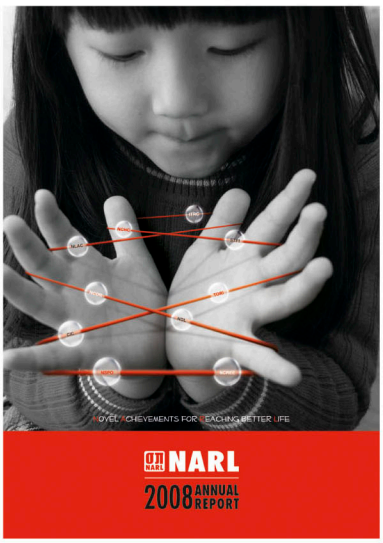
NOVEL ACHIEVEMENTS FOR REACHING BETTER LIFE

NARL

2008 ANNUAL REPORT



NOVEL ACHIEVEMENTS FOR REACHING BETTER LIFE

Honorable Publisher: Lou-Chuang Lee

Publisher : Kuang-Chung Wu

Vice Publisher : Yeong-Her Wang

Editorial Committee : Liang-Chun Chen, Forng-Chen Chiu, San-Chi Liang, Jiun-Jih Miau, Ding Ping Tsai, Keh-Chyuan Tsai, Chin-Long Wey, Fu-Liang Yang, C. Eugene Yeh

Chii-Wen Hung, Ying-Yun Lee, Ching-Ping Lu, Jyun-Hwei Tsai, Sheng-Hao Tsai, Lung-Jieh Yang, Shiann-Jeng Yu

Editor-in-Chief : Ming-Chih Cheng

Executive Editor : John Clegg, An Yeh

Editorial Group : Dennis Chiang, Sandra Chiang, Ting-Yu Hsu, Hsin-Ning Huang, Jackson Hung, Chieh-Hua Li, Beryl Lu Annie Wei, Cherry Wu, Chi-Ray Wu

Layout : CANDYSIGN

National Applied Research Laboratories
3F., 106 Hoping E. Rd., Sec. 2, Taipei 106, Taiwan, R.O.C.
TEL: 02-2737-8000
FAX: 02-2737-8044
http://www.narl.org.tw

Publishing Date : June 2009

Our Missions

- Establish R&D platforms
- Support academic research
- Promote frontier science and technology
- Foster high-tech manpower

2008

CONTENTS

Preface

Overview

Our Laboratories

Contact Information

Message from the Chairman

The National Applied Research Laboratories (NARL) has made huge progress in areas of research and development, academic services, and professional personnel training since its establishment in 2003. Currently, the entire world is confronting several critical issues such as climate change, global warming, and economic recession, which impact our society dramatically. In the face of such problems, the NARL must make appropriate changes and adopt active strategies in order to contribute to the better development of technologies, better living and a sustainable society.

In the past year, the NARL introduced to the entire organization an integration of management processes, which consolidated many facets of operational processes from project, finance, auditing, information, legal regulations, and human resources into one complete framework. This system was put into place with the goal of generating effectiveness and efficiency of the entire NARL's management performance.

The NARL also aims to construct a more complete and prospective R&D service platform for technology integration and applications by systematically upgrading its quality and scale. This service-oriented R&D platform will further help the academia to accelerate technological innovations for the next wave of industry.

Facing the challenges ahead, the entire NARL staff will strive to work together to integrate innovative technologies for sustainable development. The NARL encourages resource sharing and integration among its member laboratories. This will help the NARL to become a world-class national laboratory by building up first-rated academic service platforms. Your input and advice are welcome to help NARL reach the next level of excellence!

Chairman

Jong Lee

Message from the President

The year 2008 witnessed the beginning of a transformation for the NARL. Since its establishment in 2003, the NARL has continuously provided academia with high-quality integrated R&D platforms, striven for new developments in prospective technologies, and extended its reach into all fields relevant to the public livelihood. The NARL has gradually evolved from a "research facility provider" to an "innovative system integrator." The results of its hard work have strengthened Taiwan's ability in terms of technology prowess and established a good foundation for international cooperation.

During the past year, the NARL has been devoted to the support of academic research, innovations in R&D, the promotion of its interior management system, and achieving its overall goal of organizational professionalism. Regarding core technologies in R&D, the NARL has successfully advocated its universal medium-term plan as well as the construction of a new ship for ocean research. In terms of civil applications, the NARL successfully supported the "3D medical imaging technology," "nation-wide campus dormitory safety improvement," and "bridge safety improvement and monitoring technologies." With regard to construction projects, the new Laboratory Animal Center facility was established in southern Taiwan. In addition, the Taiwan Ocean Research Institute was established to assist in the sustainable protection and use of ocean resources. Regarding organizational management, the NARL was awarded ISO 9001 and ISO 27001 certification in 2008, this being the result of the NARL's advocacy of high-quality management, information security, and operational processes systemization.

The NARL has also actively extended its academic and technological cooperative networks to other nations. By 2008, the NARL had become a cooperative partner with approximately 80 academic institutions in Taiwan and abroad. Based on the principle of resources sharing and complementary specialties, the NARL has collaborated with its partners through innovation integration of R&D platforms. Also, in an effort to stimulate innovative research and development, the NARL has reached global standards in domestic academic fields and, at the same time, made creative contributions to technological diplomacy.

In 2009, the NARL aims to head focus on the goal of "creating a world-class research laboratory." In addition to the hard work of the entire staff, the NARL also depends on the support and encouragement of other academic fields while it strives to develop sustainable technologies in Taiwan.

President (Acting)

Kuang-Chung Wu

Organization

Board of Directors & Supervisors

Chairman	Lou-Chuang Lee
Managing Director	Jin-Fu Chang, Cheng-Hong Chen, Shyi-Ming Lin, Che-Ho Wei
Director	Wen-Tsuen Chen, Chenming Calvin Hu, Cheng-Yan Kao, Kuen-Yao Lee, Wen-Hsiung Li, Chao-Han Liu, Shie-Ming Peng, Andrew H.-J. Wang, Maw-Kuen Wu, Se Hwa Wu, Chau-Shioung Yeh
Executive Supervisor	Wen-Chang Chang
Supervisor	Wen-Ji Hwang, Mi-Ching Tsai, John Yu

President (acting)	Kuang-Chong Wu
Vice President	Yeong-Her Wang

Headquarters

Planning & Evaluation Division	Director Jyun-Hwei Tsai
Business Development Division	Director Ming-Chih Cheng
Administration Division	Director Shiann-Jeng Yu
Accounting & Finance Division	Director Ching-Ping Lu
Auditing Division	Director Ying-Yun Lee (acting)
System Management Office	Director Sheng-Hao Tsai (acting)

Laboratories

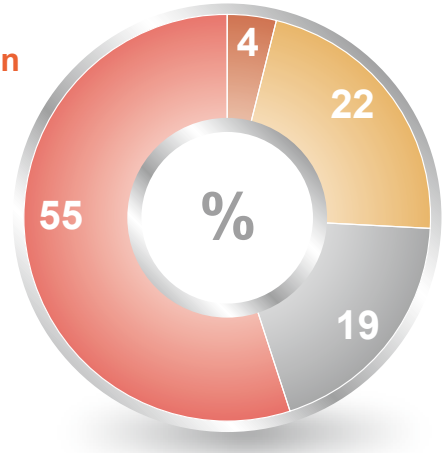
National Nano Device Laboratories	(NDL)	Director General Fu-Liang Yang
National Laboratory Animal Center	(NLAC)	Director General San-Chi Liang
National Center for Research on Earthquake Engineering	(NCREE)	Director General Keh-Chyuan Tsai
National Space Organization	(NSPO)	Director General Jiun-Jih Miau
National Center for High-performance Computing	(NCHC)	Director General C. Eugene Yeh
National Chip Implementation Center	(CIC)	Director General Chin-Long Wey
Instrument Technology Research Center	(ITRC)	Director General Din Ping Tsai
Science & Technology Policy Research and Information Center	(STPI)	Director General Yeong-Her Wang (acting)
National Science and Technology Center for Disaster Reduction	(NCDR)	Director General Liang-Chun Chen
Taiwan Ocean Research Institute	(TORI)	Director General Forng-Chen Chiu
Taiwan Typhoon and Flood Research Institute (Preparatory Office)	(TTFRI)	Director General Whey-Fone Tsai (acting)

(Organization structure as of December 2008)

Human Resources

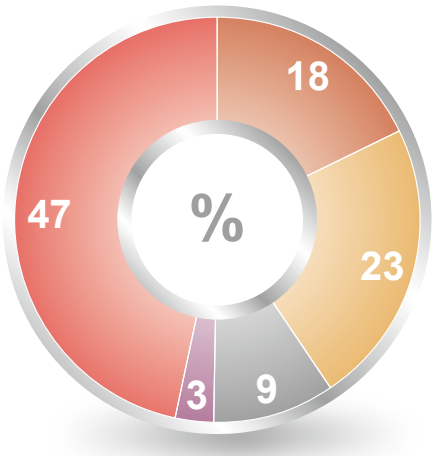
Number of Employee 1349

Human Resource Allocation



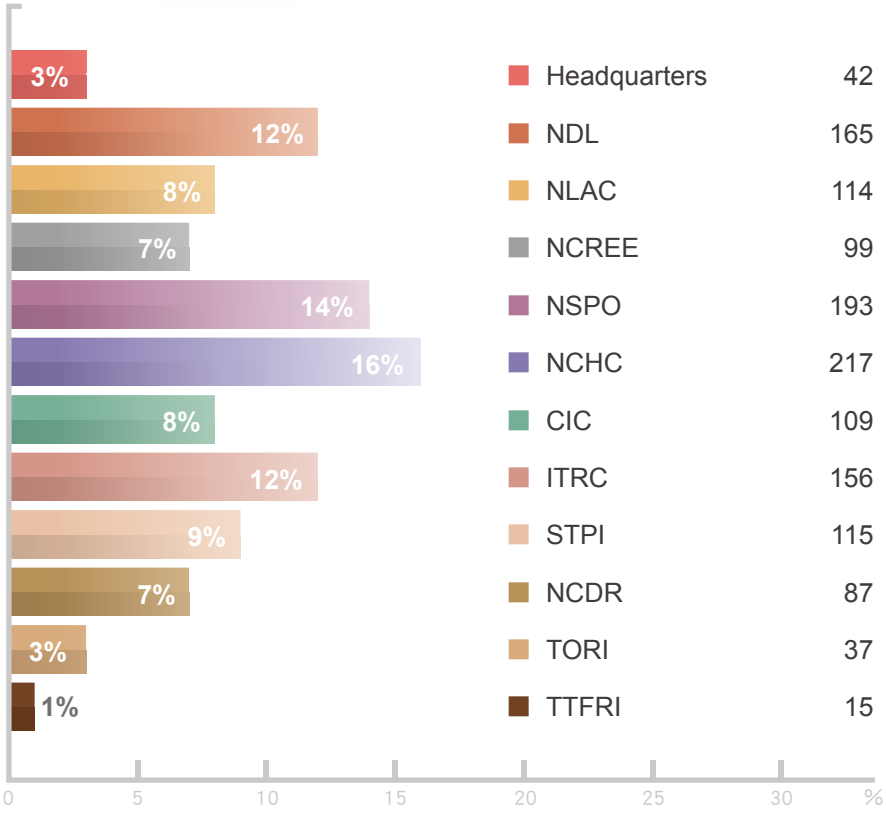
R&D Staff	742
Engineer	49
Technician	296
Administrator	262

