program

Space technology development program is to build self-reliant know-how technology for critical space components. Aligning with satellite system development program, this program is aiming at producing critical components for NSPO's self-developed satellite system. Meanwhile, applications of these technologies to civil industries and other creative products are also considered in this program.

6.International Cooperation and Space Science Research

To explore the international collaboration opportunity for advanced space science research. The project objective is to increase the participation of universities and research institutes in space science research and technology development, to increase the international visibility and position Taiwan as a significant player in space science and technology arena.

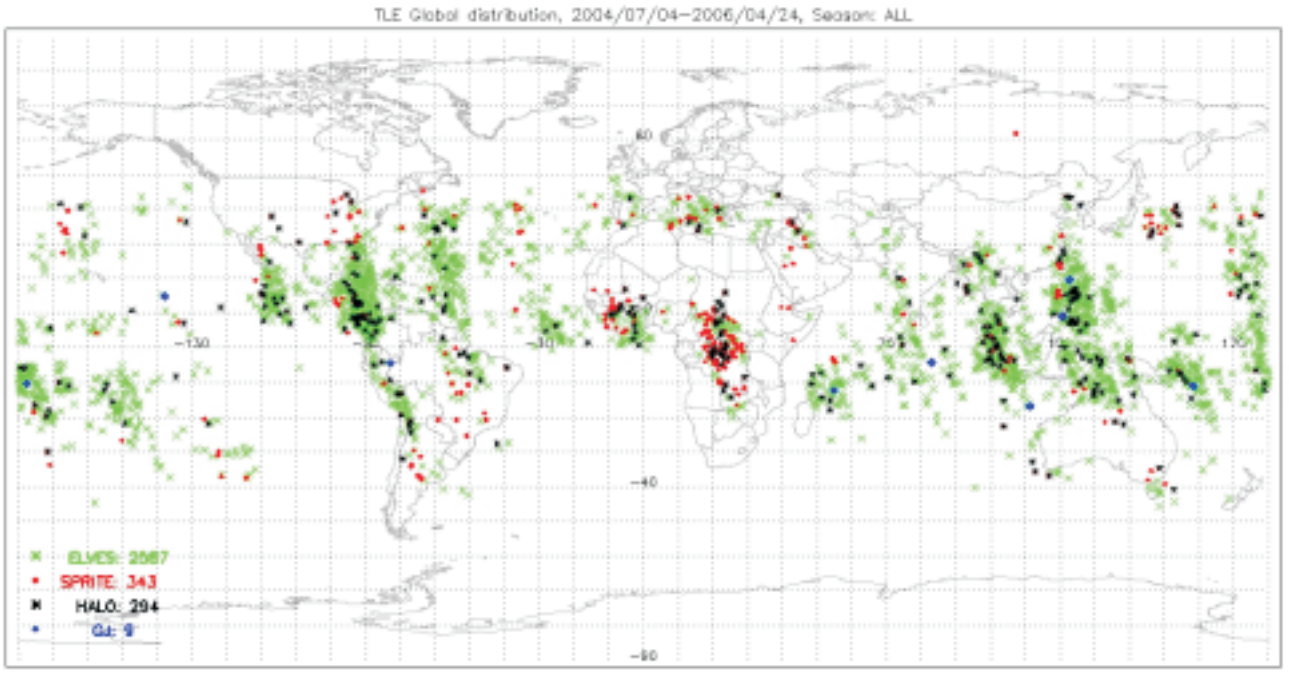


Figure 4-1 Transient Luminous Event(TLE) global distribution recorded by ISUAL

Figure 4-2 Sounding Rocket V on Launch Stand

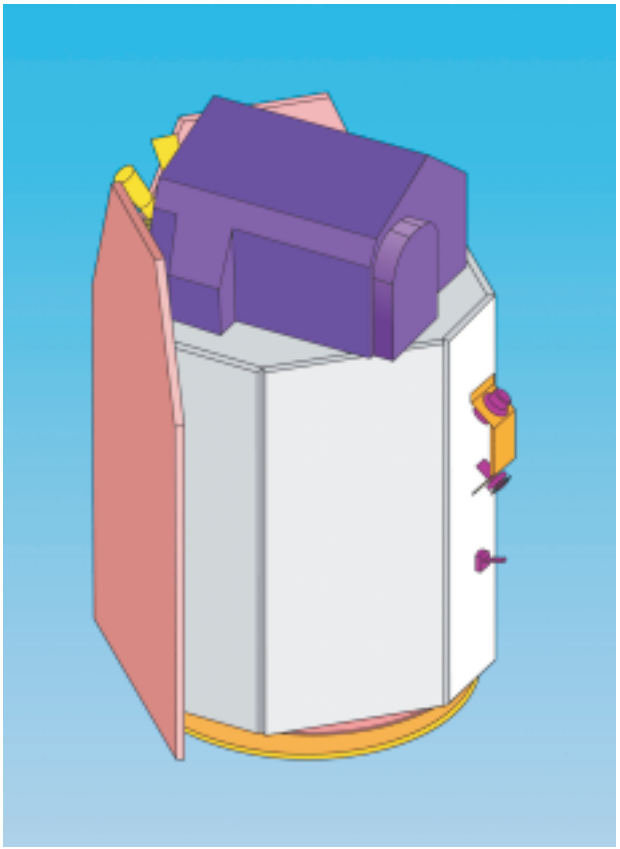


Figure 4-3 Argo Satellite

Major Accomplishments

1.Established 5 FORMOSAT-2 Image Distribution Centers and Successfully Distributed FORMOSAT-2 Image Data

NSPO has signed contract with 5 different universities; i.e. National Cheng Kung University, National Taiwan Normal University, National Central University, National Taiwan University and Feng-Chia University, as the distribution centers and as the sells center to form a service network around the Taiwan island for the Formosat-2 image products. In addition, in the promotion of special users, NSPO has directly provided the service and data to the customer, like NSB, Armaments Bureau, M.N.D, and National Fire Agency Ministry of Interior. For International market, NSPO has authorized Spot Image to expand the market of FORMOSAT-2 image products. Up to date, NSPO has successfully delivered hundreds of images to countries around the world.

2.Significant contribution of FORMOSAT-2 satellite to space research

FORMOSAT-2 carries remote-sensing and science payloads to perform earth imaging and various luminous phenomena observation in the upper atmosphere. The official name of its scientific payload is Imager of sprites and upper atmospheric lightning (ISUAL). By performing summer ground campaigns in Taiwan and space observation using ISUAL, researchers from National Cheng Kung University have found a type of upper atmospheric transient luminous phenomena, called gigantic jets, that visually linked the thunderclouds and the ionosphere at 90km. It is a direct proof that the troposphere and the upper atmosphere are coupled energetically. The results have been published in the prestigious scientific journal "Nature". As of the end of year 2005, ISUAL has recorded more than 2500 transient luminous events, including 7 gigantic jets, five hundred sprites, and near two thousands elves. On an average day, ISUAL can record more than seven transient luminous events, much higher than the less-than-two events estimation prior launch. It is a good indication that the true impacts of the transient luminous phenomena could be greater

than expected. A paper on this new finding is currently being written up and the paper will be soon submitted to Nature.

Besides performing transient luminous phenomena survey, ISUAL also often participates in various space-ground coordinated studies of auroras and airglows, at the requests or invitations from international research teams. The results from ISUAL will help to clarify the global distributions of these kinds of atmospheric luminous phenomena and enrich our understanding of Earth's environment.

3.Completion of integration and test of FORMOSAT-3 satellite, shipment to the launch site, and integration with launch vehicle

NSPO I&T team has conducted the integration and test of FORMOSAT-3 includes comprehensive performance test, thermal vacuum test, magnetic calibration and measurement, dynamic test of stacked satellite (six satellites), acoustic test, solar panel deployment test, and RF link test. Satellites was shipped to the launch site at Vandenberg Air Force Base of California on December 20, 2005 for integrating with launch vehicle.

4.TACC (Taiwan Analysis Center for COSMIC) ready to operation

The FORMOSAT-3/COSMIC data will be open to scientists from all nations for collaboration on atmospheric and ionospheric research. Centers around the world will have access to this new information for both research and operational forecasting. The approved users can access the global distribution of atmospheric parameters such as refractivity, air pressure, temperature and water vapor, as well as global electron density distribution of the ionosphere. TACC has established the necessary hardware and operating systems and is presently testing the analysis codes.

5.FORMOSAT-3 Science Teams are ready for science mission

The atmospheric science team of National Central University, has been using single satellite GPS radio occultation data to study their effectiveness on the improvement of typhoon prediction. The FORMOSAT-3 ionospheric science team studies the electron density distribution of the ionosphere. The ionospheric science team has also established an ionospheric data center at the National Central University to process the FORMOSAT-3/COSMIC electron density data. Those science teams have published 30 papers in international conferences and journals.

6.Sounding Rocket V is ready to launch

Sounding Rocket V carried scientific payloads of an Ion Probe and an Aspectometer developed by Natioanal Central University. NSPO is in charge of the mission planning while CSIST team provides the rocket and launch services. The mission is to measure plasma density and ion temperature between the heights of 80 to 280 km of Taiwan area.

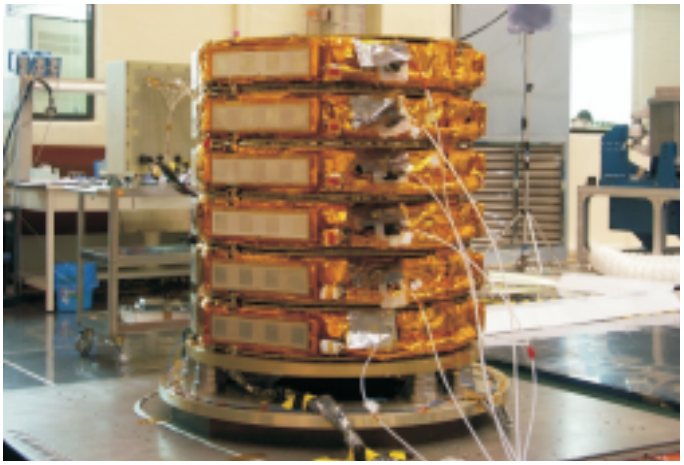


Figure 4-4 FORMOSAT-3 Stack Vibration Test

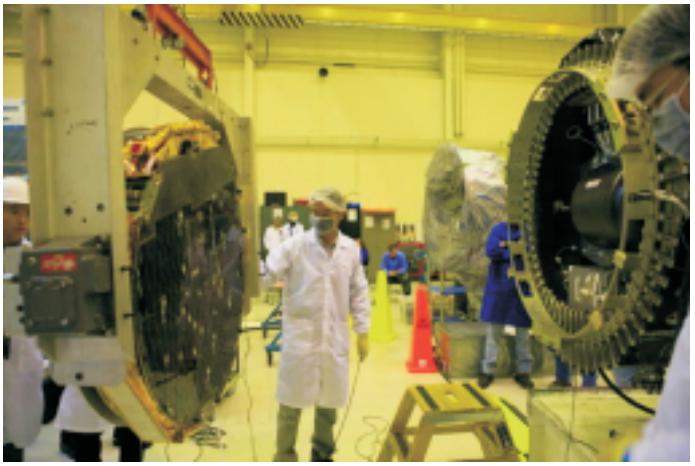


Figure 4-5 Integration of FM6 apscecraft with launch vehicle

7.Kicked off Argo program and completion of system design

The purpose of the Argo satellite is to establish complete self-reliant capabilities for satellite system development and to establish heritage spacecraft platform for NSPO future missions. The Argo satellite will participate in the RapidEye constellation for international collaboration and commercial returns.

8.Twelve satellite components selected as the first phase space technology development targets

12 critical components were selected and research and development contracts initiated in the year of 2005 with domestic companies in Taiwan. Functions or performance of these products are specified for NSPO future satellite system.

Education Outreach

NSPO values the importance of education by mentoring, tutoring, and participating in after-school programs. During 2004:

- NSPO offered satellite related information for elementary school course materials. NSPO also worked together with "Little Newton" science magazine to publish calendar for education purpose. The calendar utilized FORMOSAT-2 images of Taiwan in a creative manner to common science education.
- NSPO and Taiwan Normal University launched a joint effort, UrMap, to integrate various information, including eating, shopping, living and traveling. This service is a free web-based satellite map application.
- By means of distance learning, NSPO worked with universities to offer PicoSat system design courses aiming at promoting the climate of designing PicoSat level satellites by universities.
- Working together with NASA and National Chung Hsing University, NSPO provided a series of distance learning lectures in a hope to foster space science education in central Taiwan.

  NSPO also sponsored or involved in various space technology and science promotion activities such as FORMOSAT-3 related drawing, article competitions, Taiwan-US aerospace technology conference, etc.
- NSPO tried every effort to publicize achievements in various media and hope to promote general public's interest in space science and technology promotion.
- Up to 2800 people visited NSPO in the year of 2005 from various places and NSPO gave them an in-depth introduction on the FORMOSAT series of spacecrafts.

Vision

The major goal of the First Phase Space Program is to establish capability and infrastructure for Taiwan's space technology development. On such hasis, the Second Phase Space Program wishes to establish NSPO the world-class space research organization leading Taiwan to be one of the cutting edge space technology country in Asia and an important player in world space community.

NSPO is going to accomplish this vision by strengthening the research and development through the technology driven programs and space technology outreach and applications.

Besides satellite related programs, NSPO will also take necessary steps in this year to take advantages of being a non-profit organization by creating a well-balanced strategy between mission and technology development as well as a professional management and working environment.


Better HPC
Better Living
為更好的生活努力。
National Center for High-performance Computing
NCHC
國家高速網路與計算中心
www.nchc.org.tw

Chronicle

The National Center for High-Performance Computing (NCHC) is a national-level laboratory originally founded in 1991. Serving as Taiwan's only complete high-performance computing center, the NCHC provides domestic academic and industryl with high-performance computing, networking, storage, R&D resources, and professional training. In January 2003, the NCHC officially transformed from a governmental entity into a non-profit organization. With this transformation, the NCHC also becomes one of the nine experimental scientific institutions under Taiwan's National Applied Research Laboratories (NARL).

Our vision is to become a world-class supercomputing center and a bring in Taiwan about scientific discovery and technology innovation. In order to achieve these goals, we have placed our focus on enhancing our R&D and strengthening to internal management. In 2005, the NCHC received ISO 9001:2000 Quality Management Certification as part of its commitment to total quality management. we also received ISO 27001=2005 Security Information Management Certification.

Sep.1988

Recommendation by the National Science Council (NSC) to plan for a High-performance computing (HPC) lab to assist researchers on a national level.

Jul.1989

The NSC and Ministry of Education (MOE) form a committee to conduct a feasibility study and produce an action plan for the building of a national high-performance computing laboratory.

Jan.1991

The Executive Yuan approves a 5-year NCHC development plan.

Feb.1993

The new building in the Hsinchu Science Park is completed and begins its services.

Nov.1998

The NCHC adds high-performance networking to its mission with the commencement of the TANet network--Taiwan's first island-wide network dedicated to national R&D.

May. 2002

The NCHC southern Business Unit in Tainan, Taiwan is established.

Jan. 2003

TWAREN and KING are initiated as part of the Executive Yuan's "Challenge 2008" project.

Mar. 2005

ISO 9001:2000 certified.

Figure 5-1 The NCHC Receives ISO 9001:2000 Certification

Missions

The NCHC is Taiwan's only high performance computing, networking, and applications development institute. We also serve as the primary contact window for international exchange between global HPC and networking alliances.