Education Qualification



Doctoral Degree	239
Master's Degree	643
Bachelor's Degree	307
Associates	119
Other	41

Employees per Laboratory

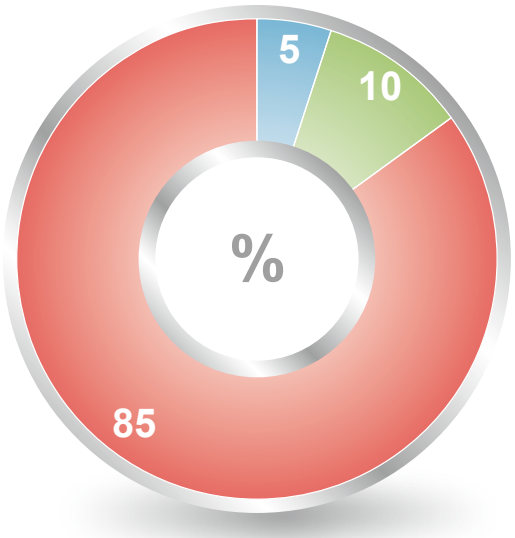


Headquarters	42
NDL	165
NLAC	114
NCREE	99
NSPO	193
NCHC	217
CIC	109
ITRC	156
STPI	115
NCDR	87
TORI	37
TTFRI	15

Financial Information

Revenue (FY2008)

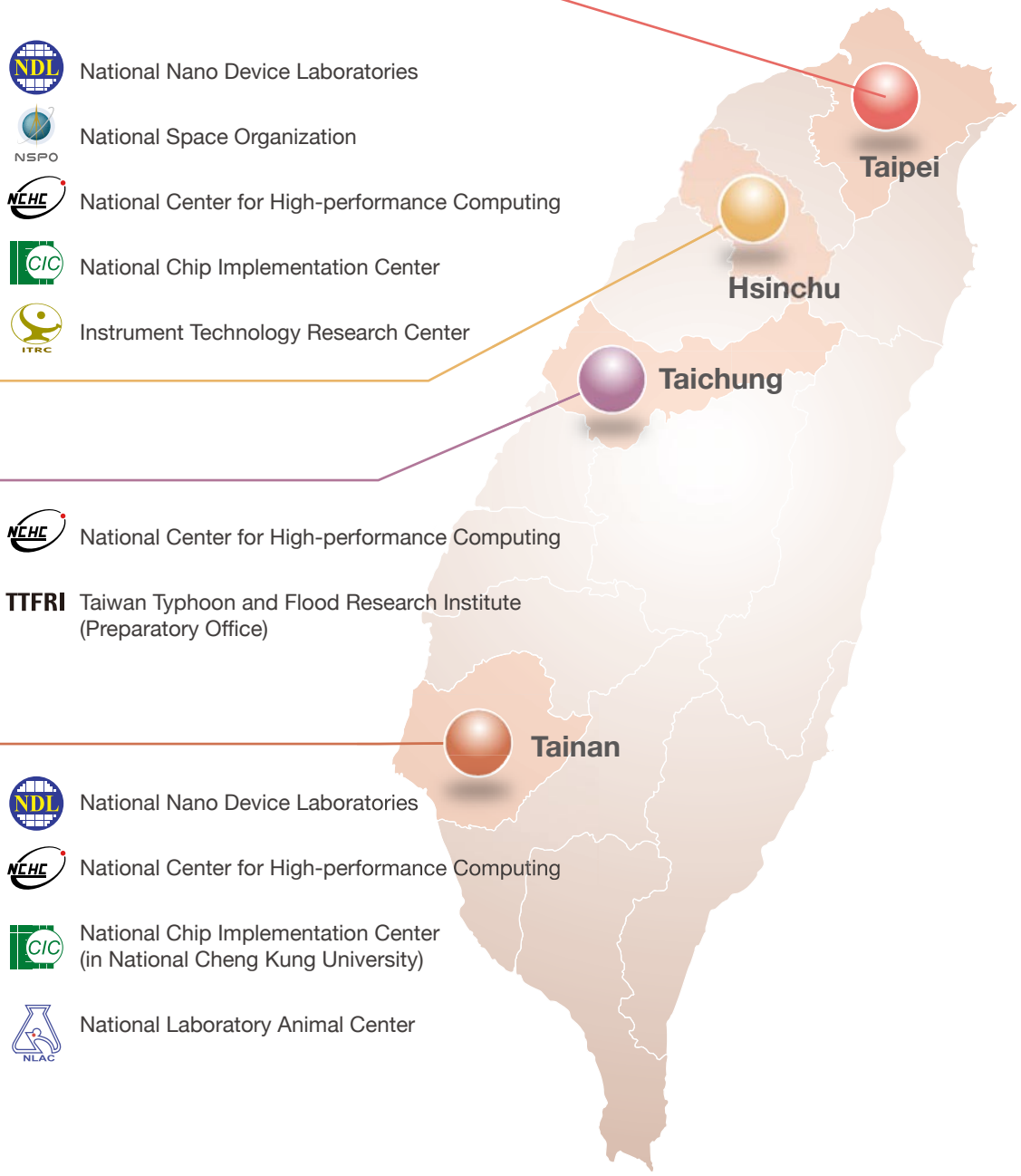
Laboratories	$M USD	%
Headquarters	5	3%
National Nano Device Laboratories (NDL)	20	12%
National Laboratory Animal Center (NLAC)	9	6%
National Center for Research on Earthquake Engineering (NCREE)	10	6%
National Space Organization (NSPO)	50	31%
National Center for High-performance Computing (NCHC)	28	18%
National Chip Implementation Center (CIC)	12	7%
Instrument Technology Research Center (ITRC)	10	6%
Science & Technology Policy Research and Information Center (STPI)	9	5%
National Science and Technology Center for Disaster Reduction (NCDR)	4	3%
Taiwan Ocean Research Institute (TORI)	2	2%
TaiwanTyphoon and Flood Research Institute (TTFRI) (Preparatory Office)	1	1%
(Rate: $1USD=34NTD)	160	



Grant 85% Fund Raised from Government Agency 10% Fund Raised from Private Entity 5%

Location

- 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
- Taiwan Ocean Research Institute



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

- National Center for High-performance Computing
- Taiwan Typhoon and Flood Research Institute (Preparatory Office)

- National Nano Device Laboratories
- National Center for High-performance Computing
- National Chip Implementation Center (in National Cheng Kung University)
- National Laboratory Animal Center

Policy

From NARL to N.A.R.L.

NOVEL ACHIEVEMENTS FOR REACHING BETTER LIFE

Waves of bad news struck Taiwan (and the rest of the world) in 2008; global warming, the oil crisis, and the global financial crisis—all unavoidable disasters. Through these crises, though, we have come to better realize the responsibilities and opportunities that we face. The NARL's future responsibilities are not only to provide experimental facilities for domestic R&D and become a world-class research institute, but also to ensure the livelihood of the commonwealth. The NARL must create unprecedented value and innovation and, at the same time, achieve this additional more important goal as well.

Integrating Innovative Technologies

In addition to providing various experimental facilities to domestic research institutes, the NARL aims to become a world-class research institute through collaborative cooperation and an innovative R&D provider. The NARL also plays an increasingly critical role in the public livelihood. Among the national science research organizations, the NARL's innovative and integrative capabilities vary widely. The NARL acts as a mediator to bridge these capabilities. If endowed with the key position of becoming the integration hub, a synergistic effect would be created. In order to achieve its goal of becoming an integration hub, the NARL has shifted its operational strategy from "research service provider" to "innovative technology integrator." First, the NARL will form strategic alliances to strengthen its integrative capabilities (Figure 1-①). Next, it will establish a large-scale integrative technology platform and collaborate with global allies to enhance its innovative force and maximize its influence as a national science research institute (Figure 1-②).

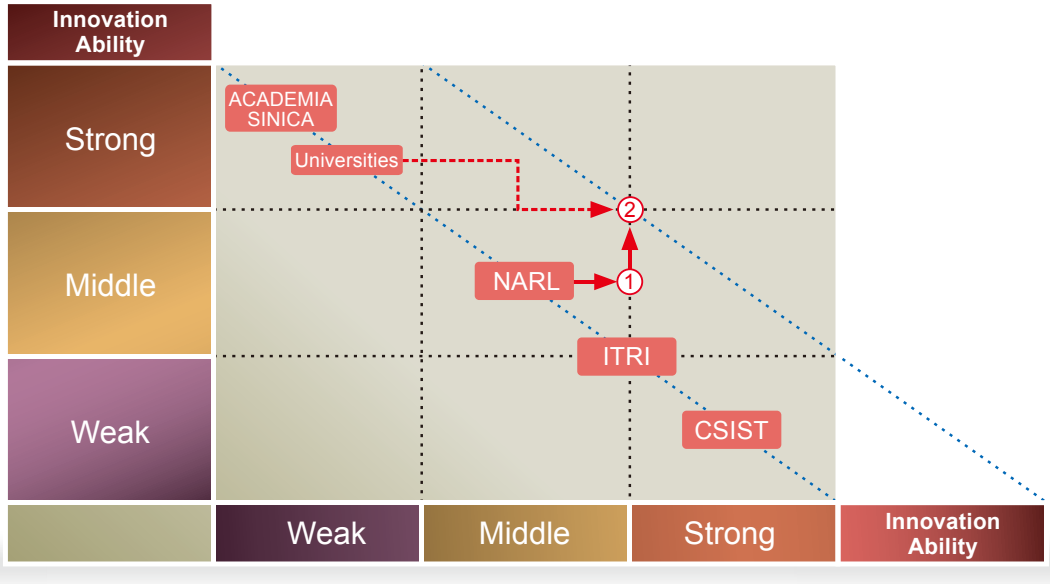


Fig. 1. The NARL's position and developmental strategies in the national science research system

Commitment to Improving the Public Livelihood

In order to become an innovative technology integrator, the NARL has redefined its English name, the NARL (i.e. National Applied Research Laboratories) to "Novel Achievements for Reaching a Better Life." The NARL staff continues to focus their skills on delivering outstanding achievements, and more importantly, on furthering issues that benefit the public and society. Also, the NARL continues to integrate innovative technology, thus enabling it to fulfill its goal of receiving from and contributing to the society as a whole.

The NARL plans its R&D strategy and execution methods based on the Strategy, Culture, Organization, Team, and Technology (SCOTT) structure (Fig. 2). In terms of the NARL's general strategies, its focus is on R&D, in meeting the "innovative technology" needs of the nation, and developing new "next generation" industries. With regard to organizational culture, the NARL will focus on incorporating forces and generating spirit with an emphasis on quality. In terms of organizational design, "matrix management" will be used to enhance vertical organizational specialization (i.e. individual professionalism) and develop horizontal integration effects (i.e. common goals). Regarding team cultivation, the NARL will establish a professional team, the focus of which will be on advanced technologies and innovations. As for technological integration, the NARL will integrate core technologies and lead key technologies for the improvement of the public livelihood thus, at the same time, effectively integrating cross-field technologies and having a positive influence on the society.