The NCHC's primary missions are to further develop Taiwan's high speed computing services, HPC-related R&D, and to foster new HPC talent. The following table outlines the NCHC's primary missions:

Table 5-1 The NCHC's Primary Missions

Focus Area	Mission
Service	To provide the best environment for domestic R&D in HPC and networking applications.
Research	To engage in HPC and networking technology R&D in order to offer quality services to our users.
Training	To foster professional development in HPC and networking applications.

Major Accomplishments

The focus of the NCHC's new slogan, "Better HPC, Better Living," is on improving the daily lives of people and their environment using advanced technologies. We are devoted to enhancing our core facility services by focusing on groundbreaking large-scale R&D in fields such as meteorological simulation, renewable energy, and medical imaging. Our 2005 achievements are evident in our core facility services, large-scale R&D, service-related R&D, and training.

A.Core Facility Services

In 2005, our computational performance totaled out at 6.7 Teraflops with an additional two Teraflops being reserved for special needs applications. Our 2005 storage capacity totaled out at 200 TB. This same year, our HPC facilities supported 782 research projects resulting in 543 scientific papers being published. Also during this same period, according to our customer satisfaction survey, our facilities service customer satisfaction was rating at 92%. We also completed Taiwan's 20 Gbps backbone network, TWAREN, and expanded our international bandwidth to 4.5 Gbps.

We established an international Lightpath link in 2005, thus, allowing us to provide multi-level Lightpath service for the first time. We also successfully completed four transcontinental Lightpath connections that same year, one of which spanned three continents. We utilized the User-Control Light Path (UCLP) software at the Asian Pacific Advanced Network (APAN), iGrid '05, and SC05 international conferences to transmit high-definition (HD) images and showcase our R&D achievements. The NCHC is the Asian Pacific leader in the use of Lightpath.

B.Service-Related R&D

In 2005, the NCHC continued to strengthen its core technology by further developing its HPC and networking infrastructure, Grid middleware and applications development, CFD and multidiscipline simulation in biological medicine, and constructing a computational biological knowledge database. Also in 2005, we applied for 20 new patents, eight of which have already been granted, and published 20 SCI/EI journal papers. Our service-related R&D achievements include the following:

1.Computational Biology Knowledge Database Construction

The NCHC continued to develop and enhance its 3D Fly Brain Neurogenomics Project, a joint collaboration between the NCHC NTHU and the USA's Cold Spring Harbor Laboratory. We upgraded the project workstations from 32-bit to 64-bit and initiated the graphics system software so as to enable it for large-scale demonstration. This VR-based system is now fully mature and able to support our academic and medical communities.

2. Electro-Optical Engineering

The NCHC's Electro-Optical Team's primary focus is on the design of backlight modules, mixing paste color analysis, and the design of non-aspheric surface lenses. In addition to assisting in the innovation and development of Taiwan's industrial and academia electro-optical industries, we also produced many outstanding results through various collaborations with local universities. Our Electro-Optical Team published a total of ten SCI/EI papers during 2005.

3. Medical Grid

The NCHC's Asthma Grid project currently has 14,307 patients, 478 doctors, and 333 medical

institutions participating therein. During 2005, we completed Asthma Grid's English version website. The NCHC's Lung Cancer Grid project, a complete platform for the advanced care of lung cancer patients, has more than 300 patients and 20 physicians participating therein.

4. Eco Grid

The NCHC's Eco Grid project, established originally to study the similarities and differences between Northern Temperate Lakes (e.g. Trout Lake, Wisconsin, USA) and Taiwan's mountainous lakes (e.g. Yuan Yan Lake (YYL)), has since expanded to the international forum. The project, now called the Global Lake Ecological Observatory Network (GLEON), includes a total of ten lakes located in eight countries. The project is led by researchers from Taiwan, the USA and Australia.

The NCHC's innovative use of wireless sensors on YYL made the cover of the July, 2005 BioScience international scientific journal. Additionally, President Arden Bement of the USA's National Science Foundation (NSF) mentioned the NCHC's achievements at YYL during his inaugural address.

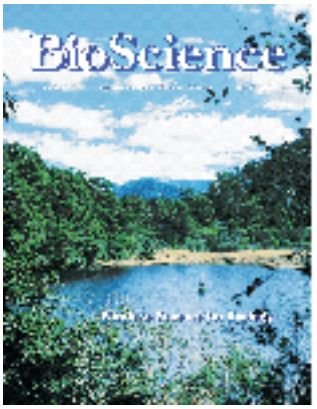


Figure 5-2 The NCHC's YYL Project Makes the Cover of BioScience (July, 2005)

5. Flood Mitigation Grid

In 2005, the NCHC's Flood Mitigation Grid Team completed the installation of the project's infrastructure. The infrastructure now consists of 30 remote monitoring stations and 106 video cameras. The Flood Mitigation Grid project was initially established to upgrade Taiwan's Water Resource Agency with the advanced equipment it needed (e.g. teleconferencing hardware/software and wireless video cameras) to monitor rising water levels during typhoon season. Because of the success of the Flood Mitigation Grid, the project has since become part of the Water Resource Agency's long-term administrative plan and the Executive Yuan's "National Flood Disaster Information Center."

6. The Development of Network Measurement Tools

The NCHC has developed many network measurement tools to help monitor the TWAREN network and provide TWAREN's users with detailed, real-time performance measurements. These measurement tools are designed to enhance TWAREN's service quality. They include path tracking, round-trip-time, packet loss, and real-time throughput. The NCHC also participated in USA's National Laboratory for Applied Network Research (NLANR) Active Measurement Project (AMP) to develop Asia's first Local AMP Mesh unit.

C.Large-Scale R&D

In 2005, the NCHC, with the help of several renowned international experts, further developed its large-scale R&D in the fields of meteorology, renewable energy, and medical imaging. We have already begun to realize several preliminary achievements in the following large-scale R&D fields:

1. Computational Meteorology Simulation

The NCHC's Computational Meteorology Simulation service will provide Taiwan's policy-makers with the tools they need to help protect people's lives and the environment. The project seeks to increase native HPC facilities (i.e. supercomputers, networking, and storage) in an effort to produce a good CFD environment in which researchers can develop a weather forecasting system to help them forecast mid-sized typhoons. Our goal is for Taiwan to have its own meteorology and flood forecasting system in the very near future.

Our 2005 Computational Meteorology Simulation achievements included the co-sponsoring of the Hydrometeorology seminar and the establishment of the Taiwan Computational Hydrometeorology Consortium with Purdue University. Also, we began the construction of the "National Typhoon and Flood Center."

2.Renewable Energy Computational Simulation

The goal of NCHC's Renewable Energy Computational Simulation project is to seek inexpensive means by which to replace and/or renew energy and to discover new ways to reduce manufacturing production costs. The project seeks to develop pure and sustainable energies by examining the solar battery's transfer efficiency and understanding the mechanism by which ethyl alcohol is transformed into hydrogen. In 2005, we established several large-scale solid and gas chemistry mechanism patterns and published four scientific papers on the subject.

3.Computational Medical Imaging and Its Application

Medical imaging has evolved from the primitive Magnetic Resonance Imaging/ Computer Tomography (MRI/CT) to the much more advanced computational mesh pre-processing, cardio-vascular flow field simulation, stent design, carotid artery flow field analysis, and image reconstruction of the human body (e.g. skull, cervical spine, lumber spine, and femur). We demonstrated our medical imaging achievements at the SC05 conference and published five domestic and international scientific journal papers on the subject in 2005. We also began discussions on a correlation cooperative plan with Chang-Gung Memorial Hospital and National Taiwan University Hospital(NCTU).

D.Promotion and Training

1. Cultivation of Local HPC Talent

In 2005, the NCHC trained 8,152 individuals via conferences, lectures, and training courses. We also completed our ination of Distance Learning platform. We teach pioneering subjects such as computational plasma physics, MEMS device design, and multidiscipline simulation over our Distance Learning platform.

Table 5-2 2005 Training Achievements:

Category		Instances	Participants	Student Preparation
Seminars		6	445	543
Education and Training	Professional	123	2,548	4,461
	Specialist	12	150	850
Lectures		10	340	340
Outside Lectures		28	1,944	1,958
Grand Total		179	5,427	8,152

2.SPNCHC's International Reputation and Influence

The NCHC is recognized internationally as an active participant in various global HPC-related organizations. We are dynamic members in both the Asia Pacific Grid (APGrid) and the Pacific Rim Applications and Grid Middleware Assembly (PRAGMA) organizations. We have held two seats on the Board of Directors of PRAGMA since 2002 and our Grid Division Manger, Dr. Fang Pang Lin, was appointed Vice President of PRAGMA in 2005.

The NCHC is also a founding member of GLEON. This organization, jointly led by Taiwan and the US, was established to research global lake ecology. Currently, a total of ten countries are participating in the program and 15 lakes are under observation at present.

The NCHC also initiated the Underwater Reef Monitoring System, the goal of which is to link coral reef knowledge databases worldwide. The US and Australia are involved deeply in this project as well. The accomplishments of NCHC's Eco Grid project have long been recognized by the USA's NSF and Taiwan's NSC. The Eco Grid project is listed as one of the NSF's and the NSC's key co-projects.

In 2005, the NCHC co-hosted the 20th Asian Pacific Advanced Network APAN conference. During the conference, the (NCHC) presented its TWAREN research achievements and demonstrated the UCLP by successfully completing a cross-Atlantic connection. Currently, UCLP is heavily utilized in

Europe and America. The NCHC is the Asian Pacific leader in UCLP use.

In 2005, the NCHC signed MoUs with several international academic and industrial institutions including the Information Technology Center at the University of Tokyo, the Information Institute at Edinburgh University, the University of Chicago, Argonne National Laboratory, and Telcordia Technologies.

The NCHC is the only research institute in Asia to have a MOU with the University of Tokyo. Also, Ian Foster, often referred to as the "Father of Grid Computing," personally visited the NCHC to sign the MOU between the NCHC and Argonne National Laboratory.

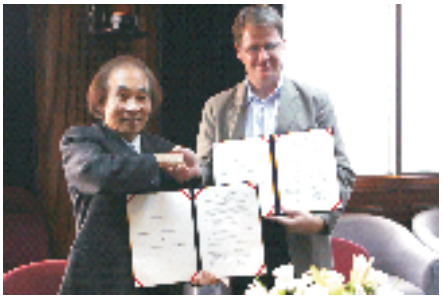


Figure 5-3 The MoU signing between the NCHC's Dr. Joe Juang and Argonne National Laboratory's Dr. Ian Foster, the "Father of Grid Computing."

3.Patents

The NCHC applied for a total of 41 patents 2003 through 2005. Twenty-three of these patents were applied for in 2005 alone. By the end of 2005, eight patents had been granted.

Table 5-3 NCHC's 2005 Patent Grants:

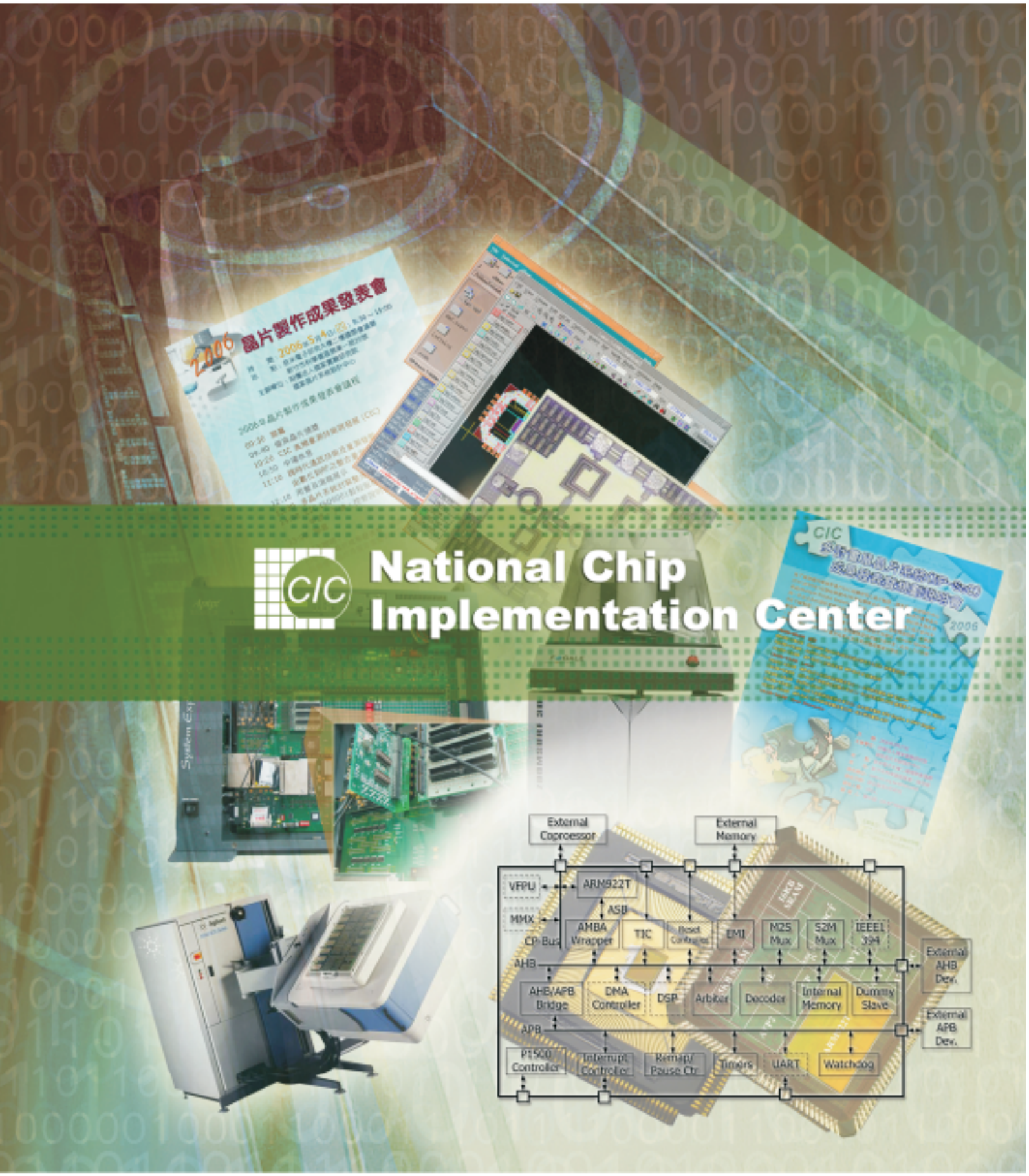
Name of Patent	Country of Origin	Attribute
Method for Storing and Searching Email Data By Classification	ROC	Invention
GIS/Video Teleconferencing System Integration	ROC	Invention
System for the Management of Disease Symptoms	ROC	Invention
Using a WLAN to Monitor Sites Remotely	ROC	Invention
Method for Displaying Multiple Images Simultaneously via Remote Control	ROC	Invention
Mechanical Horse Remote Control System for Setting Program Parameter	ROC	Invention
Network Status Monitoring and Warning Method	ROC	Invention
Light Guide with Color Mixing Zone	ROC	Invention

Vision

The NCHC will continue to strengthen its service by integrating all of its HPC resources (i.e. supercomputers, networking, storage facilities, software, and databases) and allowing our clients to easily access them via Grid middleware. The NCHC will also continue its commitment to service-related R&D by maintaining close contact with our users and other supercomputing centers located throughout the world. We will assist them in the further development of middleware and system technologies. The NCHC will also continue to develop its customized services such as PC Cluster technology and the 3D Fly Brain Neurogenomics Project database.