Fig. 2. The NARL's SCOTT strategy

Strategic Alliance with Academia

In addition to its past support of individual scholars, the NARL actively cooperates with domestic universities. The NARL hosted the first "Taiwan Conference on Perspective Technology" in August to propose its mission, vision, and its "Strategy, Culture, Organization, Team, and Technology" (SCOTT) management system to university decision makers. Participants in the event included the principals from 19 domestic universities. [1]

Through the communication of its management strategies, the NARL has promoted itself as an innovative ideal to domestic universities. In so doing, the NARL has become the integrator of cross-field innovative technologies and has established a common R&D foundation between domestic academia and Taiwan's IT-based industries. In order to achieve this, the NARL will carry out, in cooperation with domestic universities, the following activities (Fig. 1): facility services, R&D services, and collaboration research for general and domain specific purposes. Furthermore, the NARL also plans to build common employment relationships, share facilities with academia, and construct a common knowledge sharing system with scholars in order to move toward the goal of strengthening its integration abilities.

In a similar action, the National Cheng Chi University (NCCU) hosted the first formal and complete meeting with the NARL in November 2008. The focus of the meeting was on the NARL's science and technology-based services and facilities whereas the art, law, and business schools at NCCU were also highlighted. Through integrated cooperation, the NCCU gained insight into the advantages and resources that the NARL has to offer. The NARL was also able to identify several cooperative possibilities within various fields at NCCU such as science management, technology policies, and disaster psychology.

We look forward to a profound alliance relationship with Taiwan's domestic universities and to even more successful cooperative patterns in the very near future. As a result, Taiwan's universities will have more complete research resources available while the NARL works to transform its relationship with domestic universities from "company" to "partner."

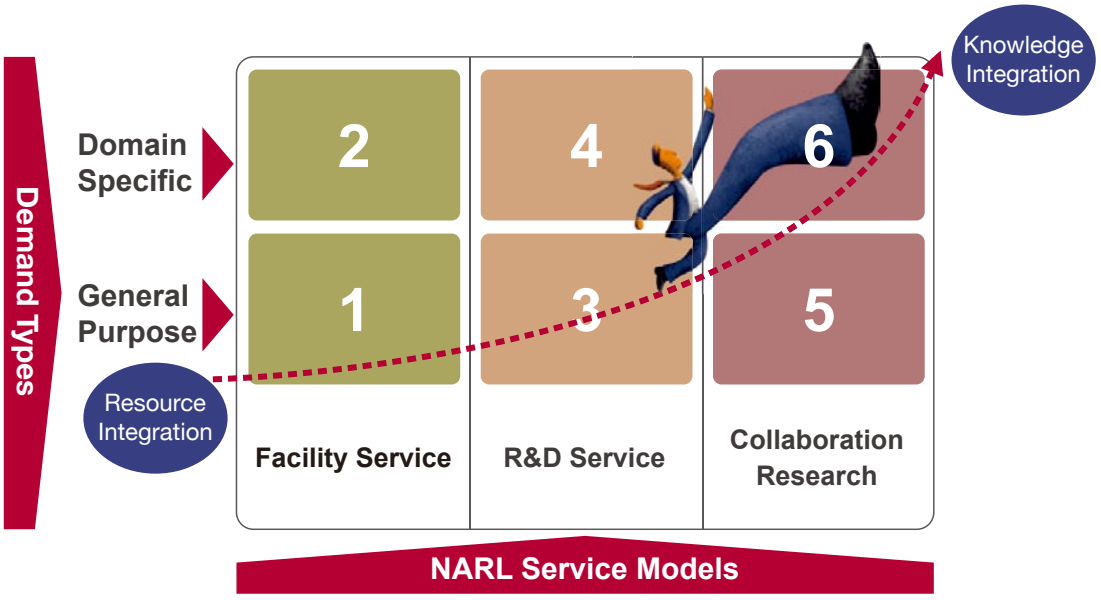


Fig. 1. Six Service Models of NARL

International Cooperations

Each year, The NARL signs several MOU's and MOA's with internationally renowned academic research institutions in the hopes of establishing collaborative research projects, technological cooperation, resource sharing, training programs and exchange programs with other research organizations. Also, the NARL participates in various international conferences, symposiums, and other activities each year with the goal of sharing its research results and promoting its technological R&D accomplishments. The NARL has signed more than 60 cooperative agreements with 59 research institutions in 18 nations from around the world.

[1] National Tsing Hua University, National Chiao Tung University, National Central University, National Cheng Kung University, National Taiwan Normal University, National Taiwan University, National Defense Medical Center, Tatung University, Taipei Medical University, National Taiwan Ocean University, Chang Gung University, Dayeh University, National Chung Hsing University, Yuan Ze University, National Ilan University, National Sun Yat-sen University, Southern Taiwan University, National University of Kaohsiung, Kun Shan University. (Tunghai University also signed the MOU in Oct.)

Current Status of International Cooperation

59 Research Institutions in 18 Nations

USA：22
Georgetown University Medical Center
The Board of Trustees of Leland Stanford Junior University
National Institute of Aerospace
Texas A&M University / Texas Engineering Experiment Station
Woods Hole Oceanographic Institution
Global Science Institute, State of Alaska
Agilent Technologies Inc.
Asian-Pacific Network of Centers for Earthquake Engineering Research (ANCER)
Multidisciplinary Center for Earthquake Engineering Research (MCEER)
Mid-America Earthquake Center (MAE)
Pacific Earthquake Engineering Research Center (PEER)
The Advanced Technology for Large Structural on Earthquake Engineering (ATLSS) Research Center, Lehigh University
Thomas T.C. Hsu Structural Research Laboratory (THSRL), University of Houston
Texas A&M University
Air Force Research Laboratory
Air Force Weather Agency
The University Corporation for Atmospheric Research
Telcordia Applied Research Center, Taiwan (TARC-TW)
Cold Spring Harbor Lab.
National Library of Medicine(NLM)
National Technical Information Service (NTIS)
Pacific Disaster Center
Japan：8
BioResource Center (BRC), RIKEN BioResource Center
Biomaterials Center, National Institute of Materials Science (NIMS)
Institute of Fluid Science (IFS), Tohoku University
Disaster Prevention Research Institute (DPRI), Kyoto University
Kyoto University
Information Technology Center, Tokyo University
VLSI Design and Education Center
Japan Science and Technology Agency (JST)
Korea：4
The Korea Institute of Geoscience and Mineral Resources (KIGAM)
Korea Institute of Science and Technology Information (KISTI)
Science and Technology Policy Institute (STEPI)
Korea Institute of Science & Technology Evaluation and Planning (KISTEP)

France：4
Federation MicroNano Technologies (FMNT) National Center for Scientific Research (CNRS)
Ecole Normale Superieure De Cachan-Institut (ENSC) D' Alembert
The University of Technology of Troyes, Troyes
Circuits Multi-Projets (CMP)
UK：5
The Medical Research Council (MRC)
Satellite Applications Met Office
The School of Informatics, The University of Edinburgh
Oxford Instruments
Institute of Nanotechnology (ION)
Germany：3
The Innovations of High Performance Microelectronics (IHP), Frankfurt (Oder)
RapidEyes AG
High Performance Computing-Center Stuttgart (HLRS), The University of Stuttgart
Canada：2
The Innovations and Solutions Directorate/ Public Works and Government Services Canada (PWGSC)
Canada Institute for Scientific and Technical Information (CISTI)
Belgium：1
Interuniversity Micro-Electronic Center (IMEC)
Denmark：1
Research Department, Danish Meteorological Institute (DMI)
Italy：1
The Institute for the Protection and the Security of the Citizen (IPSC), Joint Research Centre, Ispra (IPSC-JRC)
Spain：1
The Institute of Microelectronics De Barcelona (CNM-IMB)
South Africa：1
Council for Scientific and Industrial Research
Brazil：1
Sinapse-Instituto de Neurociências Clinicas Ltda., Campinas-SP-Brazil
Greece：1
Institute of Microelectronics (IMEL) National Center for Scientific Research (NCSR) "Demokritos", Athens
India：1
Vellore Institute of Technology
China：1
Institute of Engineering Mechanics of China Seismological Bureau (IEM)
Philippines：1
Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD)
Russia：1
Institute for Statistical Studies and Economics of Knowledge (ISSEK), State University – Higher School of Economics (HSE)

Integration

Synergy of Research Programs

In comparison with other research institutes in Taiwan, the NARL's most significant advantage is the inclusion of eleven research laboratories of distinctive fields. They are not only constituted by outstanding researchers of various expertise, but also equipped with unique core facilities and databanks throughout Taiwan. Examples include earthquake engineering core facilities, oceanographic research ship, satellite integration and testing facilities, academic research network backbone, nanofabrication process core facilities, and the government research bulletin (GRB).

Considering our core capacities and the current international trend, with the goal of coordinating the key competence of each institute, facilitating the synergies of inter-disciplinary cooperation, and assisting Taiwanese government in service-oriented and integrated application research projects, the NARL will concentrate its future research on the following five programs: (1) environment & disaster reduction, (2) nanoelectronics & systems technology service platform, (3) space technology, (4) biotechnology laboratory resource & platform and (5) cyber infrastructure.

In 2007 and 2008, the NARL formulated the four-year development plan for 2009~2012 on these five programs. This plan has been approved through the government's Sci-Tech program review process. During 2008, the program management process and information system was also established. Starting 2009, the five NARL programs will be implemented under this integrated mechanism. Through the synergy of core competences, the NARL will elevate its R&D capabilities and enhance its global competitiveness. Fig. 1 illustrates the NARL's matrix structure for the laboratories and major programs.

Also in 2008, the NARL promoted preliminary research of projects with high potential including "Research and Development of Coordinated Accelerators for Cluster Computing on a Hybrid Cluster," "R&D Platform for the Application of Bio-electronic Micro system," "The Establishment and Application of the Biomedical Digital Image Database and 3D Digital Image Analysis Technology," and "Taiwan S&T Information Gateway Program." These projects will serve to enhance the transverse integration of the NARL research laboratories' core capacities.

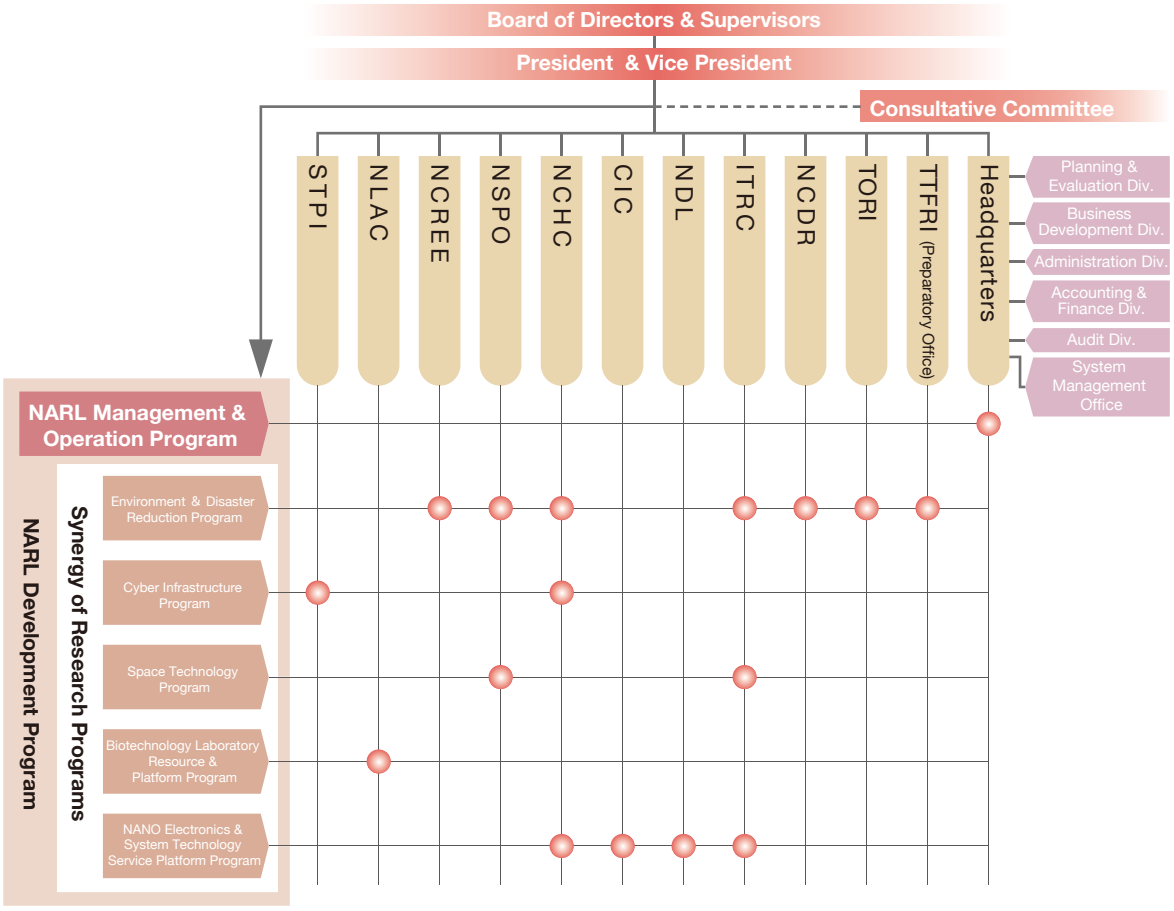


Fig. 1 The NARL's matrix structure for the laboratories and major programs.

The Executive Yuan's 2007 Award for Outstanding Contributions in Science and Technology

Fig. 1. The NSPO's IPS development team receives the award from ex-premier Chang.

The Executive Yuan established the Award for Outstanding Contributions in Science and Technology to honor Taiwan's researchers and research teams that make influential contributions to the country and to society as a whole. In 2006, the National Center for High-Performance Computing's (NCHC) Dr. Fang-Pang Lin was the recipient of the award for his work in developing Taiwan's Eco Grid project. In 2007, yet another NARL laboratory has won this prestigious award. This year, a team of researchers from the National Space Organization (NSPO) won the award for their work in developing the Image Processing System (IPS), an extremely agile high resolution image processing system for satellites that sets the standard for future domestic and international terminals (Fig. 1). The project was developed and executed by several independent research teams within the NSPO. Each team was tasked with developing a specific aspect of the system. The result of the project is one of the largest and most advanced satellite image processing systems in the world today (Fig. 2). The system is currently in orbit over the North Pole and receives its data from the FORMOSAT-2 satellite. The NSPO's IPS system meets international standards in terms of stability, efficiency, and quality and demonstrates that Taiwan is on par with other technologically advanced nations in terms of image processing technology capability.

The NSPO's IPS system won the Award for Outstanding Contributions in Science and Technology, in part, because the FORMOSAT-2 satellite is the only remote sensing satellite in the world that can acquire images from the same vantage point. In addition to its being highly versatile, FORMOSAT-2 is able to process remote sensing image data extremely quickly. This feature has proven particularly useful in evaluating the effects of large-scale disasters. In the five years since it was launched into orbit, FORMOSAT-2 has provided images of several natural disasters including the disastrous aftermath of Typhoon Mindulle in Taiwan on July 4th, 2004, and the earthquake and tsunami in southern Asia on December 26th of the same year. FORMOSAT-2 was able to obtain near real-time images of the disaster areas, thus, greatly aiding rescue operations and post-event reconstruction efforts. Also, FORMOSAT-2 collected image data over a one week period during the Tzini oil spill which polluted the ocean for two nautical miles south of Suao Harbor, Taiwan in December of 2006. That same month, an earthquake measuring 6.7 on the Richter scale hit Pingtong, Taiwan. The NSPO's IPS system obtained images of the areas affected by this disaster which were then used to support rescue operations.

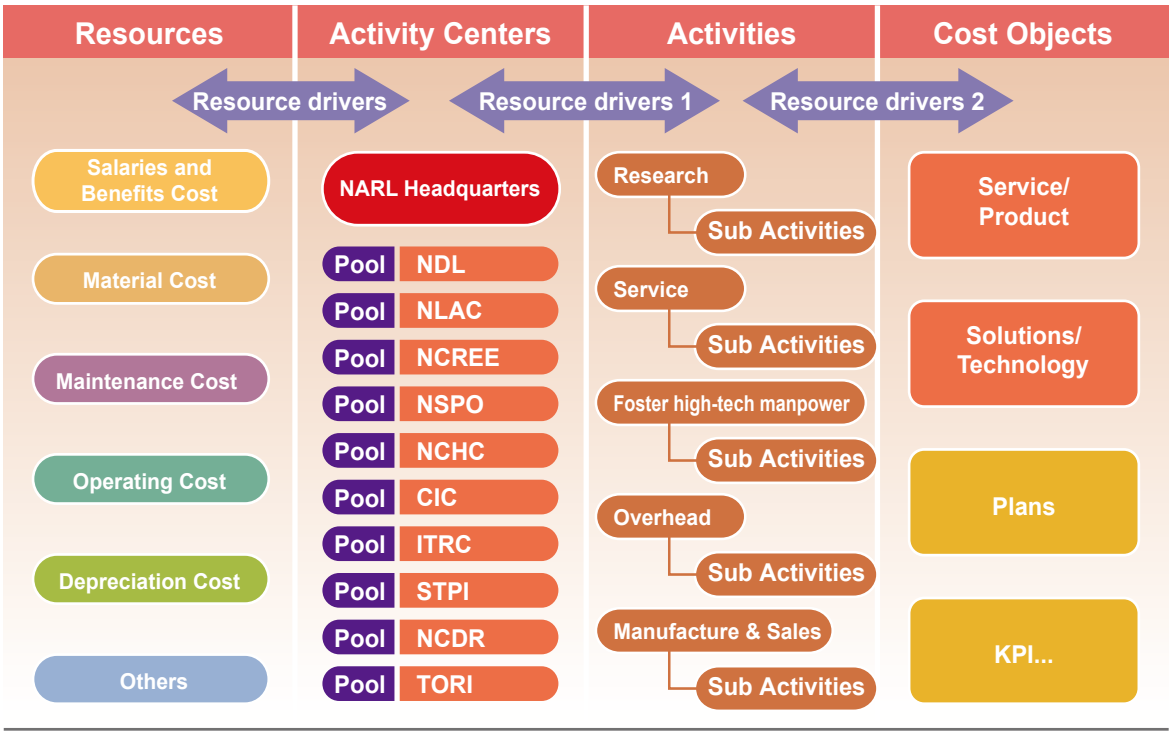
Fig. 2. FORMOSAT-2's first remote sensing image—Nanlia Harbor in Hsinchu, Taiwan.

Also in 2007, the NARL's NCHC contributed to the research project, The Olfactory Map of the Mushroom Body in the Drosophila Fruit Fly Brain, which was led by National Tsing Hua University's (NTHU) Dr. Ann-Shyn Chiang. This research also received the Executive Yuan's 2007 Award for Outstanding Contributions in Science and Technology. With the help of the NCHC, Dr. Chiang was able to complete the first-ever mapping of the olfactory neural circuits of the drosophila fruit fly. Since 2004, the NCHC, the Brain Research Center at NTHU, and the USA's Cold Spring Harbor Laboratory have been working together on this groundbreaking collaboration (Fig. 3) to build the world's first neural network 3D image system database.

Fig. 3. The NCHC, the Brain Research Center, and the Cold Spring Harbor Laboratory extended agreement signing ceremony in 2007.

Activity-Based Costing (ABC)

Beginning 2007, the NARL began implementing Activity Based Costing (ABC). As a result of great effort on the part of each of the NARL's laboratories, we have moved from a calculating and collecting activity-based costing data stage to the cost analysis and management stage (ABC/M). Once each laboratory has prepared the necessary data and incorporated its quarterly review report, the ABC-generated data will be used to facilitate their internal administrative, quotation, and decision management efficiency and cost control.



Activity-Based Costing Model

Once the NARL had completely internalized the concepts and values of ABC, we implemented the electronic operation of the ABC/M system. This was done in order to shorten the ABC cost calculation cycle and acquire cost calculation information faster. This, in turn, strengthened management control and utilization of ABC/M. This ABC/M electronic operation includes the systemization of core calculation modules (e.g. basic information, module build-up, and calculation and report modules), the time card system, and the WF system. Thus, the ABC/M system is able to automatically connect itself with the aforementioned systems and the ERP general ledger, begin automated motivated factor collection and cost calculation, and use a multi-dimension report editor to generate the cost report.

During the second stage of ABC implementation, each laboratory successfully completed the educational training and online practice with the help of IT specialists, accountants, and planning and coordination personnel. Because of the ABC/M logics module design, it was much easier for each department to absorb the ideology of the entire system and utilize it to facilitate administrative management.

The system will be fully implemented within all laboratories beginning 2009. It will replace the manual calculation systems and begin generating administrative reports at that time. This system will also connect relevant information from the ABC with the time card and WF systems. In so doing, the data will be consistent and, as a result, the daily administrative management will be much improved. In the near future, the entire system will be able to integrate daily operation management to allow laboratory managers to analyze the relationships between the cost occurrence of cost objects, working hours, and expenditures. It will also allow laboratory managers to evaluate and manage or eliminate both the value-added and the non value-added operation items. Finally, this system will also enable the integration of each laboratory's plans and adjust service chargeable pricing in order to maximize the synergy and value of NARL.

ISO Adoption and Certification Campaign

In order to improve its management efficiency, the NARL initiated the "Quality and Information Security Management System Adoption Campaign" in 2007 per instructions from the National Science Council, to adopt ISO 9001 and ISO 27001 standards and methodology. Through the standardization of its quality and information security management systems, the NARL hopes to establish a world-class management mechanism that will "strengthen operation efficiency, reduce operation costs, and synchronize operation quality."

To meet its schedule and quality goals, the NARL formed an ad hoc inter-laboratory team, led by Vice President Yeong-Her Wang, to coordinate the activities. After one year of thorough planning, evaluation, implementation, and enhancement, coupled with the dedication and hard work of all colleagues, the NARL Headquarters and all constituent laboratories successfully became ISO 9001 Quality Management System and ISO27001 Information Security Management System certified in September 2008. They were also certified to both ISO standards by SGS Taiwan Ltd., who officially awarded them the ISO 9001:2000 and ISO 27001:2005 compliance certificates on October 27th, 2008.