The NCHC is working diligently to enhance the quality of its internal management with the goal of becoming a world-class supercomputing center. Our first step toward realizing this goal was gaining ISO 9001:2002 certification in 2005. We are also working toward attaining ISO 27001=2005 Security Information Management Certification and R.O.C. Science & Technology organizational approval.

The NCHC will continue to focus on the development of innovative applications in the fields of biology, ecology, and medicine. The NCHC will also focus further on developing ground-breaking large-scale computational simulation systems in the fields of medical imagery, renewable energy, and computational meteorology. We will also continue to grow and strengthen our existing relationships with international associations by establishing new and innovative cooperative projects. We will be at the forefront of such projects in order to make the NCHC more visible in our global society.


2006 晶片製作成果發表會
CIC
National Chip
Implementation Center
External Coprocessor
External Memory
VFPU
MMX
CP Bus
ARM922T
ASB
AMBA Wrapper
TIC
EMI
M2S Mux
S2M Mux
IEEE1394
AHB
External AHB Dev.
AHB/APB Bridge
DMA Controller
DSP
Arbiter
Decoder
Internal Memory
Dummy Slave
APB
External APB Dev.
P1500 Controller
Interrupt Controller
Remap/ Pause Ctr.
Timers
UART
Watchdog

Chronicle

May 1992
Chip Implementation Center (CIC) Project was initiated by the National Science Council.

Jan. 1993
The project office was established in Technology Rd. III of the Hsinchu Science Park.

Oct. 1999
The project office was relocated to Prosperity Rd. I of the Hsinchu Science Park.

Sep. 2002
The Southern Regional Office was established in the Tainan Science Park.

Jun. 2003
CIC was regrouped as one of the centers under the National Applied Research Laboratories (NARL).

Nov. 2004
The office was relocated to the Nanoelectronics Research Building in the Hsinchu Science Park.

Missions

The main missions of CIC include: integrating and developing the IC/System design environment; providing chip fabrication and measurement services; promoting technological exchange and cooperation, and driving research in southern Taiwan.

Major Accomplishments

In 2005, CIC provided the following services to academia and made the following four related contributions.

A. Integrating and developing the IC/System design environment

To meet the demands of academic research and industrial development, CIC selected various EDA tools which have been widely adopted by industry. By integrating these tools into design flows for different research fields, CIC aims to establish a complete IC/System design environment. Furthermore, various standard cell libraries and SIP libraries were introduced for academic use. Some EDA tools were newly introduced in 2005, including CoWare ARM922T and AMBA PSP, CoWare PrimeCell Library, Synplicity Synplify Pro and Verisity SpeXsim. Additionally, CIC re-integrated and updated design flows including Electronic System Level (ESL), Cell-Based IC, Platform-Based SoC, Full-Custom IC, FPGA, Mixed-Signal IC, RF/MM IC, MEMS, IC measurement, and so on (Figure 6-1).

Figure 6-1 Agilent 93000 SoC Test System

To assist academic in research in IC/System design, CIC has offered EDA tools from 13 world renowned companies, including Altera, Agilent, Cadence, CoWare, Dolphin Integration, Magma, Mentor Graphics, SpringSoft, Synopsys, Synplicity, SynTest, TransEDA and Xilinx. These tools can support design flows, which can be accessible to academia, such as Electronic System Level, Cell-Based IC, Platform-Based SoC, Full-Custom IC, FPGA, Mixed-Signal IC, RF/MM IC, MEMS, IC Testing and so on. As of the end of 2005, CIC has helped 89 universities/colleges to establish over 1,600 seats of IC/System design environment.

Regarding SoC/IP design, CIC has established the IP Center and SoC design platform. Along with IC designs produced by academia during recent years, five self-developed IPs (ADC, DAC, MPEG4 Shape Encoder, Audio Codec and MPEG4 Codec) and several imported IPs (ARM and Tensilica CPUs) have been made available on the website for

Table 6-1 EDA Tool supported by CIC

Vendor	Software Contents	Vendor	Software Contents
Agilent	ADS_DSP	SpringSoft	Laker
Altera	MaxPlusII	Synopsys	Apollo
	Quartus II		Astro
Cadence	Allegro		Astro-Rail
	Analog Artist		Astro-Xtalk
	Assura		Cocentric System Studio
	BuildGates		Cocentric System C Compiler
	Composer		DFT Compiler
	Dracula		Design Compiler
	Fire&Ice		FPGA-Compiler II
	LEC		Formality
	NC VHDL		HSPICE
	NC-Verilog		Hercules
	NeoCircuit		LEDA
	SOC Encounter		NanoSim
	Spectre		Pathmill
	Verifault		Physical Compiler
	Verilog-XL		Power Compiler
	VoltageStorm		PrimePower
Coware	ConvergenSC		PrimeTime
			PrimeTime SI
	SPW		RailMill
DolphinIntegration	SMASH		Scirocco Simulator
Magma	Blast Fusion		Star-RCXT
Mentor Graphics	Calibre		TCAD
	Calebre Xrc		TetraMAX
	FPGA Advantage		VCS
	LeonardoSpectrum		VERA
	ModelSim	Synplicity	Synplify Pro
	Seamless CVE	SynTest	SynTest
SpringSoft	Debussy	TransEDA	Verification Navigator
	nLint	Xilinx	ISE Foundation

reference. Presently, professors and students can refer to the design templates from the self-developed IPs of CIC, re-deliver their research results into Soft or Hard IPs, and then integrate these IPs into SoC designs. Finally, these designs can be realized via the Multi-Project SoC (MP-SoC) projects of CIC.

B. Providing chip fabrication and measurement services

To enable the continued development of the IC design industry by training designers with experience in IC implementation, CIC has introduced various advanced processes from domestic foundries, and provides services for prototyping IC manufacture.

In 2005, several process environments were established, including five CMOS processes (TSMC 0.13um MS/RF1P8M CMOS、TSMC 0.18um 1P6M CMOS、UMC 0.18um 1P6M CMOS、TSMC 0.35um SiGe BiCMOS and TSMC 0.35um 2P4M CMOS), two GaAs processes (WIN 0.15um PHEMT and GCTC InGaP HBT) and the TSMC 0.13um Digital Mixed-Signal CMOS process which was introduced in the fourth quarter. Furthermore, CIC integrated the design rules, model files and EDA verification environments, and made them available on the website. Additionally, related training courses were offered.

In 2005, 404 papers, published by professors in the IC/SoC design fields, have benefited from the advanced process environments provided by CIC. Among these papers, ten appeared in ISSCC 2005 and 13 in ISSCC 2006. This result demonstrates the rapid progress and significant achievements of the advanced research. Additionally, the papers presented in other journals and conferences also increased gradually, showing the remarkable progress of academia in terms of both quality and quantity of research and development.

Regarding services for industry and research institutes, CIC adopts the Multi-Project Chip (MPC) approach by integrating multiple IC design projects onto a single chip, and then entrusts foundries with manufacturing to share resources and reduce costs. CIC continued offering fabrication services with advanced processes to the National Science and Technology Programs for Academia, industry and research institutes in 2005. These services reduced the inconvenience and uncertainty associated with direct contact between designers and foundries. Regarding the demands of conducting NSC projects, teaching and researching, professors can have their designs manufactured for free after passing the preliminary and final reviews. In 2005, a total of 1,351 ICs were fabricated, including 1,159 advanced and 192 educational ICs, which were designed by 1,709 students under the supervision of around 1,395 professors. Furthermore, 67 prototyping ICs designed by industry were successfully manufactured (Figure 6-2).

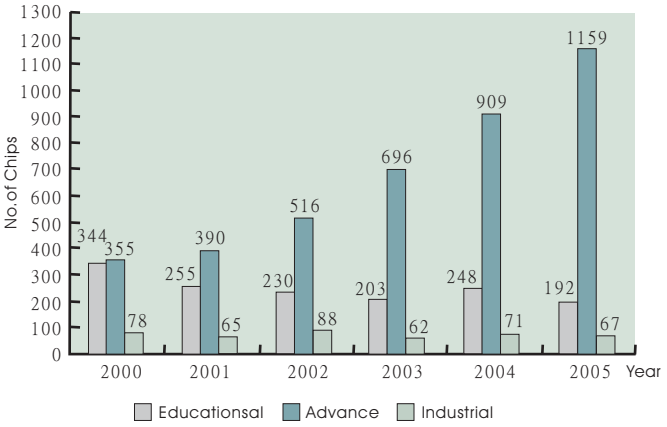


Figure 6-2 Statistics of chips had been taped out

Regarding measurement services, CIC has a full range of basic services, including those for digital, analog, mixed-signal, RF, MEMS, and so on. Specifically, network analyzer, on wafer probe station, load-pull measurement system, high frequency S-parameter, noise, spectrum are also available (Figure 6-3). In 2005, academia used these testing equipments on 409 occasions. Notably, 94 of these cases involved use of the Agilent 93000 SoC Test System.

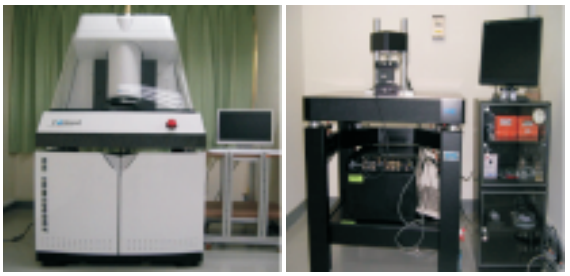


Figure 6-3 Fogale ZoomSurf 3D Optical Profilometer and Etec MEMS Motion Analyzer G2

C. Promoting the technological exchange and cooperation

Regarding manpower cultivation, CIC runs training courses on Full-Custom IC design, Cell-Based IC design, FPGA design, IC Testing, RF/MMIC design, SOC/IP design, and so on. Furthermore, most of the lecturers are engineers of CIC. In 2005, CIC arranged six categories of courses, comprising 41 separate courses and 146 classes , and involving 4006 attendees(Figure 6-4).

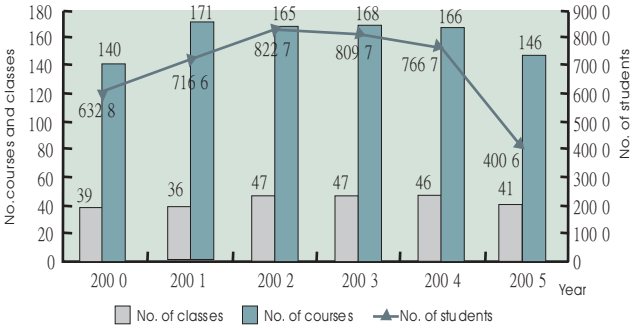


Figure 6-4 Statistics of courses, classes and students

To implement the strategy of 3E, namely Economical, Effective and Efficient, e-Learning courses are also provided to educate academics for on-line learning without constraints of time and space. Seven courses were available in 2005, namely HSPICE, Full-Custom IC design concepts, VHDL, RF CMOS IC design, MMIC design, HW/SW Co-Verification with Seamless CVE and ADS-Circuit.

Furthermore, CIC jointly organized the 2005 IC Design Contest with National Chiao Tung University and the 2005 SIP Design Contest with National Taiwan University to encourage academia to engage in IC/SIP design and upgrade design technology (Figure 6-5).

Figure 6-5 In the year 2005, CIC co-hosted the IC design contest with Ministry of Education and National Chiao Tung University

The IC Design Contest involved 545 teams and 1090 participants. Meanwhile, 97 teams participated in the SIP design contest, and the competition was intense. These two contests have turned out to be the major competitions for academia (Figure 6-6). Additionally, CIC hosted the 2005 Multi-Project Chip Workshop in April to demonstrate outstanding IC designs, increase the value of academic research and further promote university/industry cooperation. In this workshop, outstanding designers were invited to present their research results(Figure 6-7).

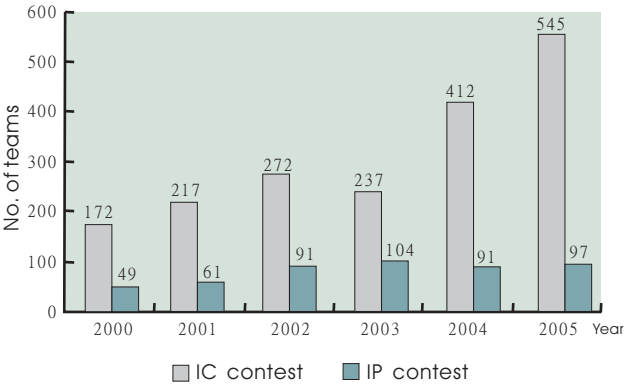


Figure 6-6 Statistics of IC and IP contests

Figure 6-7 CIC 2005 Multi-Project Chip Workshop

Regarding technology introduction and achievement promotion, besides close contact with international research institutes, CIC hosts numerous visits from foreign professors and experts each year, including groups from the USA, Japan, Korea, Canada, and so on(Figure 6-8). Hopefully, opportunities for international collaboration and mutual exchange can be increased by publicizing

the research environment and accomplishments of CIC. To date, CIC has signed Memorandums of Understanding with VDEC from Japan and CMP from France. Moreover, to promote IC design concepts to colleges and high schools nationwide, CIC also welcomes domestic visits from college summer camps and the Physics/Chemistry teachers.

Figure 6-8 CIC hosts many visits from foreign professors , experts and welcomes domestic visits from the college summer camp and the Physics/Chemistry teachers every year.

Technology innovation and intellectual property are indispensable assets in global industrial competition, and are also the prerequisites for Taiwan to become a so-called Green Silicon Island. Since 2004, CIC has encouraged staff to apply for patents, and has treated patens and technology transfers as important items. Presently, two patents have been granted, including one USA invention patent and one Taiwan new pattern patent. Furthermore, four patent applications have been filed on CMOS and MEMS process technology.

D. Promoting research in southern Taiwan

In line with Taiwan's overall Science and Technology Programs, strengthen the IC/System design environment in southern Taiwan, provide academia convenient IC measurement services, and cultivate related manpower, CIC established the southern regional office in the Tainan Science Park. To date this office has focused on the establishment of analog design and measurement environments, for example design flows and testing techniques for analog IC/IP.By building the research infrastructure, CIC aims to increase its support for professional services and gradually increase research momentum in the southern region. Additionally, to improve its verification and debugging services, CIC plans to introduce probing equipment and establish die-probe stations. Currently, the measurement environment includes digital measurement system (IMS100), wire bounder, prototyping printed board making system, and so on(Fig.6-9). In the future, more analog testing facilities will be offered for advanced chip testing. To facilitate human resource cultivation and technology promotion, the southern regional office organizes various activities, including training courses, MPC reviewing meetings, workshops and so on.

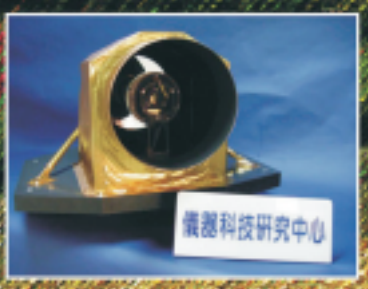
Vision

The operating model of CIC has been changed to that of a non-profit organization. The main objectives have thus focused not only on service but also research. In the future, besides providing services to academia, industry and research institutes, CIC will emphasize related research to establish a complete design environment and continuously upgrade service quality. By targeting both service and research, it is expected that growing numbers of excellent designers and advanced technologies can be developed. Additionally, as a national laboratory, CIC will spare no effort to meet the demands of the National Science and Technology Programs and industrial developments. CIC will also strive to be a leader in the global community and realize its vision of becoming a world-class research and service center for IC/System design.