This certification not only symbolizes the international recognition of the NARL's integrity and high standards, but also imposes stiffer goals and more responsibilities on the NARL's operations. In the process of establishing this management system, the NARL fully integrated the quality and information security management standards with its internal management culture, thus, allowing it to continue to improve and pursue perfection. Via this international management certification, the NARL will expand its capacities to provide more efficient services and research, nurture talent, promote its international competitiveness, and, ultimately, achieve the goal of developing itself into a world-class national laboratory.

Statistics of NARL Achievements

No.	Item	2004	2005	2006	2007	2008	Total
1	Patent Application	60	81	81	66	111	399
2	Issued Patent	23	38	31	36	63	191
3	Technology Transfer	0	5	4	11	35	55
4	Journal Paper	292	267	349	316	635	1859
5	Conference Paper	517	457	649	491	1574	3688
6	Domestic Conference	16	35	29	31	42	153
7	International Conference	11	8	14	18	18	69
8	Training Course (persons)	17357	16784	19887	25871	27723	107622
9	Press Conference	17	18	23	15	17	90
10	Award	8	6	14	19	23	70
11	Publication	19	37	31	39	42	168

National Nano Device Laboratories

Device Manufacturing Services

Upgrading Existing Equipment and Tools

In an effort to build an open environment for experiments and research that is geared to the standards of other world-class research institutions, the National Nano Device Laboratories (NDL) recently upgraded the equipment that processes the 6-inch wafers (which require a high degree of maintenance) to an 8-inch wafer compatible core pilot line. The NDL has completed the modifications and tested the equipment which is now ready for use. This equipment includes the TCP 9600 Metal Etcher, the UNAXIS SiGe Ultra-High Vacuum Chemical Vapor Deposition (UHVCVD) System, and the ELIONIX E-beam Writer. Also, the NDL recently purchased an E-gun evaporator, horizontal furnace, physical vapor deposition (PVD) system, and an inductively-coupled plasma (ICP) etcher. The E-gun evaporator and furnace are currently operational.

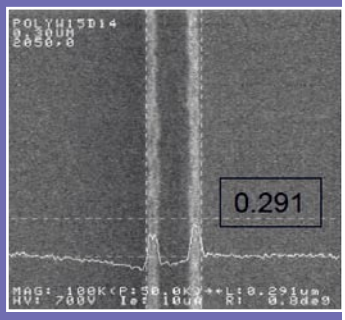


Fig. 1. 290nm single line.

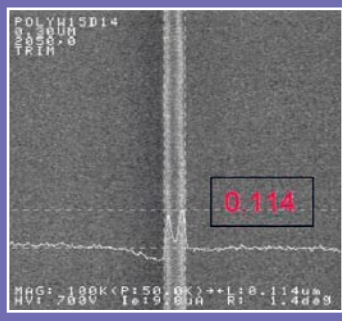


Fig. 2. 110nm single line.

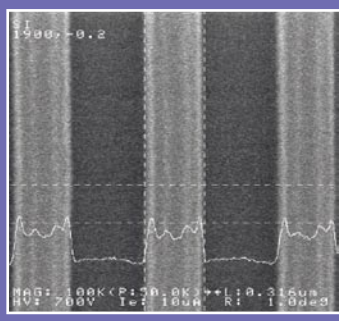


Fig. 3. 310nm dense line.

I-Line Stepper Technical Improvements

The exposure step in semiconductor processing is to define the desired nanostructure patterns. Currently, the I-line Stepper is capable of achieving a pattern size of 350nm. To push the limit of the I-line Stepper and advance its existing processing capability, other techniques such as thinned resist, hard mask, and phase-shift mask (PSM) must be implemented. Using thinned resist can enhance the stepper resolution. Potential pattern transfer failure is a concern where in the etching process the thinned resist cannot effectively block the reactive ions and chemical reactions. As a result, hard mask is required to render successful pattern transfer on to the bottom layer. Within the limited available resources, NDL is able to achieve the following milestones in I-line Stepper by implementing several critical processing techniques without advanced equipments and tools:

- Fabrication of 110nm single line: By tuning various I-line Stepper processing parameters, the NDL has pushed the stepper limit from 350nm to 290nm (Fig. 1). Utilizing the photoresist trimming (PR Trimming) recently developed for the etching equipment in conjunction with the hard mask technique, the NDL has successfully scaled the as-defined 290nm pattern to a final size of 110nm (Fig. 2).
- Fabrication of dense line with 700nm pitch: Since the fabrication of dense line is much more challenging than that of single line, additional resources are required. Currently, the NDL is capable of fabricating dense line with 310nm linewidth and 700nm pitch (Fig. 3).

Enhancement of Technical Service in Nanoscale Energy and Optoelectronic Devices

The NDL's Southern Tainan branch has developed a new solar cell prototype made of radial silicon nanowires. It features a fairly high p-n junction area and an extremely low surface reflection rate. The NDL's Southern Tainan branch is establishing a platform for the research and development of organic solar cell and has completed the following three crucial technical indicators: (1) R&D of optoelectronic devices including organic solar cells and organic light emitting diodes (OLED). Processes such as coating, baking, and packaging are carried out in a glove box environment which ensures strict control of water and oxygen content and connects to a multi-chamber evaporator, thus, rendering a streamlined process. (2) The installation of the Incident Photon Conversion Efficiency (IPCE) Spectroscopy and material/device analytical capability for the solar simulation system. (3) The completion of the Surface Modification System for the synthesis and distributed coating of nanoparticles.

Education and Research Service

ISO 17025 Approval for Testing Laboratory Management and Operation

In order to provide reliable, precise, and speedy testing and inspection services, the Nano Imaging and Metrology Group's Nano Metrology Laboratory was approved by the Taiwan Accreditation Foundation (TAF) in 2007 and accredited ISO17025:2005 certification in AFM step height measurement and SEM line width measurements. Also, on January 3rd 2008, the laboratory signed

an agreement with the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement (ILAC-MRA) (Fig. 4). In August of 2008, the laboratory received accreditation for measurement techniques in AFM (line width measurements), SEM (surface image observations) and TEM (line width measurements) (Fig. 5). These test reports are accepted by all participating members of ILAC-MRA, including 58 accreditation organizations and 46 countries in the USA, Asia, and Europe.

Fig. 4. The International Laboratory Accreditation Cooperation Mutual Recognition Arrangement (ILAC-MRA) composite label.

Fig. 5. ISO 17025 accreditation for metrology techniques.

ISO 27001 Security Information Management Certified

In order to enforce its operational procedures and improve its professional management of information security, the NDL began preparing for ISO 27001 certification in July 2007 and received certification on September 27th 2008.

Process and Equipment Service Modules Installed and Ready for Use

In order to enhance the efficiency of its outreach services, an online public use service portal (http://www.ndl.org.tw) was launched which contains the process and equipment services modules. Regarding the service of lab equipment use, the NDL's primary focus is on supporting the activities of academic research. By December 2008, a total of 1,072 professors and graduate students had utilized the NDL's core facilities to conduct their research. During 2008, the equipment uptime reached 137,774 hours; an increase of 9.4% when compared to the 125,908 service hours in 2007. The corresponding service charges were USD 16.3 million; a growth of 24.4% from USD 13.1 million in 2007.

Frontier Device Research and Development

Development of low-temperature activation anneal

Low-temperature activation annealing is a critical step in the fabrication of nano devices because high temperature over an extended period of time results in diffusion and leads to short-channel effects. The NDL collaborated with the USA's DSG Corporation to develop microwave annealing of ultra-thin Ge film. The results show germanium thin films without degrading short-channel effects and were published in EDL, a prestigious microelectronics journal.

Development of radio-frequency transistor modeling

The goal of this research is to better understand the effects of temperature variations on the characteristics of RF transistors. The RF transistor characteristics were studied at elevated temperatures and a device model was established. Two techniques were developed in this area: (1) the temperature effect on the high-frequency noise of RF MOSFET was studied and a formula established. This is very helpful in creating a precise temperature model for high-frequency noise and is vital to domestic RF CMOS industries. (2) The study on the temperature effect on the capacitance characteristics of RF LDMOS facilitates building a device temperature model that can be used in power amplifiers. This is crucial to enabling the self-sustained development of domestic base station techniques.

Development of the world's first silicon-based ferroelectric memory

The NDL plans to build the world's first silicon-based ferroelectric memory that will not rely on charge for data storage. This memory will be made of super lattice thin film material which consists of silicon quantum dots and saves energy by utilizing a single material. Other related devices under development include a silicon quantum dot detector for light communication and a prototypical third-generation high-efficiency, high-frequency silicon quantum dot solar cell.

National Laboratory Animal Center

Isolator Technique-related Research Cooperation

The National Laboratory Animals Center's (NLAC) germ-free isolator team began a three-year project in 2007 called the "R&D of Health Food Project," an inter-ministry, mission-oriented research project that is administrated by Taiwan's National Science Council (NSC), Department of Health, and Council of Agriculture. The purpose of this project is to evaluate the functions of probiotics based on germ-free animal models. The project includes four sub-projects whose participants include the NLAC, the Food Industry Research and Development Institute, Fu Jen Catholic University, Chung Shan Medical University, the Agricultural Biotechnology Research Center, and Chinese Cultural University. Three SCI papers, based on the project, were already published in the international journal "Immunopharmacology and Immunotoxicology", and is accepted and will be published in "Veterinary Medical Science" in 2009.

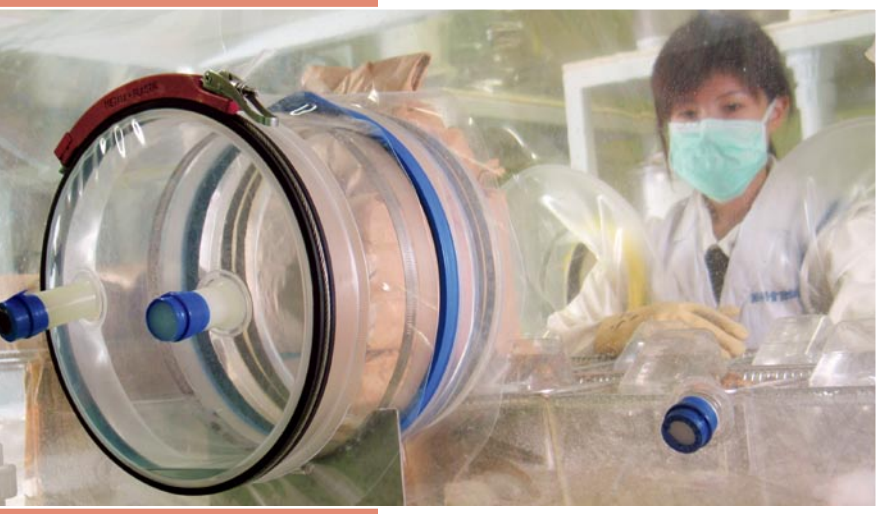
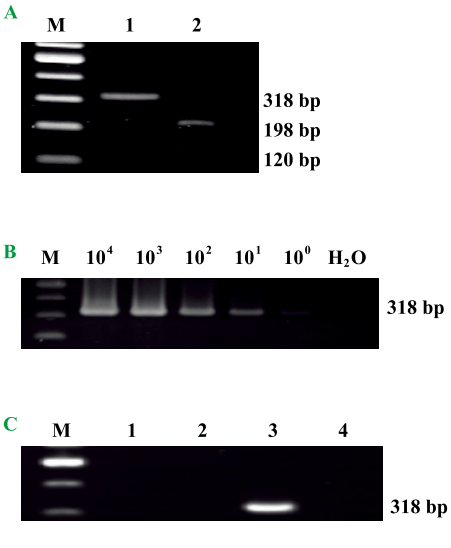


Fig. 1. Germ-free isolator techniques

In order to establish high quality breeding colonies at their Tainan facility, the NLAC's germ-free isolator team successfully utilized the isolator technique to re-derive mice (Fig.1). Currently, the NLAC has established a total of 38 germ-free isolators with a total production of 1,889 germ-free mice and rats. Because of the increasing demand for germfree animals, scaling-up of the operation has become necessary.