Figure 6-9 IMS100 and prototyping printed board making system

ITRC

Instrument Technology Research Center



Chronicle

Given the significance of precision instruments in scientific research and industrial development, the Executive Yuan - National Science Council transformed the previously known "Scientific Data and Instrument Center" into the Precision Instrument Development Center in January 1974, to establish and develop specific technology and manufacturing capabilities for precision instruments in Taiwan. In January 1987, the Center moved to its present site in the Hsinchu Science-based Industrial Park and expanded to reach to its present size. In 2005, the Center began operating under the National Applied Research Laboratories, and was renamed the Instrument Technology Research Center.

1968
The National Science Council established the Scientific Data and Instrument Center in National Tsing Hua University.

1974
Under the auspices of the Executive Yuan, transformed from Scientific Data and Instrument Center into the Precision Instrument Development Center.

1987
The Center moved to its present location in Hsinchu Sciencel Park.

2003
The Center was recognized as an outstanding organization in the "Performance and Management Evaluation of the Government funding Research Organization" by the Public Construction Commission.

2004
The Center won the Agency Participation and Suggestion System R&D proposal Superior Award for 2004 given by the Executive Yuan.

2005
The Center began operating under the National Applied Research Laboratories, and was renamed the Instrument Technology Research Center.

Missions

The Instrument Technology Research Center focuses on boosting domestic standards in advanced instrument technology, establishes and develops precision instrument technologies in Taiwan, and fosters domestic instrument manufacturing capability. To achieve its mission, the Center offers nation-wide instrument engineering and technology support to academic research and prospering high-tech industries.

Major Accomplishments

Following three decades of efforts, the Center has established distinctive core and established rooting technologies including "Vacuum Technology, NEMS/MEMS Fabrication and Inspection Technology" and "Optomechatronic System Technology". Based on these rooted core technologies, the Center has recently invested its resources in four fields including "Remote Sensing Instrument, Vacuum Systems and Application, Instrument Miniaturization on Bio-medical/Opto-electronic Industries" and "Optomechatronic System Technology". The commendableachievements for the year 2005 are as follows：

A. Innovative Instrument System and Technology Implementation

In 2005, the Center developed nine innovative instruments including "Aspheric Conjugated Polishing Machine, Atomic Layer Deposition System,

Discrete and Digitized Fluidic Analysis micro-Chip, Digital Micrographic Camera and On-line Backlight Unit Luminance Inspection System" to name a few. Among these, the Atomic Layer Deposition System was designed and built to meet academic research needs and is an example of academic research oriented program. Aside from Atomic Layer Deposition System, some of the above systems are industrial application orientated, such as the On-line Backlight Unit Luminance Inspection System which is a leading instrument in the global flat panel industry. This system enabled a local flat panel firms to win manufacturing orders exceeding NT$ 200 million immediately after it was installed into production lines. Digital Micrographic Camera was developed to fulfill industrial needs; the Camera thus creates a very new market exceeding NT$300 million per year.

1.Aspheric Conjugated Polishing Machine (ACPM)

The system is an example of the optomechatroic system. ITRC developed the ACPM system utilizing owned patents to meet the needs of the domestic optical industry, especially for non-image optic systems, such as Automobile Light, LED, etc. The developed ACPM has benefits in mass manufacturing, which offered three times faster manufacturing than is presently available and is expected to override current aspheric lens manufacturing processes.

2.Discrete and Digitized Fluidic Analysis Micro-Chip (DDFAMC)

The system is practically application for microchip. DDFAMC comprises three parts including the digital fluidic control platform the light absorption and detection system, and the micro-fluid transmission system. DDFAMC has been successfully applied to cardiovascular disease inspection and the outcomes miniaturized system establishes key milestones for the industry practicability of the microchips and helps domestic nursing.

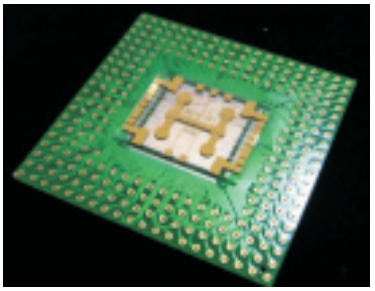


Figure 7-1 Discrete & Digitized Fluidic Analysis micro-Chip

3.Atomic Layer Deposition System (ALD)

In order to meet the requirements of the ultra thin high-k materials with high aspect ratio structure, deposition techniques for next generation semiconductor industry and nanostructured materials research. ITRC integrates its homegrown vacuum technology and various thin-film deposition engineering experience to develop the new Atomic Layer Deposition System. ALD is a surface-controlled sequence layer-by-layer deposition process involving alternating, self-limiting surface reactions (precursor, water and substrate) to achieve controlled atomic-level deposition.

4.Optical Monitoring System (OMS)

The system is a new on-line thin-film coating monitoring device ITRC combines posed optic coating engineering, vacuum technology, automatic control technique and accumulated optics thin film design experience to develop a new on-line thin-film coating monitoring system. The control algorithm is designed to compare the measured optical parameters with the design data on time and enables precise control of the coat film thickness. ITRC is closely involved in developing this system and expects the system to be able to help optical industry firms enhance their international competitiveness.

5.Nanosphere Lithography

The technique is a key process for manufacturing growth of nano structures. This technique is based on the principle of making a self-assembled nanosphere to serve as a template and could rapidly produce a regular nano structure. The most important feature of this manufacturing method is that the technique is compatible with thin-film and MEMS fabrication. Consequently, by combining growth of carbon nanotubes and molded nanostructures.

6.High Vacuum Chemical Beam Epitaxy System

The system is a novel III-V epitaxy system. ITRC uses this high vacuum system core technology to develop novel III-V epitaxy system with background pressure around 1×10^{-9} Torr. Unlike commercial systems, this system attempts to combine the advantages of the MBE and MOCVD methods by

combining a plasma-assisted chemical beam epitaxy system. The system thus can operate at relatively low temperature and has none of the associated risks of ammonia. The developed system not only is suitable for mass production, but can also offer a high-quality thin film of III-V nitride compound.

7.On-line Wafer Positioning Detection System

The system is based on remote-sensing geometric calibration technology and is designed to monitor the position of a wafer during loading/unloading into a chamber by a machine arm based grabbed images. This system uses remote-sensing image geometric calibration. The system performance has been validated by application at the site of a major domestic semiconductor fabrication facility. The system is expected to have potential as an on-line inspection device and can be able to improve yield rate on production line.

8.On-line Back-light-Unit Luminance Inspection System

The System is an innovative instrument expected to replace modern off-line inspection systems. The On-line Back-light-Unit Luminance Inspection System has an inspection speed over ten times that of previous systems. The system has been promoted for use on the production lines of the subcontractors of major flat panel companies in Taiwan. The device efficiently increases inspection efficiency, ensures back light unit quality and reduces the risk of products being returned.

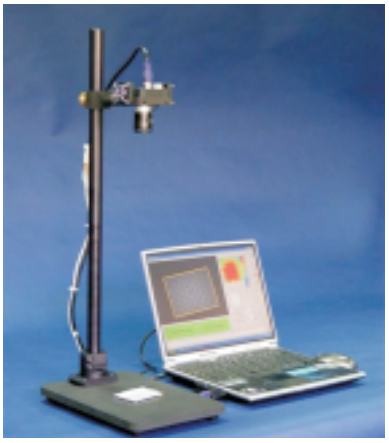


Figure 7-2 On-Line Backlight Unit Luminance Inspection System

9.Digital Micrographic Camera

This device is designed to meet the requirements of short-distance microscopic photography and its design includes a LED apparatus for illuminating specimens. This camera is a powerful tool for skin analysis as well as for collecting micro-evidence for use in identifying criminals. The camera is also potentially a convenient teaching aid for observing and recording the life and motion of small creatures. For industrial applications, the camera can rapidly inspect LCD for bad pixels on the production line. Applying LED illumination, the "Digital Micrographic Camera" was awarded an Excellence Medal in the individual group category in the "National LED illumination innovation design contest" for 2005.

Figure 7-3 Digital Micrographic Camera

B.Key Subsystems and Core Technologies

In 2005, the Center has accomplished key subsystems and core technologies for use including SWIR linear CCD module, 14403 pixel linear CCD module, airborne hyper-spectrum system, wide-spectral-range optical filter, high voltage single-shot function generator, super-lattices film, plastic base conductive/transparent thin film, cell-culture nanostructure, micro pump, Diffraction/Refraction compound image lens, and fluid manipulation device. Moreover, ITRC collaborated with National Tsing Hua University by combining IZO and OLED technologies from each site and developing a new flexible white light device. In the near future, this device is expected to be widely applied to the LCD and illumination industries.

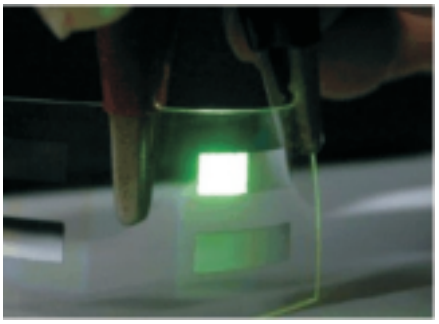


Figure 7-4 Flexible organic thin-film emitting white light as 8 Voltage current is applied

C.Patents and Publications

The patents, papers and technological reports of the Center are described as follows：

1.Patents

The Center filed 40 patents, and awarded nine new patents in 2005. The details of the newly awarded patents are listed as follows：

Table 7-1 Patents list

Patents	Category	Issued by
Driver for amplifying operating voltage of luminary	Invention	US
An ambient noise Driving Amplitude Modulation Electronic Speckle Pattern Vibration Measurment System	Invention	ROC
Electro-wetting Electrode Design with Electromagnetic Field for Actuation of Magnetic-Beads Biochemical Detection System	Invention	ROC
Micro-sensing structure made of iron and electricity materials and the manufacturing method	Invention	ROC
Thin films SAW devices and the associated manufacturing method	Invention	ROC
Method and device for droplet manipulation	Invention	ROC
optical fiber nano light wave-increased parts and its manufacturing method	Invention	ROC
It is the non-rotated drive basic circuit rotating hoist applied to epitaxial coating machine for high-temperature growth.	Utility Model	ROC
Light emitting diode employing low supply voltage and generating negative oscillating voltage	Utility Model	ROC

2.Papers and Technology Reports

IIn 2005, the Center has published 130 papers, including 36 journal papers and 94 conferences papers. Furthermore, the Center's researches have completed 46 technical reports, which have been managed and treated as Trade Secrets. For reference, the published journal papers are tabulated as follows：

Table 7-2 SCI paper list

Paper Title	Journal
Temperature-Dependent Photoluminescence of Highly Strained InGaAsN/GaAs Quantum Wells (λ = 1.28-1.45 μm) with GaAsP Strain-Compensated Layers	Japanese Journal of Applied Physics
Realization and characterization of SU-8 micro cylindrical lenses for in-plane micro optical systems	Microsyst. Technol.
Influence of sputtering parameter on the optical and electrical properties of zinc-doped indium oxide thin films	J. Vac. Sci. Technol. A
Microstructural evolution of AIN coatings synthesized by unbalanced magnetron sputtering	J. Vac. Sci. Technol. A
Structural and optical properties of erbium-doped Ba0.7Sr0.3TiO3 thin films	J. Vac. Sci. Technol. A
Investigation of layered structure SAW devices fabricated using low temperature grown AlN thin film on GaN/sapphire	IEEE Trans. Ultrason. Ferroelectr. Freq. Control
An intelligent view box system for cephalometry	IEEE Trans. Instrum. Meas.
An improved LED driver	ElectronicWorld
Direct experimental evidence of hybridization of Pb states with O 2p states in ferroelectric perovskite oxides	Appl. Phys. Lett.
Graphic method for numerical analysis of a periodically stratified thin-film omnidirectional reflector	Appl. Optics

D.CNLA certification laboratory (ISO/IEC 17025)

The Center has long been devoted to establishing general competence requirements for carrying out tests and/or calibrations, including sampling with ISO/IEC 17025:2005. The Center specifies second laboratory where testing and calibration are comprise part of inspection and product certification. ISO/IEC 17025:2005 is applicable to all international laboratories regardless of number of personnel or the scope of testing and calibration activities. CNLA certified laboratories are for use by the center in developing their system for managing quality, administrative and technical operations. Customers, regulatory authorities and accreditation bodies may also use the certified document to confirm laboratory competence. The Center has already constructed the vacuum standard calibration laboratory and opto-electronics inspection laboratory. The vacuum standard calibration laboratory has already been certificated for many years and passed the re-evaluation of CNLA in 2005. The opto-electronics inspection laboratory is CNLA certified on "Glossy calibration" item, and has been able to provide public measurement and calibration services since Jan. 2006.

E. Technology service and promotion

To enhance the efficiency of technological services relating to research on the high-tech industry and academia, the Center has long offered one-step technical service. The Center provides technological services including instrument design, implementation, calibration, maintenance, technical consultation, and technology transfer. To promote instrument technologies and human resources, the Center provides various workshops, professional technology training programs, and National Instrument Information on-line Retrieval Services.

1.Technology promotion

The Center actively hosts and participates in technological forums and exhibitions, and the related promotional activities are as follows：

- 2005 Taipei International Optoelectronics Show

At this major optoelectronic trade show, ITRC exhibited self-developed airborne remote sensing instruments and miniaturized bio-analysis systems, optical fabrication and inspection capabilities as well as associated technology.

- 2005 Tainan Automation Industry Exhibition

To strengthen technology promotion between industry and academia in southern Taiwan, the Center participated in this exhibition in Pei-Ju Exhibition Hall from Sep. 2 to 7.

- Taiwan Nano Tech 2005

This exhibition is held at the Taipei World Trade Center and the Taipei International Convention Center from Sep. 21 to 26. The Center presented an innovative biomedical miniaturized instrument that combines micro/nano fabrication, droplet manipulation device, and other bio-medical detection devices, developed using the MEMS/NMES technologies of the Center.

- The 2005 Taipei International Invention Show and Technomart

At this show, ITRC presents various self-developed instrument systems to the public and all other systems developed using the Center's innovative patents.

- 5. First Taiwan Instruments International Exhibition 2005

This exhibition is held in Taichung from November 2 to 7. The Center hosts a forum regarding "Instrument Industry Promotion and Development", which ITRC dwelled on "The Importance of Optomechatronic Technology in the Instrument Industry" and "Tenders of instrument miniaturization".

- Promotion of the Instrument Technology Research Center

Promotions are held in Tainan, Taipei and Taichung to facilitate industrial, academic and other research in southern Taiwan and to fully understand efficiently the use of this technology in ITRC. In 2005, the promotion focused on opto-electronics and biotechnology industry companies. The Center also invited the professors of instrument related departments of universities, R&D institutions, and innovation incubation centers.

- Conference on Optomechatronic Integration Application

This Conference was held on Aug. 30, and ITRC hosted the "Conference on Optomechatronic Integration Technology Application" and released a newly published book— Introduction of Optomechatronic Systems to the public. The conference invited Liu Jung-sheng, Director of Opto-Electronics and System Laboratories, Industrial Technology Research Institute, to provide a lecture entitled "Current development situation and trends of the Opto-Electronics industry". Lo Jen-chuan, President of National Cheng Chung University and Professor Wang Wei-chung of National Tsing Hua University, also gave an introduction on the applications of optomechatronic technology in the smart robot and mechanics fields.

2.Instrument Manufacturing Maintenance and Recalibration

To maintain domestic instrument resources and upgrade instrument usage efficiency, the Center actively promotes an "instrument maintenance system" to provide instrument manufacturing, repair and recalibration. This system targets hi-tech industry firms, universities, research institutes, the military institutions and hospitals. In 2005, the Center service 2,041 cases, and accumulated cases served reached up to 6,935 cases during the last three years, as listed in Table 3.