Development of Laboratory Animal Diagnostic Techniques

- The NLAC has established identification tests for emerging diseases and hard-to-distinguish pathogens using a reverse transcription polymerase chain reaction (RT-PCR). In 2008, the NLAC successfully developed molecular diagnostic techniques for three emerging hamster diseases: *Pasteurella pneumotropica,* Murine Norovirus (MNV), and Tyzzer's Disease.
- The NLAC performed initial analysis of the Murine Norovirus (MNV) genotype in Taiwan. Most of samples supplied by different organizations in Taiwan were analyzed as MNV-1 type. The genotypes were published on GenBank with the ID numbers EU482057 and EU482058.



(A) The sample is positive for RFLP: Lane 1: Original PCR product; Lane 2: PCR product digested with Taq I.

(B) Sensitivity test: dilute MNV plasmid by ten times consecutively (10^4~10^0 copies number) to perform PCR.

(C) Specificity test: Lane 1: Intestine RNA of TMEV infected rat; Lane 2: Whole genome plasmid of MHV; Lane 3: MNV positive control; Lane 4: Blank (H2O).

Fig. 2. Sensitivity and specificity of MNV RT-PCR

Image Analysis System Setup for Laboratory Animals

- Setup of a non-invasive fluorescent/bioluminescence image analysis system: Transgenic mice with reporter genes, such as green fluorescent protein/luminescence enzymes, are useful for studying gene regulation and signal transduction *in vivo*. Consequently, these mice are excellent models for drug screening and experiments on infectious diseases. They are also valuable tools for pharmacology/toxicity testing and for the development of new drugs. The NLAC has established a bioluminescence transcription factor (NF κ B-Luc) transgenic mouse for drug screening. Other useful models are forthcoming.

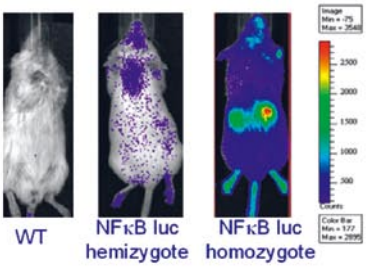


Fig. 3. NF κ B-Luc transgenic mouse (LPS Challenge)

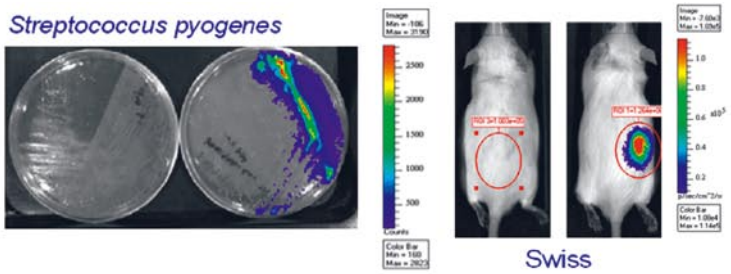


Fig. 4. Setup of infectious disease mouse model using bioluminescent bacteria

- The NLAC collaborated with the National Center for High-Performance Computing's (NCHC) Visualization and Interactive Media Lab (VIML) to develop a 3D image analysis system called the medical image illustrator, or "miil," which enables the analysis of genetically modified animals, laboratory mouse pedigree identification, and bio-diversity database setup. This year, the NLAC produced an 18 minute 3D movie. Shooting, editing, and post production of the film were all done in-house. The project was showcased at the SC08 supercomputing conference.

  The NLAC also assisted researchers in performing analysis of 3D mouse images. There are four ongoing projects: (1) the native rodent strain database, (2) the 3D image analysis of mutant mouse with upper limb dystrophy, (3) the ear bone morphological analysis of coastal cetacean in Taiwan, and (4) the analysis of biological morphology by using 3D image analysis techniques and conventional measurements.

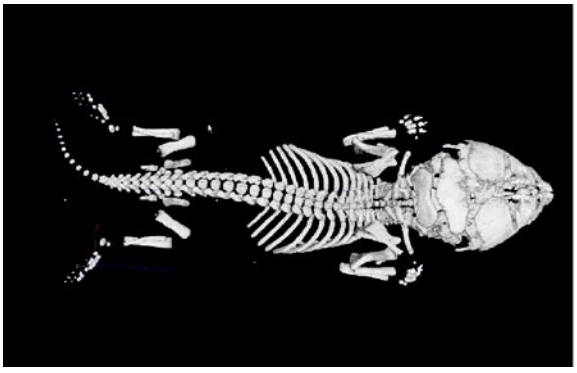


Fig. 5. CT analysis of 3D mouse skeleton

Fig. 6. Pedigree mouse identification analysis by lower jaw dentition

National Center for Research on Earthquake Engineering

Study and Future Strategy Planning on Improvement of School Building Seismic Capacity

The NCREE experienced many great achievements during 2008. In particular, we made much progress on our strategy to improve the seismic capacity of Taiwan's school buildings. One of the requirements of Taiwan's school buildings is that they have good lighting and ventilation. Sometimes, though, these requirements form "soft spots" in the building's structure which makes them more susceptible to earthquakes.

Recently, tens of thousands of students lost their lives when their school buildings collapsed in the 2005 earthquake in Kashmir, Pakistan and the 2008 earthquake in Wenchuan, China. During the 1999 Chi-Chi earthquake in Taiwan, a total of 293 school buildings, almost half of the school buildings in Nantou County, were seriously damaged or collapsed entirely as a result of the magnitude 7 earthquake. Had this earthquake hit during the day when the school buildings were full, many more lives would have been lost.

Improving the seismic capacity of buildings is an extremely important issue, especially in those regions of the world most susceptible to earthquakes. Because government spending is very limited, the seismic capacity of existing buildings must be carefully evaluated before retrofitting takes place. Also, if it is determined that retrofitting is necessary, an economical and efficient "action plan" needs to be developed.

To this end, after the 921 Chi-Chi earthquake, the NCREE conducted a series of research experiments, the focus of which was on the evaluation and retrofitting of school buildings in Taiwan. The methodology used in the study included theoretical analysis, laboratory verification, and four onsite pushover experiments. As a result of this study, a simplified method of investigation, preliminary evaluation form, specific evaluation form, and several economic retrofitting methods were proposed in the "Manual of Seismic Evaluation and Retrofitting Techniques for Existing School Buildings" (published 2008). The manual is used as a reliable reference for professional building engineers in Taiwan.

In cooperation with Taiwan's professional engineering associations, the NCREE also hosted several training workshops in Taipei, Taichung, and Kaohsiung in 2008. During these workshops, NCREE researchers shared their accumulated experience with other professionals in the field. Also, as an

Fig. 1. A satellite image showing the Taipei basin

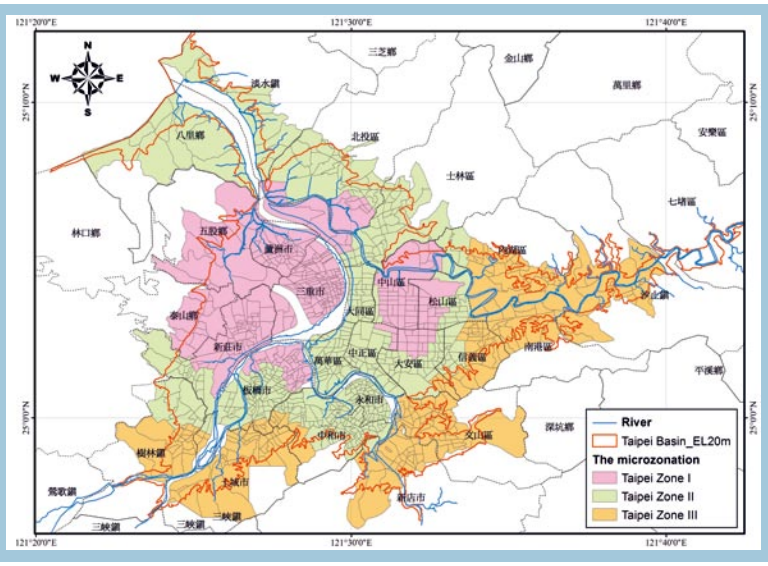


Fig. 2. The latest seismic microzonation map of the Taipei basin (under review)

extension of the original "Reconstruction of Old School Buildings In Taiwan" project, the NCREE is assisting the Ministry of Education to execute a new USD $1.5 million project, "Accelerating the Reconstruction and Retrofitting Process of Existing High School Buildings In Taiwan" (2009~2012). The seismic capacity of all of Taiwan's school buildings will be entirely upgraded by the year 2012. The NCREE will provide technical consultation for the project to help ensure that the project goals are reached.

Revision of Taiwan's Seismic Codes

The Taipei basin is a sedimentary plain surrounded by terraces and hills. It is also a complex geotechnical structure with a soft layer of soil that is more than 700m deep. The region around the Taipei basin is one of the least seismically active regions in Taiwan but, because of its specific geotechnical and geographical conditions (Fig. 1), seismic waves propagated from far-field earthquakes can easily be amplified by the basin effect. This phenomenon must be carefully considered when engineering structural seismic designs for this area.

Taiwan's current seismic code was designed using data from earthquakes that occurred before June, 1999. Because of the massive destruction caused by the 921 Chi-Chi and 331 earthquakes, it has been suggested that Taiwan's seismic code be revised and updated. To aid in this effort, many strong ground motion stations were installed in the Taipei tide basin. In a direct response to the need for code revision, the NCREE revised the design seismic microzonation map of Taipei basin to include updated physical geotechnical conditions (Fig. 2). The revised version will replace the old version once it has been approved by the Architecture and Building Research Institute (ABRI), Ministry of the Interior.

The Construction of Multi-Axis Testing Systems (MATS)

Recently, much research has been done on the use of passive structural control technologies against natural hazards, however, until recently, there were no reliable or convenient component testing facilities in Taiwan. Because of this, performance tests could not be carried out on control devices such as the seismic base isolator. In the past, testing of these devices was conducted by well-known overseas laboratories. This, though, greatly increased R&D costs and decreased progress. The same situation exists in the testing of full-scale single columns (e.g. steel/RC/SRC) and beam-column joints (e.g. steel/RC/SRC) under high axial loading.

In order to address the aforementioned component testing issues, the NCREE opened a MATS facility where experimental studies on structural component behaviors (under multi-directional loadings) are conducted (Fig. 3). The system in use at the MATS facility includes three translational and three rotational directions, including longitudinal and vertical directions. The introduction of the MATS facility significantly leverages Taiwan's R&D capability in earthquake engineering. The newly completed MATS facility, with its state-of-the-art testing capability, will help public officials prepare the next-generation structural control design codes. In the meantime, the facility will also be used by domestic industry to improve their manufacturing processes of high-tech structural control products.