Table 7-3 Instrument Maintenance System performance during the past three years

	2003	2004	2005
Suppliers	98	106	97
Academic	46	58	17
Research Institution	10	9	7
Military	--	2	1
Hospital	1	--	1
Government	1	3	3
Total services cases performed per year	2,416	2,478	2,041

3.Technology transfer and Industry Projects

In 2005, the Center successfully turned over the Manufacturing of micro-flexible structures and Lens set for digital micrographic camera to private firms. Additionally, the Center also completed three industry projects requested and funded by private hi-tech firms. (as Table 7 - 4)

Table 7-4 Technology Transfer and Industry Projects

	Technology Terms
Technology Transfer	Lens set for digital micrographic camera
	Manufacturing of micro- flexible structures
Industry Projects	Optic system performance evaluation and upgrade of a CO_2 laser drilling machine
	Design and Manufacturing of a Micro-probing devices
	Beam shape design and component manufacturing of a CO_2 Laser machining system

F.Training Programs & Talent cultivation

In 2005, the Center provided training courses on both professional theories and practical technologies, including precision engineering, opto-electronics technology, vacuum technology, and instrument utilization and maintenance. In 2005, the Center hosted 21 courses involving 712 students.

1. R&D Training Program

To cultivate high-tech industry research manpower, the Center made R&D facilities available to all graduate students nation-wide, allowing graduate students to apply to participate in ongoing projects of the Center. In 2005, 55 graduate students from 15 universities and colleges have participated on this program.

2.International Instrument Training and Join-in Research Program

With support from the International Cooperation Program of the National Science Council, the Center hosts a long-term training and join-in research programs to help international technology organizations and countries develop scientific instrument technology. In 2005, ITRC hosted 20 researchers, who are officers of government scientific sections and professors, from Thailand, Philippines, Indonesia, and Vietnam who participated in the Program. Through this program, ITRC has provided a platform for conducting technology exchanges and cultivating friendships between Taiwan and its neighboring countries.

Figure 7-5 2005 International Scientific Instrument Training Workshop Opening Ceremony

G.Domestic Instrument Resource Information System

The Center constructs and maintains a "National Instrument Information System". This information system gathers instruments purchased by public/private sectors during the past ten years which has price greater than NT$ 1 million. In 2005, the system accumulated 17,529 instruments data. This system can assist people to understand the distribution of instrument resources and predict trends in instrument needs in Taiwan. This system is important to the government in terms of planning instrument R&D projects and associated policies.

Education Outreach

A.Specialized publications on instrument

In 2005, the Center published a further six volumes of "Instruments Today", including special issues on "Nano Imaging on Bio Structures, Tera-Hertz Technology, Nanofabrication and Characterization, Gas analysis Method", and "Scanning Probe Microscopy", for delivering new instruments and metrologies to researchers and the public. The Center also published a new book, entitled Introduction to Opto-Mechatronic Systems, to provide essential knowledge to industry and academia. Optomechatronic systems always involve various technologies. To provide readers with a clear picture for a both theory and application, ITRC invites experts from different technological fields, including optics, electronic engineering, mechanical engineering, and physics to author books.

Figure 7-6 New published book "Introduction to Opto-mechatronic Systems"

B. Scientific education

To promote the importance of scientific instruments, the Center accepts requests from high schools and universities for educational activities. The Center arranges for professional researchers and/or engineers to explain on-going projects and provide visitors with a good understanding of the cutting-edge instrument development in Taiwan. In 2005, the Center hosted 1,518 visitors, and thus played an important role in national scientific education development.

Moreover, the Center also instructs students of the National Science Council Taiwan Tech Trek 2005 to manage the study report and empirical design of "Compass Chariot". Their project entitled "The Legendary Compass Chariot" was awarded the top prize from among 22 presentations in the engineering session of the TTT 2005 conference. Figure 7 - 7 shows that the students received medals and commendation from Dr. Wu, the minister of NSC. The compass chariot, as illustrated in figure 7 - 8, was implemented by students at ITRC.

Figure 7-7 Students of Overseas Second Generations worked together at ITRC on Compass Chariot andwere awarded the First Prize in the Taiwan Tech Trek Academic Conference Engineering Session.The picture shows that the students received a medal and commendation from Dr. Wu.

Figure 7-8 Compass Chariot

Vision

Precision instruments are not only an important tool for fundamental research, but also a driver of high-tech industry development. With breakthroughs in academic study and the needs of the high-tech industry, the development of instrument technological has advanced rapidly. Various new instruments have emerged and system complexity is growing. In the increasingly competitive future, the "Instrument Technology Research Center" will continue to hold the self-required on pursuit of excellence, thus maintaining itself as an important role in research relating to national precision instruments and technologies.


Science & Technology Policy
Research and
Information Center
STPI

Chronicle

The Science & Technology Policy Research and Information Center (STPI), formerly the Science & Technology Information Center (STIC) and subordinate to the National Science Council (NSC), Executive Yuan, was reassigned to the National Applied Research Laboratories (NARL) on January 16, 2005 in order to meet the government's overall science and technology development needs. We at STPI look forward to employing our 30 years of information processing and analysis experience to strengthen Taiwan's sci-tech policy analysis and research and continue to establish knowledge banks. By relying on the services of both domestic and foreign experts and specialists, STPI is creating a sci-tech policy interchange platform to promote the development of a domestic sci-tech decision-making system. We will continue to work towards our overall goals of "reaching a consensus concerning Taiwan's national sci-tech development roadmap for the next 5 to 10 years, consolidating the developmental foundation of sci-tech industry, and enhancing international competitiveness."

Jan. 1974
Science and Technology Information Center, National Science Council was established with Executive Yuan approval.

Oct. 1980
Offers International Database Online Retrieval Service.

Dec. 1988
Offers the Science & Technology Information Retrieval Network (STICNET).

Sep. 1995
Provides online information services.

Jun. 1998
Provides online Government Research Bulletin (GRB) information retrieval service.

Sep. 1998
Establishes the CONsortium on Core Electronic Resources in Taiwan (CONCERT).

Sep. 1999
Provides Nationwide Document Delivery Service (NDDS).

Mar. 2000
Establishes the online APEC Science and Technology Policy Research Center (APEC-STPRC).

Sep. 2000
Establishes Policy Research, Information Analysis, and Survey & Statistics Divisions.

Oct. 2001
Provides online Information and Communication Security System (ICS) retrieval service.

Jan. 2002
Provides "Sci-tech Policy Think Tank" online information retrieval service.

Jul. 2002
Launches the "Nano Web" online information retrieval service .

Jul. 2004
Offers the "REsearch All In One" (REAL) integrated sci-tech information retrieval service.

Oct. 2004
Offers the "National Profiles of Human Resources in Science and Technology" (NPHRST) online information retrieval service.

Jan. 2005
The "Science & Technology Policy Research and Information Center" (STPI) comes into being after STIC is reassigned to the National Applied Research Laboratories.

Apr. 2005
Provides the "Database of Research and Innovation Capacity" (DBRIC) online information retrieval service.

Jul. 2005
Implements the Information and Communications Safety Management System (ISMS) and receives ISO BS-7799 certification.

Missions

- To support the governmental decision-making system by constructing a well-structured platform for policy research and building knowledge databases for science and technology.
- To support academic research and development by integrating national and international information resources, and providing all-in-one services.
- To support industry innovation by providing the cutting-edge technological development, strategic directions and training programs.
- To promote international exchange and cooperation by expanding international network. Hence, STPI provides critical insights for government policy decision-makers by undertaking policy research of science and technology development and value-added analyses. In addition, developing and integrating national and international information resources to foster the domestic sci-tech research are also the primary goals of STPI.

Major Accomplishments

A.Sci-tech Policy Research

1.Sci-tech Policy Planning and Management Research

Addressing implementation issues in the wake of the 7th National Science and Technology Conference, STPI completed the study "Sci-tech Policy Formulation Mechanisms," systematically proposed a sci-tech policy formation system, and analyzed the system's constituent elements. This work helped guide the government in formulating sound sci-tech policies. STPI also assisted the Science and Technology Advisory Group (STAG) as well as think tanks such as Taiwan Institute of Economic Research (TIER) and Industrial Technology Research Institute (ITRI) to jointly complete the "Setting-up of the Pilot Plan for Technology Foresight Program in Taiwan" addressing the areas of energy, agriculture, and biotechnology...etc. In addition, STPI implemented the "Humanities and Social Sciences Academic Activity and Research Assessment," which provided directions and operating mechanisms for assessing the performance of academic activities, and was used by the National Science Council as a reference for drafting relevant incentive and evaluation measures. With regard to joint international research, STPI participated in the Eurocores joint international research workshop with organizations from 9 other Asian and European countries, and discussed national innovation systems and other major issues.

2.National Major Sci-tech Policy Research

STPI has performed systematic research on various key national issues affecting Taiwan's sustainable development, including Energy Technology, Agricultural Innovation, Information Society, National Security, Sci-tech Diplomacy, China's Technological and Socio-economic Development, in order to provide the government with forward-looking policy recommendations. STPI has recruited domestic and foreign senior research personnel and doctoral-level research manpower to assist in this work. In addition, STPI has organized a specialist think tank comprising over 60 experts from Taiwan and abroad affiliated with industry, government, academia, and the research community, and has set up mechanisms for policy research interchange, communication, and professional support. STPI held more than 30 specialist panel discussions with close to 500 participants in 2005. The views expressed at these discussions are already yielding impressive results after less than one year.

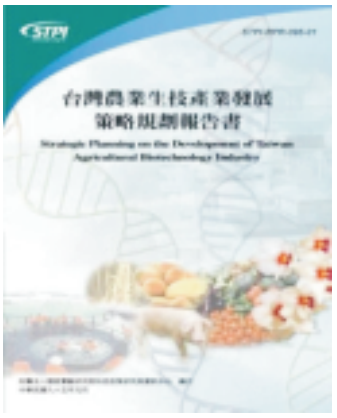


Figure 8-1 Strategic Report

■ Energy Technology

STPI proposed a conceptual national energy technology program at the 21st Science and Technology Meeting of the Executive Yuan held in July 2005. The Executive Yuan then immediately established an energy policy and sci-tech

development task force and working group in October of the same year. STPI helped the NSC establish a national program office responsible for staff matters relating to the integration of resources and planning of energy development strategies. STPI also devised a framework for the first estimates of net carbon dioxide emission volume, established a dynamic monitoring platform for carbon dioxide emissions, and conducted international comparisons and measurements.

■ Agricultural Innovation

STPI conducted the "Agricultural Biotechnology Industry Development Plan Study" on behalf of the Science and Technology Advisory Group, and helped research and establish an agricultural biotechnology industrialization platform implementation plan. In addition, STPI developed Taiwan's first integrated policy roadmapping method for agricultural upgrading using strategic planning technologies. At the same time, STPI completed an analytical framework and industry analysis for the agricultural production/shipment/marketing system, and issued the monograph "Analysis of the Agricultural Networking Development in Taiwan, Japan, and China."

■ Information Society

STPI compiled the "White Paper on Information and Communications Security" as part of the Science and Technology Advisory Group's staff operations team, and completed the "Study of Information and Communications Security Policy in the US, China, and Japan."

■ National Security

STPI completed policy recommendations concerning domestically-made unmanned aircraft and a domestically-built small submarine, and invited the National Security Council and other relevant units to hold a wrap-up presentation.

3.Industrial Technology Development Strategy Research

STPI completed five research projects on relevant industrial technologies and published monographs on the projects' results; these projects were entitled "Microarray Biochip Technology Roadmapping," "Microfluidic Biochip Technology Roadmapping," "Patent Analysis of Super-RENS Disk," "Patent Analysis of Micro and Submicro Bionsensor Systems," and "Patent Analysis of Drug Delivery Nanotechnology." STPI also issued 8 technical papers including "Renewable Energy Policy and Current State of Renewable Energy in Germany" and "Market Analysis of Photovoltaic Renewable Energy." Furthermore, STPI maintained the "Nano Web" information service website, established nanotechnology manpower and industry databases, actively accumulated technical knowledge and provided that knowledge in value-added form to industry, and promoted interchange and cooperation between industry, academia, and the research community.

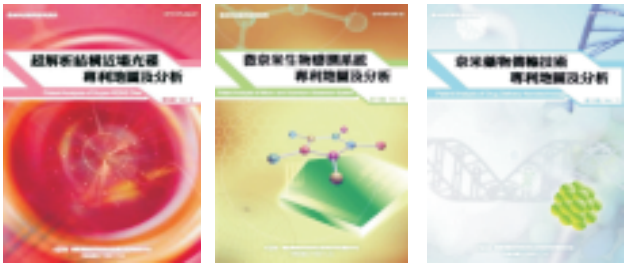


Figure 8-2 Research Publications-Patent Analysis Series

4.Development of Sci-tech Performance Assessment Methods

STPI completed the project "Research Capacity of Asian Countries Bibliometric Analysis of International Journal Papers." This project used bibliometric analysis of literature with an international perspective to conduct an overall analysis of Taiwan's sci-tech performance. The project also established a comprehensive and systematic quantitative indicator system for international journal paper output; this system incorporated the indicator items of output, productivity, citation impact, and co-authorship, etc. Furthermore, the project's analysis of the relative academic research competitiveness of Taiwan, South Korea, China, Singapore, and Japan in 248 fields from 1995 to 2001 was the first systematic study of international research capacity ever undertaken in Taiwan. In this area, STPI is also developing science- and technology-linked research measures. STPI will continue to pursue this line of work in the future in order to accelerate progress in the analysis of national sci-tech capacity.

5.Establishment of Sci-tech Policy Research Knowledge Banks

STPI collects sci-tech policy decision-making data from Taiwan and the US, Japan, the EU, Korea, and Singapore, etc., and compiles and maintains the "Sci-tech Policy Research Website" and relevant databases. The systematic collection of the most up-to-date sci-tech policy research information allows STPI to support sci-tech policy research and provide relevant information service to external users. STPI publishes the monthly Sci-Tech Policy Review and the annual report Knowledge & Innovation. STPI also completed the 2005 Yearbook of Science and Technology on behalf of the NSC actively and disseminated of sci-tech policy research information.

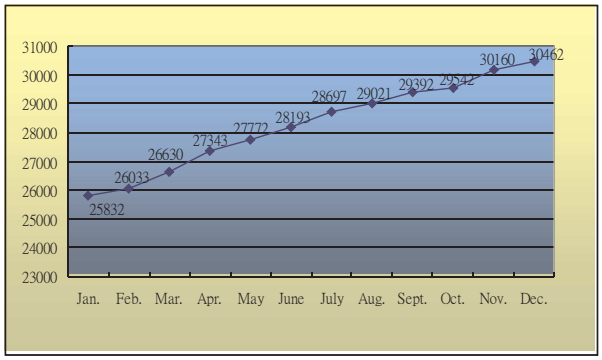


Figure 8-3 Cumulative Number of Papers Submitted to the Sci-tech Policy Research Website

6.Establishment of R&D Resource Databases and Promotion of Practical Applications

In order to strengthen Taiwan's R&D infrastructure, in 2005 STPI continued to update and maintain 7 database clusters in the respective areas of research projects, research reports, sci-tech manpower, R&D and innovation capacity, conference papers, M.S./Ph.D. theses as well as information and communications security and has processed more than 50,000 articles. STPI also provided 5 academic research service websites: Government Research Bulletin (GRB), National Profiles of Human Resources in Science and Technology (NPHRST), Database of Research and Innovation Capacity (DBRIC), Electronic Journal System (EJS), and the Information and Communications Security (ICS) Website. STPI published 7 monographs and 1 collected papers on information and communications security. In order to lend impetus to sci-tech policy research, STPI established 3 new research databases on the subjects of technology forecasting, fuel cells, and agricultural biotechnology. With regard to promoting the practical application of databases, STPI completed an Executive Yuan-acclaimed strategic plan for the development of Taiwan agricultural biotechnology industry; this strategic plan is based on databases established by STPI and other agencies containing information on agricultural biotech R&D inputs & outputs, and domestic and foreign enterprises, and was completed after many discussions with more than 20 experts affiliated with industry, government, academia, and the research community. STPI further completed an academic cooperation plan in 2005, expects to establish and begin a trial operation of an academic cooperation mechanism in 2006, and looks forward to implementing joint academic research projects in 2007.