Fig. 3. Multi-Axis Testing System (MATS)

National Space Organization

FORMOSAT-3 – Leading the Way in Atmospheric Research

The launch of the FORMOSAT-3 satellites on April 15th 2006 witnessed the arrival of the world's first satellite constellation to utilize the radio occultation of Global Positioning System (GPS) signals to provide near real-time atmospheric data for the scientific community. With an average of 2,000 data measurements daily, over 1.3 million samplings have been recorded to date. These samplings are readily available at the Taiwan Central Weather Bureau's Taiwan Analysis Center for COSMIC. As of December 2008, over 943 registered users from 49 countries have subscribed to this online service.

On December 1st 2008, the National Space Organization (NSPO) hosted the 4th Asian Space Conference (ASC) together with the 3rd FS-3/COSMIC conference at the Howard International House in Taipei. With leading experts from domestic and international research organizations in attendance, the focus of the conference was on the exchange of the latest scientific discoveries and ideas. The conference's 300 registered attendees came from countries including the U. S. A., Germany, Spain, Austria, Brazil, Canada, Australia, Bangladesh, Iran, India, Japan, South Korea, Singapore, and China.

FORMOSAT-2 – Enabling Scientific Breakthroughs

The FORMOSAT-2 scientific instrument, known as the Imager of Sprites and Upper Atmospheric Lightning (ISUAL), is the first experiment to employ satellites to study upper atmospheric optical flash transients. Between July 4th 2004 and September 30th 2008, ISUAL detected 10,948 such occurrences of this atmospheric phenomenon. These occurrences consisted of 9,127 Elves, 887 Red Sprites, 906 Halos and 28 Gigantic Jets. The scientific data acquired by ISUAL was processed by Taiwan's Science Data Distribution Center and then uploaded to the Internet for global access. Fig. 1 shows the global distribution of the upper atmospheric optical flash transients detected by ISUAL.

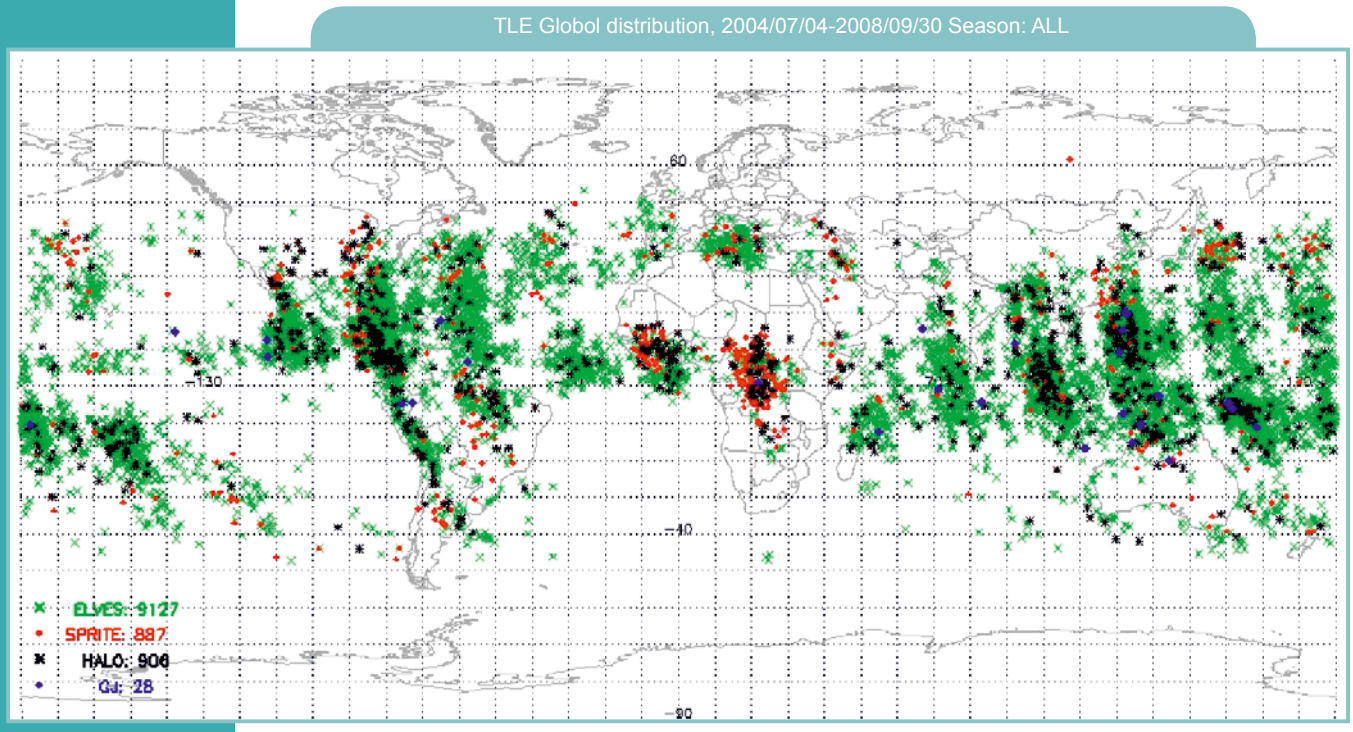


Fig. 1. The global distribution of optical flash transients between 2004/04/07~2008/09/30

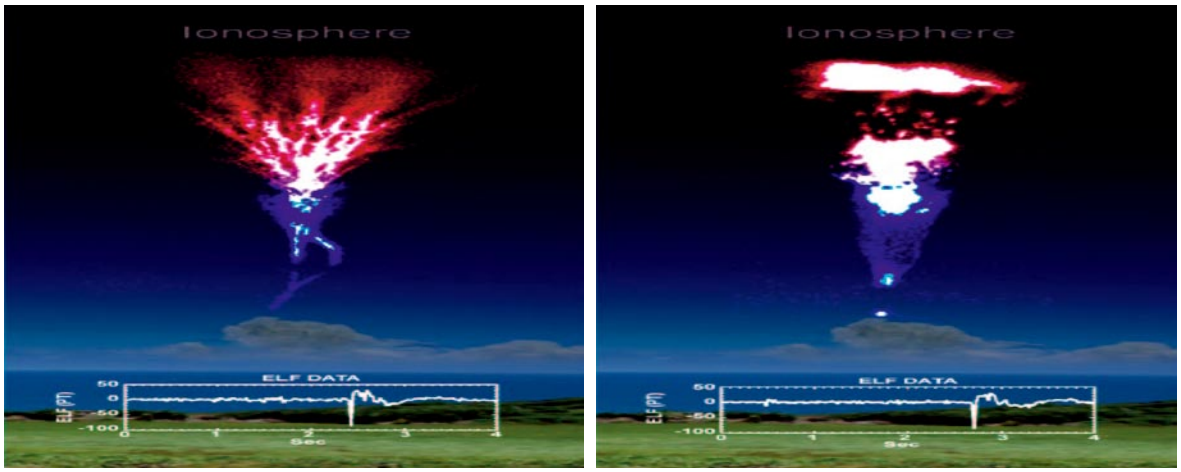


Fig. 2. Gigantic Jets

FORMOSAT-2 – Enhanced Image Processing

FORMOSAT-2's image processing capabilities continue to evolve and improve. By December 2008, over 49,000 hours of image data covering a total land area of 463,028,124 square kilometers had been captured. This is equivalent to 308% of the earth's entire surface area or approximately 12,861 times the size of Taiwan. Due to its highly maneuverable design and large field-of-regard, FORMOSAT-2 is currently the only high-resolution remote sensing satellite capable of imaging the far reaches of the polar regions. FORMOSAT-2 monitors specific sites and details the receding glaciers and the collapse of the polar ice shelves. This has gained the attention of renowned field experts and research organizations that use the data exclusively in their scientific studies. The contributions of FORMOSAT-2 in the study of climate change are crucial in establishing environmental policy and tackling the effects of global warming.

Regarding international relief efforts on natural and man-made disasters during 2008, FORMOSAT-2 continued to support the International Charter on Space and Major Disasters. Of the missions carried out in 2008, emergency assistance was provided to Asia, North America, Central America, and Europe. This assistance came in the form of relief from flood, fire, volcanic eruption, and pollution from oil spills. In response to the powerful 7.2 earthquake that struck China's southwest Sichuan province on May 12th, 2008, the NSPO dispatched an emergency operation to survey the area the very next day. On May 14th, 2008, in order to help with damage evaluation and rescue efforts, the NSPO provided the Chinese authorities with the first satellite images of the earthquake stricken region (Fig. 3).

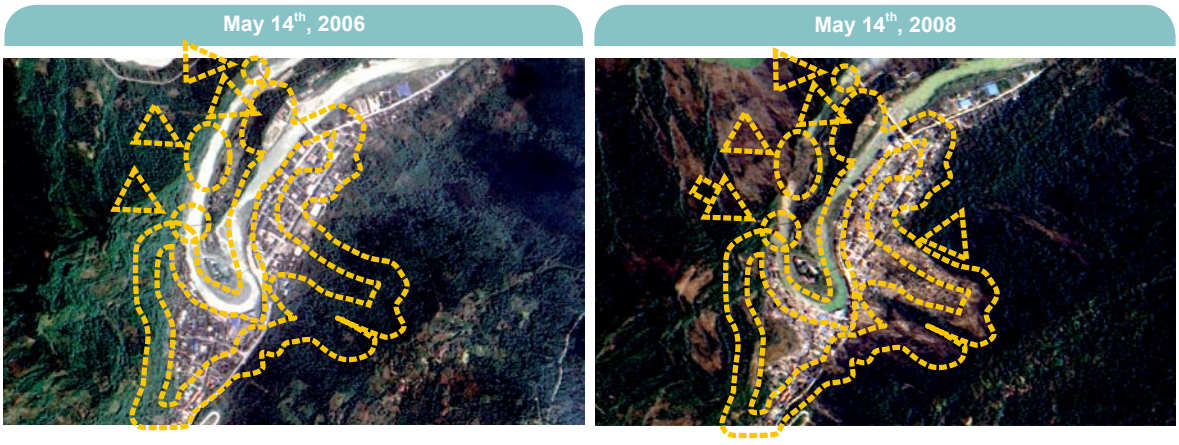


Fig. 3. Satellite imagery of China's Sichuan Province: Before (Left) and After (Right) the devastating 7.2 Earthquake

National Center for High-Performance Computing

High Performance Computing Service Achievements

In 2008, the NCHC's high performance computing facilities serviced more than 20 multi-disciplinary national projects, more than 700 National Science Council (NSC) projects, and more than 30 proprietary facility projects. Users of our HPC resources published more than 600 articles and 80 Ph.D. theses during 2008. In order to create a better relationship with our users, we also held a HPC Users Symposium, the focus of which was on tackling important issues such as global warming, energy creation and consumption, and earthquake engineering. This symposium allowed for cross pollination of many fascinating theories and ideas. In all, during 2008, we supplied 25 TFlops of computing power to our users.