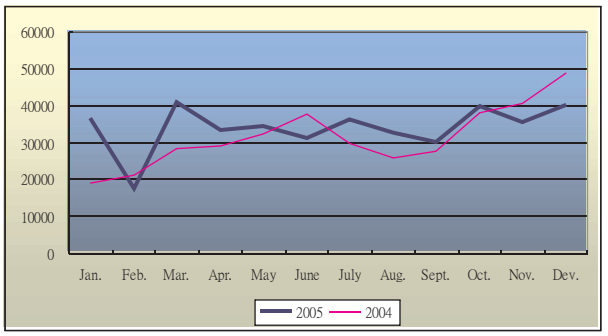


Figure 8-4 Number of Access in GRB Website

B.Information Services

1.CONsortium on Core Electronic Resources in Taiwan (CONCERT)

Established and headed by STPI, the "CONsortium on Core Electronic Resources in Taiwan" (CONCERT) is Taiwan's primary mechanism for acquiring electronic academic information resources. Electronic information resources acquired via CONCERT constitute the most important source of research and reference information in Taiwan. The CONCERT program has yielded extraordinary results since it was initiated in 1999. A total of 202 academic and research institutions including 97 universities, 57 colleges, 15 junior colleges, and 33 research organizations participated in CONCERT's operations in 2005. CONCERT acquired 28 systems and 96 databases

during that year, including 47 abstract databases, 21 full-text databases, 13 electronic journal databases, and 15 reference tool databases. CONCERT now provides approximately 10,900 titles of electronic journals. STPI is in charge of CONCERT negotiations and price, terms and condition of licensing agreement. It is estimated that Taiwan saved NT$220 million in 2005 due to CONCERT. STPI has further formulated a plan to strengthen CONCERT's functioning and enhance its performance, so that it better promotes the development of the academic research environment.

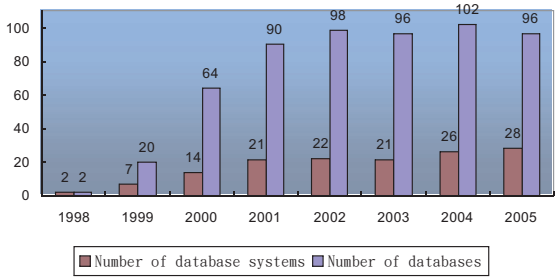


Figure 8-5 Number of Database Systems/Databases Acquired by CONCERT

2.Nationwide Document Delivery Service (NDDS)

STPI's Nationwide Document Delivery Service (NDDS) is Taiwan's only nationwide online literature application system. NDDS's resources include 59,000 periodicals at the libraries of 410 major domestic academic and research units. NDDS has provided online query, full-text reprint, and interlibrary loan services to over 120,000 users at 471 libraries. NDDS is used for online queries 1.32 million access and for interlibrary reprints and interlibrary loans 200,000 access in 2005. NDDS takes an average of 4.5 days from the time of application to provide a document. In order to make NDDS more effective, STPI added the Union List of Japanese Periodicals, converted the system to Unicode, and implemented an interface with the National Central Library's READ service system in 2005. STPI's efforts have increased the breadth of NDDS's library information and literature resources, while strengthening overall service quality and effectiveness.

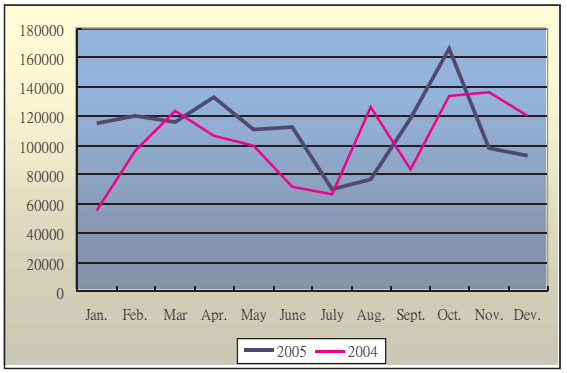


Figure 8-6 Number of Access in NDDS Website

3.Establishment of Sci-tech Information Systems and Network Infrastructure

The accumulation of policy research information and provision of online information services must be backed up by powerful information technology. STPI must continue to improve its integrated information service platforms and strengthen information and communications security safeguards in order to satisfy sci-tech policy research and information service needs and accomplish the missions of information transmission, knowledge diffusion, and public education. Items completed in 2005 include the establishment of the "Sci-tech Information e-Commerce Service System," strengthening of Science & Technology Information Retrieval Network (STICNET) functions, establishment of a project management system, and enhancement of "REsearch All in One" (REAL) performance. These actions effectively supported the overall development of STPI's services. STPI also successfully adopted the ISMS system and established information security management mechanisms. STPI is the first unit to receive ISO BS-7799 certification among NARL's laboratories and research centers.

Figure 8-7 BS-7799 Certificate

Table 8-1 Information Service Accomplishments in 2005

Information service item	Service performance
Government Research Bulletin (GRB)	Cumulative whole-year service of 410,055 access
Database of Research and Innovation Capacity (DBRIC)	Cumulative whole-year service of 23,128 access
National Profiles of Human Resources in Science and Technology (NPHRST)	Cumulative whole-year service of 27,664 access
Information and Communications Security (ICS) Website	● Cumulative whole-year service of 2,296,434 access ● Provided Selective Dissemination of Information (SDI) service ● 2,220 registered users
Research Literature Database and Electronic Journal System (EJS)	Cumulative whole-year service of 5,471,974 access
Science & Technology Information Retrieval Network (STICNET)	● 50 group users ● 9,147 user account applications ● Issued 27,480 user IDs ● 883,037 retrieval services provided ● 676,689 print-outs
Research All In One (REAL)	● Cumulative whole-year service of over 120,000 access ● 834 registered users
Sci-tech Policy Research Website	Cumulative whole-year service of 56,608 access
Nano Web	● 368 registered users ● Cumulative whole-year service of 60,000 access
Publications & Information Service Desk	● Commissioned retrieval services on 1,040 topics ● 2,288 publications sold ● 23,000 full-text articles service
Industry Information Services	● Over 7,000 registered users ● Cumulative whole-year service of 1.4 million access

Education Outreach

STPI held 15 seminars attended by 1,151 persons in 2005 as part of its mission of promoting the circulation and sharing of information. These seminars included the "2005 International Seminar on Planning the Next Wave of ICT-Biotech Convergence" and "2005 International Symposium on Nanotechnology Industrialization". In addition, STPI participated in the "2005 Taipei International Invention Show and Technomart," which helped to boost awareness and extension of research results.

STPI also conducted a total of 87 training courses for CONCERT, GRB, and other information services; a total of 2,400 persons participated in these activities.

Table 8-2 List of Activities

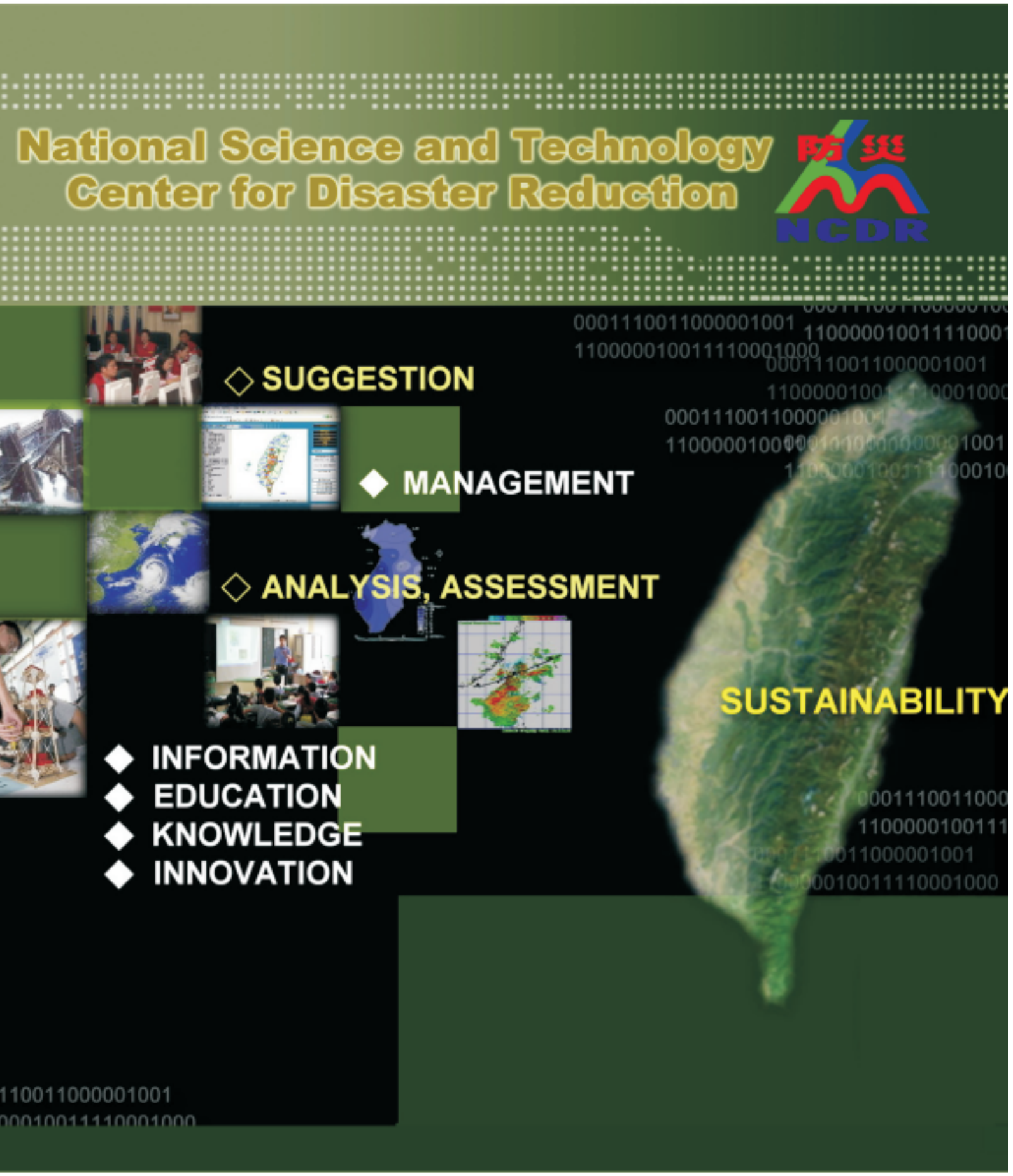
Type	Time	# of Sessions	Title/Activity
Wrap-up Presentation & International Symposium	May	2	• Seminar on Practical Information and Communications Security • Explanatory meeting for NARL Staff (Taipei)
	Jun. 21	1	• Explanatory meeting for NARL Staff (Hsinchu)
	Dec. 6	1	• International Seminar on Planning the Next Wave of ICT-Biotech Convergence
	Oct. & Nov.	2	• 2005 annual convention of CONCERT • Annual meeting of NDDS users
Seminar	May 27	1	• Co-hosted the "Patent Exploration Seminar – Nanometer Research and Patents"
	Oct. 29	1	• Co-hosted the "Seminar on the Newest Developments in Biomass Energy"
	Jun. to Dec.	10	• Co-hosted the "Nanotechnology Industrialization Seminar Series" with ITRI ◆ 3 sessions of "Dream and Challenge of New Substances" Biochemical Engineering Seminars in July ◆ 3 sessions of "Dream and Challenge of Micromachinery" Metallurgy/Electromechanical Engineering Seminars in September ◆ 2005 International Symposium on Nanotechnology Industrialization in November ◆ 3 sessions of "Dream and Challenge of Terabit Data" Electronic Information Seminars in December
Exhibition	Sep. 29-Oct. 2	1	• 2005 Taipei International Invention Show and Technomart
Education & Training Course	Jan. to Dec.		• 75 CONCERT training courses & workshops • 12 GRB training courses

Vision

"Serving as a national-level sci-tech think tank; helping transform Taiwan into a modern society possessing high-tech industrial competitiveness."

Sci-tech development is a major driving force of economic growth, and is cornerstone of the nation's sustainable development. In a world of increasingly global trade, Taiwan must depend on sci-tech research, development, and innovation to boost its competitive ability. The country must therefore possess a specialized sci-tech think tank to provide forward-looking sci-tech policy research, analysis, and information so as to guide the government's formulation of policies and strategies.

Responding to the fast-paced evolution of information technology and Taiwan's urgent sci-tech research and development needs, as well as the demand of industry, government, academia, and the research community for all-round services, STPI has consistently dedicated itself to improving the country's information infrastructure and performing information technology research and development. STPI's vigorous upgrading and improvement efforts in recent years have improved existing service processes and operating modes. STPI is providing sci-tech information resources accumulated over many years to government for use as references in the drafting of sci-tech policies. STPI aspires to make the jump from being a pure information provider to being an important sci-tech policy research and analysis unit playing the role of a "national-level think tank."


National Science and Technology Center for Disaster Reduction
防災
NCDR
◇ SUGGESTION
◆ MANAGEMENT
◇ ANALYSIS, ASSESSMENT
SUSTAINABILITY
◆ INFORMATION
◆ EDUCATION
◆ KNOWLEDGE
◆ INNOVATION

Chronicle

In September, 1996, according to the suggestion of the 5th National Science and Technology Conference, "... to intensify the fundamental research of technology for disaster mitigation especially on objective-oriented, multi-disciplinary integration should be promoted by National Program Office ... "

On November 21, 1997, the 138th Committee Meeting of National Science Council (NSC) approved the National Science and Technology Program for Hazard Mitigation (NAPHM) and establishment of the program office.

On January 16, 2001, according to the suggestion of the 6th National Science and the Technology Conference, " Set up National Science and Technology Center for Disaster Reduction in 2002 with the functions of development, promotion and evaluation of disaster technology; implementation of application from academic result; technology transfer for strengthening support to government."

On May 17, 2003, the Executive Yuan announced the "National Science and Technology Center for Disaster Reduction Establishment Regulations."

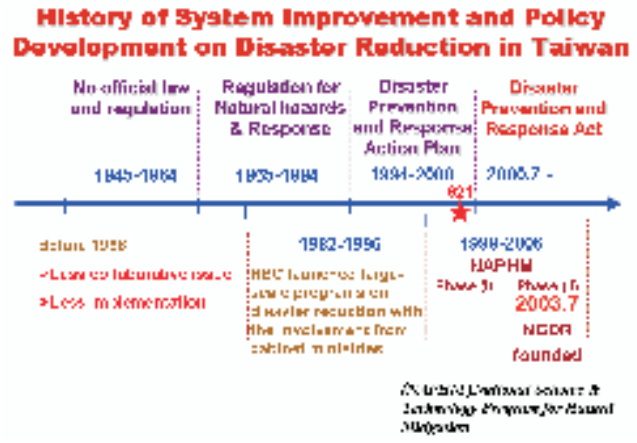


Figure 9-1 The historical development on disaster reduction in Taiwan

On July 15, 2003, the minister of NSC convened the Technical Advisory Committee of Executive Yuan to formally declare the establishment of National Science and Technology for Disaster Reduction (NCDR), which handles the operation of NAPHM.

Missions

The core missions of NCDR include "research and development," "technical support," "implementation and application," plus designing the policies of disaster prevention. As a result, the foundation for sustainable development could then be consolidated by the improvement of disaster management capacity in whole and the assurance of the homeland security with the reduction of casualty and property loss.

- Coordinate, plan and implement disaster reduction and response technology related research and development.
- Apply disaster reduction and response technologies to support the actual field tasks.
- Promote research and development and apply those results on the disaster reduction and response system.
- Other implementation and design for any tasks related to disaster reduction and response.

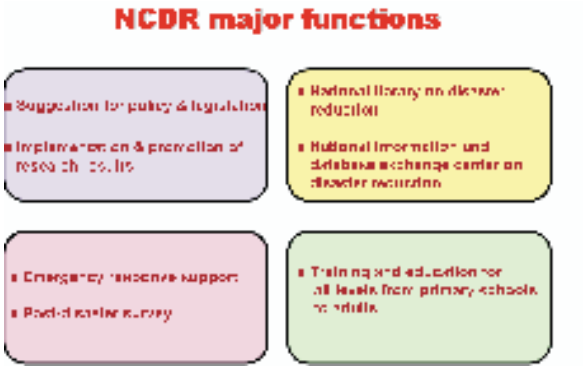


Figure 9-2 The major functions of NCDR

Major Accomplishments

A.Promote Research and Development

1.Coordination and implementation of National Science and Technology Program for Hazards Mitigation (NAPHM)

In 2005, 16 agencies within 11 ministries had participated in NAPHM and produced impressive results. For the continuity after 2006, end of NAPHM, NCDR cooperated with all related ministries and academic institutes to map out an "Operation Plan for Intensification and Implementation of Technology Development on Disaster Reduction" for further increasing the disaster-resistant capacity in Taiwan. The plan had been adopted by NDPPC and will submit to the Executive Yuan for final approval.

2.Application and Improvement of the NCDR Typhoon Rainfall Model

Typhoon impacts cause great damages and loss of human lives in Taiwan every year, and other disasters in the past were also induced by the heavy rainfall brought by typhoons. For the purpose of pre-event estimation of the potential of heavy rainfall and its possible distribution, the NCDR meteorology division developed a typhoon rainfall prediction model based on climatology and persistence (CLIPER). The calculated outputs provide the inputs for inundation and debris flow potential analysis model. An example is shown for Typhoon Longwang (2005) in Figure9-3. Research is conducted on utilizing radar rainfall estimation as well as outcomes from dynamical prediction models.

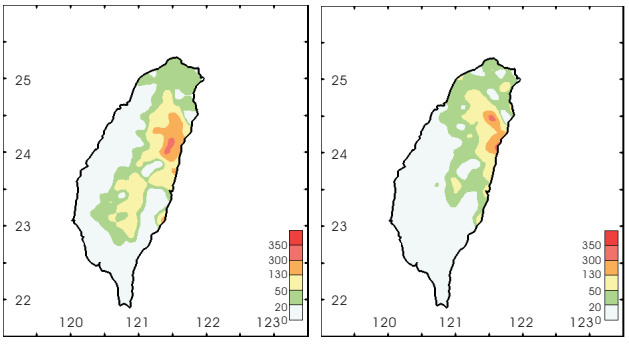


Figure 9- 3 Observed (left) and CLIPER forecast (right) accumulated rainfall for Typhoon Longwang (2005) during 0500-0800 LST 2 October

3.Strike Probability Analysis of Typhoons toward Taiwan

The tracks of all typhoons in the Taiwan history during 1970 ~ 2004 are analyzed to create a map of strike probability for typhoons coming toward Taiwan. In our analysis, a "hit" is defined as when the center of typhoon is ranging from 200 km or closer to the coastline. The strike probability map shows that the most possible direction for a typhoon to hit Taiwan is when it moves northwestward from the Philippines area. As found from the map, typhoons moving along the Taiwan Strait also have high potential to hit the Taiwan Island, too.

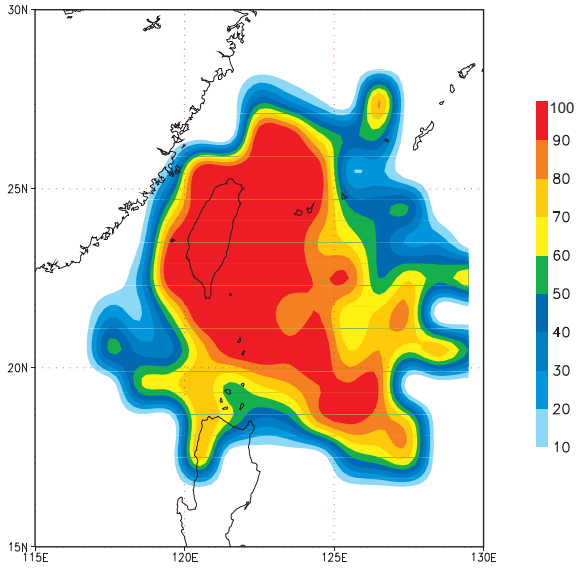


Figure 9- 4 Strike probability map for typhoons affecting Taiwan based on the 1970-2004 databases

4.Radar-Based Quantitative Precipitation Estimation

NCDR has adopted the Quantitative Precipitation Estimation and Segregation Using Multiple Sensors (QPESUMS) radar system for severe weather monitoring. Through pre-established correlation between radar reflectivity and rain rate, the system provides a good estimation of the rainfall amount. The QPESUMS system has the advantages of high temporal (10 min) and spatial (1.3 km) resolutions, and a user-friendly interface to operate. For extending the applicability of the QPESUMS, the group is conducting research on how to combine radar estimate and data from ground-based rain station observation to provide high-resolution and accurate rainfall distribution by using sophisticated statistical techniques (Figure9-5). The results are essential for the potential analysis of flash flood and

debris flow.

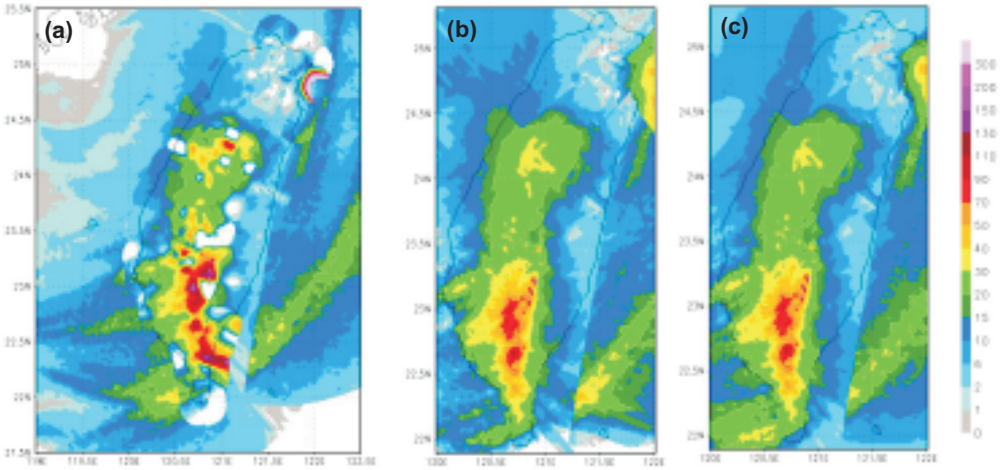


Figure 9-5 Integration of radar estimation and ground rainfall station at 0800 LST 19 July 2005 using the (a) Barnes, (b) ordinary Kriging, and (c) simple Kriging method

5.Flood Hazard Scenario Simulations

The flood and drought disasters reduction division had achieved the flood hazard scenario simulations of 0612 (2005) torrential rain event and Typhoon Haitang in Yen-Shui Creek Basin by using the latest DEM. The simulated inundation results of 0612 torrential rain event are shown in Figure 9-3 and Figure 9-6.

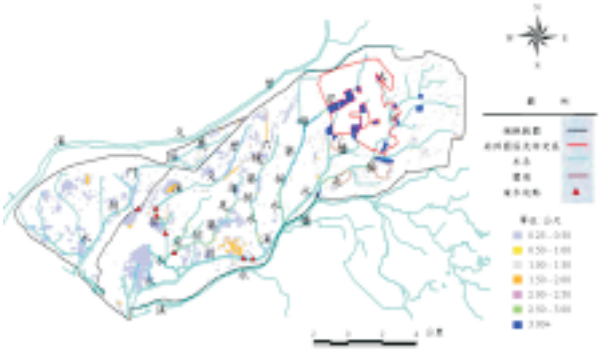


Figure 9-6 The flood hazard scenario simulations of 0612 torrential rain and Typhoon Haitang in Yen-Shui Creek Basin by using the newest DEM

6.Development of the Automatic Inundation Inquiring Technology

In order to enhance the efficiency of emergency response, an automatic inquiring system has been built to collect the real time rainfall data from the rain gauge network of Central Weather Bureau (CWB) and provide inundation areas for operation staffs by the NCDR Web-GIS System.

7.The Design on Defense Scope of Inundation Disaster

The main purpose of this project is to help the collaborative institutes of local governments to carry out the defense scope of inundation disaster for regional disaster prevention and response plan. Two pilot study areas were chosen as the study cases to check the performance of analysis flowchart of design defense scope of inundation disaster. The defense scope of inundation disaster can be applied in the Regional Disaster Prevention and Response Plans of local governments.

8.Research on Debris-Flow Potential Risk Model and Early Warning

NCDR slopeland disaster reduction division is engaged in developing a potential risk model for debris flow mitigation. A deterministic model will be used for quantifying the slopeland hazards for practical applications. Continuous research on the setup of regional rainfall threshold line for debris-flow and landslide monitoring for early warning by historical cases is conducted. The results are incorporated into the radar rainfall estimation that developed by NCDR meteorology division for real-time debris flow monitoring.

9.Field Investigations and the Modification of Debris Flow Threshold

The NCDR slopeland disaster reduction division has constructed the slopeland disaster database since 2001. To reduce the damage of debris flow disaster, we have set the rainfall threshold line and landslide monitoring for early warming in recent years. In 2005, field investigation after Typhoon Haitang and Matsa has collected almost 1,000 new records into the database. A preliminary study showed that the new collected data could help interpreting the initiation of slopeland disasters and to modify the rainfall threshold.

10.Hazards Mitigation Planning for Large-Scale Earthquakes

Taiwan has experienced many destructive earthquakes with magnitude greater than 6.0 almost in every decade since the 1900s. Those catastrophic events cause about 8,000 accumulated deaths and serious impact on the society. It is essential to organize a comprehensive hazard mitigation plan for reducing the losses induced by large-scale earthquakes. Due to the limited resources for hazard mitigation, priority is set for regions with high potential of earthquake disaster or areas of strategical and economical importance. Subsequently, the earthquake scenario simulation techniques can be applied to predict the possible casualties and damages in various seasons and time of day for these prioritized regions.

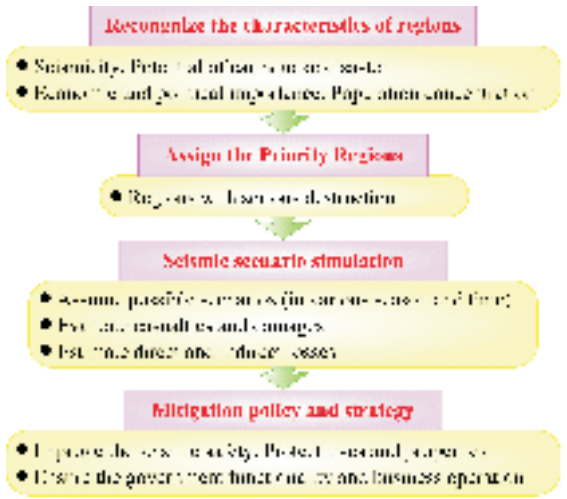


Figure 9-7 Hazard mitigation planning for large-scale earthquakes

Finally, some strategies for hazard mitigation, preparedness, emergency responses and recovery for governments to construct the detailed mitigation plans for large-scale earthquakes are proposed (Figure 9-7).

11.Regional Hazard Potential Analysis of Toxic Substances

Industrial incidents cause serious damage and losses on property as well as human life, specifically for those facilities operating toxic chemicals. Bhopal incident was one of the notorious cases. Effective hazard potential analyses benefit disaster mitigation and response. A simple approach based on Risk Index (RI) was developed for the analysis. RI was defined as the product of impact radius and release probability. ALOHA dispersion model and generic reliability data from ChE handbooks were used for the calculation of impact radius and release probability. Risk values for multiple chemicals in a given facility or multi-facility were then calculated by adding the overlapped risk indices. Contour lines and the area with the highest risk could then be easily identified. This risk potential map matches well with the locations of past incidents.

12.Hazard Potential Analysis for Freeway Transportation of Toxic Substances

A simple and manageable model based on the Transportation Risk Index (TRI) instead of the F-N curve was developed for the analysis. TRI was defined as the product of impact radius, transport frequency, incident probability, and release probability. The TRI has the unit of impact radius in km per year per million of vehicle kilometer. The calculation is more amiable for the risk analysis of large area with multiple chemicals and transportation routes compared with the typical societal risk. Upon the completion of calculation of the TRI for every segment in the selected route, the total risk was obtained by summing overlapped TRI. The final risk map was displayed with contours mapped on GIS platform. The National Freeway 1 with a total length of 370 km was used as an example to illustrate the methodology. The freeway was divided into 37 sections based on intersections.

13.Social-Economic Impacts of Disasters

The 2004 research agenda of social-economic division has built upon our risk management framework (Figure 9-8). There were three lines of researches: (1) Risk attitude survey; (2) Social-economic impact survey; and (3) A case study of risk analysis.

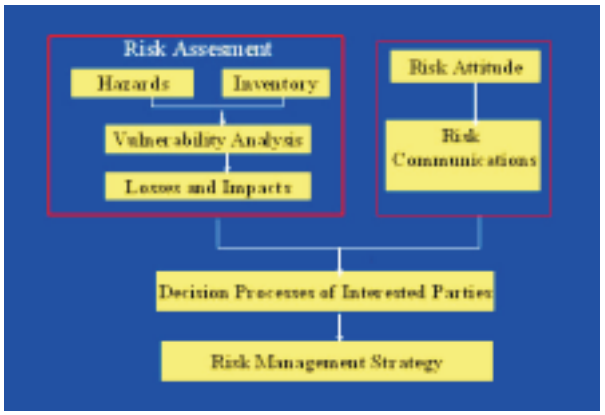


Figure 9-8 Conceptual Framework for risk management for natural hazards

14.The Surveys of Social-Economic Impact of Flood and Landslide

The main purpose of the survey is to use questionnaire-based survey data to build a flood or landslide loss estimation model. Further, we also try to understand the relationship between losses, risk attitude and mitigation behavior of the flood/landslide victims.

The face-to-face interview was conducted by a surveying team of the Directorate General of Budget. The interview was conducted from February 21 to March 11 in 2005, about six months after several major floods and landslides took place in Taiwan. The participants were the victims of the major flood or landslide, where the flood victims were sampled from six most impacted counties and the landslide victims were drawn from three most impacted counties.

15.The Investigation and Study on Inter-and Intra-Communication of Emergency Response Information in Governmental Sectors

Typhoons pose severe threats to Taiwan every year. In order to understand the operation functions of emergency management system when typhoons strike, a number of surveys and on-site investigations had been conducted from 2004 to 2005. First, we collected information about emergency management and response reactions from governmental sectors on the 2004 Typhoon Mindulle and Typhoon Aere. Then we interviewed local elected officials and sent questionnaires to the operators of the Central Emergency Operation Center in central government to gather opinions about the emergency communication and operations during typhoon events. In addition, we observed how the County Emergency Operation Centers responded to typhoon in 2005. By verifying and evaluating the information collected, we made suggestions for enhancing the emergency management and response capabilities of government at all levels.

16.The Facilitation and Improvement of Disaster-Resistant Community

Recent catastrophic disasters have underscored the necessity to enhance community disaster-resistant capability. United Nations and various countries also recognize the need of community involvement in reducing the effects of hazards, whether natural or man-made. Accordingly, the NCDR has begun to implement 5 pilot studies on community-based disaster management since 1998. In the year of 2005, we developed a training course to train professionals to help communities implement Community-Based Disaster Management Program throughout the entire country. In addition, a Facilitator Guide and a General Guide were also developed as supporting materials

17.A Quick Review and Pilot Study of Disaster Reduction Demand from the Aged Population in Taiwan According to Japan's Experience

The trend of rapid increase in aged population is making a great impact on the allocation of relief services about disaster reduction in Taiwan. In addition, the specific location of Taiwan also makes it vulnerable to natural hazards. Consequently, special consideration for seniors in disaster prevention and response is becoming more important. Similar to Taiwan, Japan is facing the same problem of rapidly aging society and is also under the threats of typhoon and earthquake. The Japanese government has taken steps in order to meet the specific needs of the elders by system

operation and facility installation. Therefore, we examined Japan's hazard-related policies and its disaster management system for supporting the elderly people. Through literature review, and data collection and analyses, we have concluded suggestions to assist and promote the legalization and systemization of our disaster prevention and response system in aged people.

18.Information and Decision Support System for Emergency Response

Natural hazards have been perceived as random acts of nature, symbolized by extremes in physical processes. Due to the particular geographical location and geological condition, Taiwan suffered from many natural hazards, such as typhoons, flooding, landslides, land debris, and earthquakes, which often caused series property damages and even life losses. Although it is almost impossible to avoid the occurrence of disasters and completely recoup the damage caused by the natural hazards, the sufferings and risks can be minimized by developing suitable strategies for disaster management, such as the developing of early warning systems, realizing of the pre-disaster developmental plans, implementing of disaster preparedness and emergency response, mobilizing of relief resources, and helping in rehabilitation and post-disaster reconstruction, etc.

The general process of disaster management involves real-time disaster information collections, compilations, interpretations, analysis, predictions, illustrations and decision support. Monitors and detectors have to be installed to collect the disaster information real time. Data-bases and mathematical models are employed and integrated to process and analyze the hazards information. It may be observed that advancement of information technology in the form of internet, Geographic Information System (GIS), remote sensing and satellite communication can help a great deal in planning and implementation of disaster management.

The Information Division of NCDR has developed a Decision Support System for Emergency Response (DSSER) for typhoon hazards. This system is based on the Web-GIS framework that the disaster information can be distributed via the internet technology. The DSSER is designed to integrate the real-time monitoring data, the dynamic hazard models and graphical user interfaces (GUIs) to provide disaster management decision support tools for emergency response. The input data of this system includes the basic maps, the real-time information of typhoon and rain-fall issued by the Central Weather Bureau, the real-time hydrologic information from the Water Resources Agency, and the hazard maps indicating areas of potential landslide, debris flow and flooding made by NCDR herself to estimate endangered areas under the current typhoon. Figure 10 illustrates the data flow of the DSSER system. There are four main modules integrated into the DSSER including the rainfall monitoring and forecasting, the estimation of potential inundation areas, the estimation of potential landslide and debris flows, and the management of disaster information. With the coming of typhoon, its future track is estimated according to the meteorological information provided by the CWB. When typhoon is approaching and the CEOC (Central Emergency Operation Center) will be activated immediately, NCDR staff will generate estimation of the hourly and accumulated rainfall distribution in the entire Taiwan for the next 24 hours. The results of rainfall forecasting will be fed into the DSSER system to analyze the possible occurrence of potential damage including the flooding and debris flows over the next 24 hours. The results of analysis and warning messages are finally delivered to the CEOC and help the commander to make the right decisions in disaster preparedness and response phases.

B.Technical Supports

1.Decision Support for the operation of CEOC during typhoon attacks

Taiwan is a subtropical island with many typhoons and floods in summer. To mitigate the disasters, NCDR introduces innovatory researches and develops practical techniques for hazard reduction, readiness, response and recovery. The disaster potential of Taiwan has been analyzed by the NCDR, and strategies for hazard preventions and mitigations are proposed with practical suggestions

and policies.

NCDR is also a member of assessment group of the Central Emergency Operation Centre (CEOC). During flood and typhoon season, NCDR provides suggestions to CEOC for emergency response and evacuation. The operational structure of CEOC is shown in the following figures and the procedures of operational response of typhoon are depicted in the following figures. In addition, the objectives and achievements in 2005 are described in the next sections. (Table 9-1)

Table 9-1 The operational response of typhoon events in 2005

Event	Time	On duty man-power
0512 torrential rain	05/12 19:00 ~ 05/12 00:20	5
0518 torrential rain	05/18 19:00 ~ 05/20 19:00	14
0523 torrential rain	05/23 17:30 ~ 05/25 07:00	6
0602 torrential rain	06/02 11:00 ~ 06/04 07:30	11
0612 torrential rain	06/12 08:00 ~ 06/18 21:00	57
0628 torrential rain	06/28 08:50 ~ 06/28 17:30	4
Haitang typhoon	07/16 13:15 ~ 07/21 18:00	126
Matsa typhoon	08/03 17:30 ~ 08/05 21:00	52
Talim typhoon	08/30 20:00 ~ 09/0 1 21:00	43
Khanun typhoon	09/10 08:30 ~ 09/11 05:30	21
Longwang typhoon	10/01 08:30 ~ 10/02 21:00	36
total		375

2.Annual evaluation of local government on disaster-related works and implementation

With the location along the frequent typhoon track and the edge of the Pacific tectonic plate, there are higher potential occurrences of many deadly natural disasters such as typhoon, flooding, debris flow, landslide and drought within Taiwan. Nowadays, the disaster prevention and response is one of the main commitments for governmental administration to achieve. In order to reduce future losses from natural hazards and prevent technological hazards, the "Disaster Prevention and Response Act," declared on July 19, 2000, is designed to define our three-level governmental disaster prevention and response framework and procedures related to disaster reduction, emergency response and post-disaster recovery. The annual review and evaluation on local government for understanding and grading disaster prevention and response are the essential mechanism to intensify the implementation and resolution from central government. The serial yearly evaluation programs have been carried out since 2003 to review all 25 local governments. In order to ensure the local government adhering to conducting policies and plans on disaster risk reduction and preparedness, the National Disaster Prevention and Response Council (NDPPC) have been performing the annual evaluation by written inquiries and formal on-site interviews. From year 2003, NDPPC have been holding about 25 county/city interviews every year, with the cooperation and support from NCDR. Each annual evaluation has been designed with specific topics and directions for identifying the accomplishments and needs in local areas. In 2005, the main goals are laid in the improvement of regional disaster response and rescue plans, the management of potential disasters, the plan and measures for emergency evacuation.

3.Analysis and suggestions of international and domestic disastrous events

In 2005, NCDR had published the special reports on international and domestic disastrous event and drafted the mechanism of pos-disaster survey with NDPPC. The main topics of special reposts include South Asia Earthquake, Hurricane Katrina, Kashmir Earthquake, Yun Kuang Firecracker Firework Corporation Explosion, Sedimentary Hazard Analysis for the Shihmen Reservoir Watershed and 0612 Torrential Rain Flood Event. Positive echoes received from governmental agencies and academic fields do show the key role of NCDR on post-disaster investigation.

C.Deployment and Application

1.Empowering the Local-Level's Capability for Disaster Reduction (ELCDR) Plan

To improve regional disaster prevention and reduction capability, the central government has authorized to launch a 3-years grant-plan ELCDER for the improvement, maintenance and updating of Regional Disaster Mitigation plans for total of 25 regions, where NCDR is assigned to execute the above-mentioned plan.

ELCDER is scheduled from the year of 2004 to 2006 in completing the plan, all academic institutes national-wide with experienced in hazard mitigation are encouraged to contribute their applications in 25 regions throughout Taiwan. The regions are divided into 3 groups to implement ELCDER (two group of 8 and 9 local governments joint initially, and

additional 8 local governments joint in the year of 2004, 2005, and 2006 respectively).

Over the past 2 years, NCDR has taken roles in facilitating and monitoring collaborative organizations in order to ensure the proper execution of ELCDER according to the initial guidelines. We also launched series of comprehensive training courses for collaborative organizations, and national emergency planners and operators to strengthen their capabilities. By the end of annual performance evaluation and review of ELCDER, collaborative organizations have built-up partnership and developed a functional mechanism with the local governments, together with the database for catastrophic and non-catastrophic information to provide better IT solutions. Moreover collaborate organizations have showed their involvement prior-, on-, and post-disaster by participating in local government's emergency management center, examining their disaster management operations capabilities and consequently identified areas of improvement in order to intensify Regional Disaster Mitigation plan during phase II of ELCDER.

Overall, implementation of ELCDER plan has brought in the satisfactory results, the partnerships network built-up between collaborate organizations and local governments has shown the involvement and participation as a whole in emergency management of on- and post-disaster with solid identified flaws in regional disaster prevention and response plans.

2.The International Communications and Collaborations

The overall purposes are to promote the scholarly and practical researches of disaster prevention and reduction via facilitating NCDR's international involvements and exposures in disaster reduction technology to maximize benefit of humankind.

These years, NCDR is delicate itself to communicating with the world through multiple channels in a broad-band and large-scale of disasters prevention and reduction with its fruitful technology research and developing achievements. Some of the major international collaborative activities in the year of 2005 include: (Table 9-2)

Table 9-2 The critical international collaborative activities and participation in the year of 2005

International Collaborative Activities	Period		Location
International Symposium on Earthquake Engineering Commemorating Tenth Anniversary of the 1995 Kobe Earthquake and the First International Conference on Urban Disaster Reduction	Jan. 12	Jan. 23	Kobe, Japan
World Conference on Disaster Reduction	Jan. 18	Jan. 22	Kobe, Japan
The Korea Institute of Geosciences and Mineral Resources	Apr. 8	Apr. 11	Korea
The 20th Annual CCPS International Conference	Apr. 10	Apr. 14	Atlanta, USA
Technical Visit of Disaster Prevention and Reduction Institution of Kobe in Japan concerning the Telecommunication System Build-up	Apr. 24	Apr. 28	Kobe, Japan
ITA 2005 General Assembly and Meeting Programme	May 7	May 12	Istanbul, Turkey
DRC2005 Disaster Reduction Conference	May 6	May 20	Sacramento, USA
2005 Euro-Thailand ICT Cooperation Event	Jun. 5	Jun. 9	Thailand
The 9th International Conference on Structural Safety and	Jun. 17	Jun. 23	Rome, Italy
Asia Oceania Geosciences Society (AOGS): The 2nd	Jun. 21	Jun. 24	Singapore
The 30th Annual Hazards Research and Applications Workshop and Hazards and	Jul. 8	Jul. 17	Colorado, USA
International Conference on Energy, Environment and Disasters (INCEED) 2005 (Charlotte, NC)	Jul. 23	Jul. 29	North Carolina, USA
The 10th International Conference on Urban Drainage	Aug. 19	Aug. 28	Copenhagen, Denmark
2005 Architectural Institution of Japan Annual Conference	Aug. 31	Sep. 6	Tokyo, Japan

International Collaborative Activities	Period		Location
The Fifth Annual IIASA-DPRI Meeting on Integrated Disaster Risk Management: Innovations in Science and Policy	Sep. 14	Sep. 18	Peking, PRC
The 4th International Symposium on New Technologies for the Urban Safety of Mega Asian Cities	Oct. 17	Oct. 20	Singapore
The 9th Cross-Straits Water Conservancy Technology	Oct. 21	Oct. 26	TianJin, PRC
The American Society of Civil Engineers (ASCE) Annual	Oct. 24	Oct. 30	LA, USA
Annual Meeting of the International Society for Traumatic Stress Studies	Nov. 1	Nov. 5	Toronto, Canada
Asian Conference on Remote Sensing	Nov. 6	Nov. 13	Hanoi, Vietnam
World Conference on Disaster Reduction Focus on Corporate Sector Role and	Nov. 16	Nov. 19	Mumbai, India
Workshop on Meteorology and Climate over South China	Dec. 5	Dec. 9	Hong Kong
The 3rd International Symposium on Mitigation of Geo-Hazards in Area around Japan Sea	Dec. 6	Dec. 10	Kanazawa, Japan
Total	22 events		13 countries

Education Outreach

In 2005, the plan continued working with 7 strategic alliances. In addition, core of the plan concerns the characteristics of the region for each promoting center. As a consequence, the suitable working items were proposed by the Program Planning Office to increase the efficiency and effectiveness of program execution. As the viewpoint of analysis plan for disaster reduction education in Taiwan, the initiative of this program is to enhance people's capacity and capability of disaster reduction to improve awareness by impetus of disaster reduction education. Thus, we could mitigate the aftermath after disaster and minimize the loss and casualty.

Vision

According to the report of "Natural Disaster Hotspots - A Global Risk Analysis" published by World Bank in 2005, 73.1% of land and population in Taiwan are exposed to three or more hazards. In the top ranking of this index, Taiwan most severe natural threats that must cope with in the future.

Form geophysical configuration, Taiwan is located in the Circum-Pacific seismic zone with the frequent reoccurrence of magintue-6-above earthquakes. In 1999, the Chi-Chi Earthquake (ML=7.3), the most devastating one during the 20th century occurred in Taiwan. Beside the death toll over 2,500 and US $10.7 billion direct property loss, the infrastructure's destruction such as lifeline systems had brought a major impact on livelihood and economic activities.

Typhoon, the tropical depression, is the most frequent natural disaster for Taiwan from July to October. Because of the high intensity rainfall, the steep terrain and the very-limited distance of river basins, all these factors would induce a serious flood or landslide in Taiwan. According to the records, 1986～2004, from the Central Weather Bureau (CWB, Taiwan), the average number of typhoons, affecting Taiwan, is 4.3 per year accompanied with the US $610 million annual economic loss.

As the rapid economy development in Taiwan, IC fabs, petrol-chemical plants, long highway tunnel and skyscraper have widened the aspects on disaster reduction consideration. The degree of integrity on disaster reduction is directly related to the index of the governmental implementation about the public safety and property protection. As the consequence, the government-founded projects and center are lunched and established to meet the demand from the general public. After intensive efforts from all sectors, academies, industries, government, communities and people, we hope to move toward a "Safe Taiwan". In the future, we sincerely expect to build a healthy and safe environment with safety and prosperity.

Location

Establish R&D Platforms

Promote Cutting-edge Science and Technology

Support Academic Research

Foster High-tech Manpower

- NARL Headquarters
- National Center for Research on Earthquake Engineering
- National Laboratory Animal Center
- Science & Technology Policy Research and Information Center
- National Science and Technology Center for Disaster Reduction

- National Nano Device Laboratories
- National Space Organization
- National Center for High-performance Computing
- National Chip Implementation Center
- Instrument Technology Research Center

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