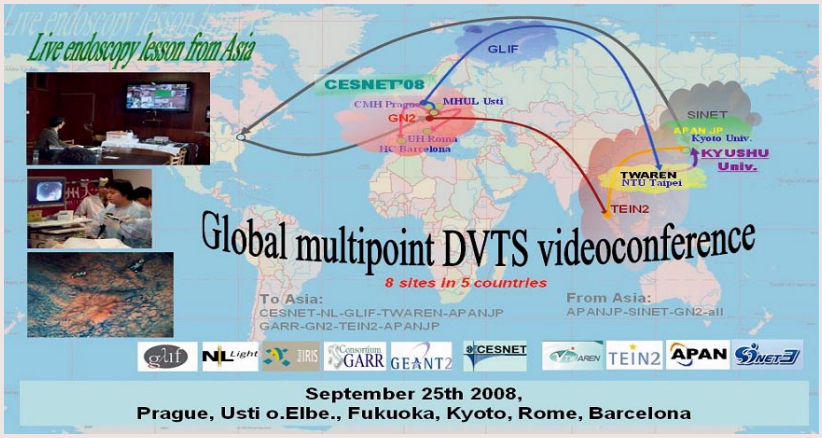


Fig. 1. TWAREN participates in the CESNET 2008 conference and assists in international point-to-point medical video teleconferencing. There were eight institutions from Taiwan, Japan, Czech Republic, Italy, and Spain participating in the event.

Academic Research Network Service Report

The NCHC provides world-class networking services to our HPC community. The TaiWan Advanced Research and Education Network's (TWAREN) uptime was 99.974% in 2008 whereas the Taiwan Academic Network's (TANet) uptime was at 99.993%. Access to international networks was at 99.988%. In order to increase our international networking and collaboration capability, we established a fiber-optic link to Prague, Czech Republic in 2008. The link spans two oceans and three continents and is linked via four major research networks. This link is currently the world's longest point-to-point fiber optic link. The link is used for medical video teleconferencing and international collaboration in education.

Storage Services Achievements

The NCHC's provided storage services to over 700 domestic projects. In order to establish a shared national knowledge database, we collaborated with the NSC and the Science & Technology Policy Research and Information Center (STPI) to establish the NSC Humanities & Social Sciences Research Resources. Other databases include the Geographic Information Database, 3D Bio FlyCircuit Image Database, and the National Oceanic Database. The NCHC has effectively become the storage site of research data for Taiwan's research community.

Education Achievements

In 2008, the NCHC held 158 HPC-related instructional courses with more than 2,000 students enrolled therein. Estimated savings for Taiwan's high-tech industry is approximately USD $6 million. Digital courses were also uploaded online in order to provide a more comprehensive learning experience to students. Working with science volunteer organizations, the NCHC held ten K12 science camps and eight middle and elementary school teachers' learning camps.

Research Achievement

Increased Research in HPC Capabilities

In 2008, the NCHC began research on using graphics processing units (GPU) to increase HPC capability. This new technology was then promoted to the domestic research sector. Thus far, the NCHC has established seven small-scale GPU computing environments and plans to establish a GPU cluster in 2009.

HPC Applications Research

The NCHC's 2008 applications research focus included medical computing, hydrology, and photovoltaics. Regarding medical computing, we collaborated with Chang Gung Memorial Hospital to establish the Cranioplasty Surgery Platform and the Sleep Apnea Visual Diagnosis Platform. These two platforms are used for patient diagnosis and pre-surgery evaluation.

Regarding hydrology research, the focus was on software program development that models fluid dynamics and water flow in canals. The NCHC also accepted the "Extended Development of Platform to Integrate Hydrologic and Meteorological Observation" project from Taiwan's Water Resource Agency. The project seeks to create an integrated database and modeling platform to assist in disaster prevention.

Regarding photovoltaics research, the NCHC's focus was on green energy technology modeling. We collaborated with National Sun Yat-sen University, National Taiwan University, and National Chiao Tung University's Dr. Ming-Chang Lin on this project. The project seeks to create a high-efficiency and environmentally sound solid-state-based generator. In 2008, we published fourteen photovoltaics research-based articles, five of which had an impact factor greater than three.

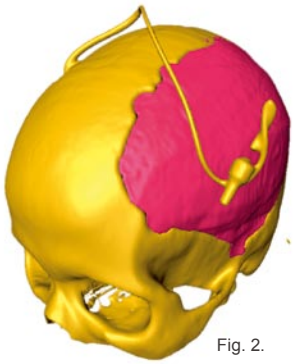


Fig. 2.

Fig. 2. The cranial implant made using the Cranioplasty Surgery Platform greatly reduces the time needed for surgery and improves the fit and finish of the implant. By June 2008, a total of 31 successful cranioplasty surgeries were performed using this platform.

Fig. 3. The Sleep Apnea Visual Diagnosis Platform is used to diagnose sleep apnea in as little as 5 minutes!

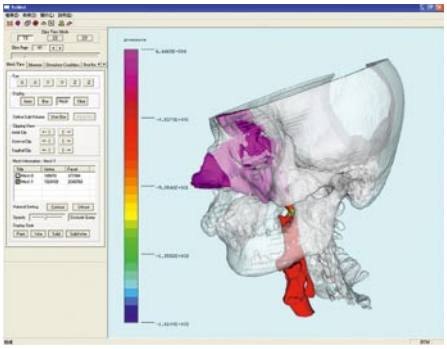


Fig. 3.

Next Generation HPC Technology Development

The NCHC's next-generation HPC technology research results for 2008 included development of the Diskless Remote Boot in Linux (DRBL)/Clonezilla platforms and the Co-Life platform. 2008 downloads for DRBL/Clonezilla surpassed 400,000 worldwide! DRBL/Clonezilla won first place in the National Applied Research Laboratories' (NARL) Notable Contribution to Technology Award. Related software, Tux2Live, also won the 6th Annual Golden Penguin award in the "Research Innovation" category.

The multi-participant video teleconferencing, Co-Life, can support video teleconferencing from up to 29 different sources. So far, Co-Life's most prevalent use has been in supporting online inter-school class participation. Over 50 educational institutions currently use Co-Life. Taiwan's Water Resource Agency also established 15 AV conference rooms using Co-Life. Co-Life offers a very high quality and stable video teleconferencing environment. Video teleconferencing reduces carbon emissions as well as increases collaborative opportunities.

Participation in National and Advanced Research Projects

The NCHC is collaborating with several organizations such as National Taiwan University's Department of Electrical Engineering, Academia Sinica's Institute of Atomic and Molecular Sciences, and National Central University's Department of Physics to create high-energy laser and plasma simulations. We hope to establish a simulation environment in the very near future.

The NCHC also continues its collaboration with the Brain Research Center at National Tsing Hua University and U.S.A's Cold Spring Harbor Laboratory on the 3D Bio FlyCircuit Image Database. Dr. Ann-shyn Chiang's Fruit Fly Olfactory Diagram won the Executive Yuan's 2007 Notable Contribution to Technology Award.

National Chip Implementation Center

Integrating and Developing the IC/System Design Environment

To meet the future demands of academic research and industrial development, National Chip Implementation Center (CIC) has developed a complete integrated circuits (IC)/system design environment. This environment consists of efficient design flows that integrates the Electronic Design Automation (EDA) tools used in the IC industry today. It also utilizes the standard cell library and silicon IPs. The design flows include Electronic System Level (ESL), Cell-Based IC, Platform-Based SoC, Full-Custom IC, field-programmable gate array (FPGA), Mixed-Signal IC, RF/MM IC, and MEMS and IC measurements. The EDA tools come from 20 world-class vendors.

CIC also provides academic researchers with a design environment in single-core and homogeneous/heterogeneous multi-core system development that includes embedded system software technology such as OS Porting, Device Driver, and Bootloader. It also includes hardware platforms such as TI-DaVinci DVEVM, SunPlus-SPCE3200, ANDES-Leopard, and ITRI-PAC-PMP. Finally, training courses and technical consultation are also provided.

CIC has recently developed a configurable SoC prototyping systems called CONCORD for university researchers to prototype and verify their SoC designs. CONCORD (Fig. 1), a fully configurable and modularized platform allows its users to: (1) add and remove IPs from the platform, (2) use single and/or multiple cores from different vendors, and (3) adopt any bus structures and/or network architecture. CONCORD system is already being used in several academic SoC design projects for system prototyping and verification.

In order to most efficiently utilize its existing resources, CIC integrates its existing IC design hardware development kits with configurable and modularized components. CIC recently developed a configurable and modularized FPGA platform, or MOR FPGA, with peripheral interfaces that allows for the sharing of FPGAs from different vendors. CIC's MOR FPGA (Fig. 2) was completed in April 2008 and was demonstrated at the annual IC-design contest in May. The MOR FPGA system is also being used as a platform for IC design education at CIC's summer training program.

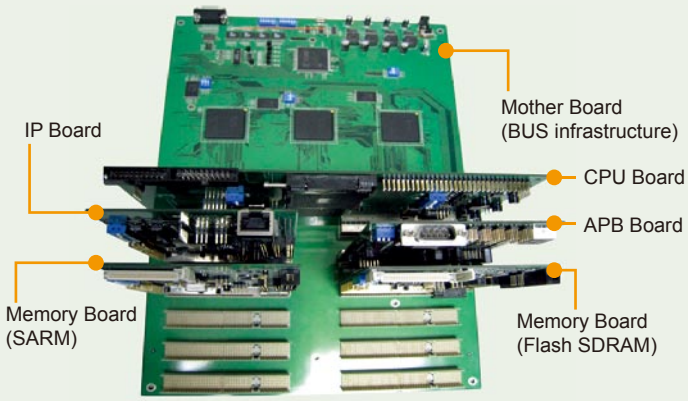


Fig. 1. The CONCORD prototype SoC verification platform

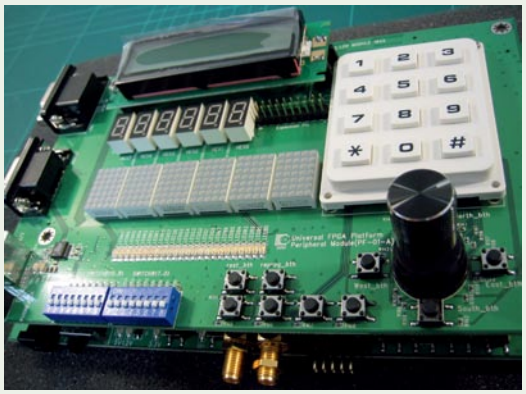


Fig. 2. The modulized sharing FPGA platform for IC contest and instruction

Providing Chip Fabrication and Measurement Services

In order to meet the future demands of the IC design industry and to foster the education of high-quality IC design professionals, CIC offered several advanced processes to domestic foundries and established several IC fabrication service flows for local academia in 2008. During the year, CIC offered the following processes: UMC 90nm MS CMOS, TSMC 0.13μm MS/RF CMOS, TSMC 0.13μm Logic/MS CMOS, TSMC 0.18μm 1P6M CMOS, TSMC 0.35μm 2P4M CMOS, TSMC 0.35μm SiGe BiCMOS, WIN 0.15μm PHEMT GaAs, TSMC 0.35μm CMOS MEMS, and TSMC 0.18μm CMOS MEMS.

In order to efficiently utilize its existing resources, the multi-project chip (MPC) approach was successfully used in the IC fabrication service. The MPC approach integrates multiple IC design projects onto a single chip that shares resources and further reduces fabrication costs. In 2008, a total of 1,794 ICs were fabricated, including 1,607 advanced research chips and 187 educational chips. CIC also provides measurement services for mixed-signal ICs, RF ICs, MEMS, and wireless communication ICs. These services include the measurement of on-wafer Load-Pull, multi-port S-parameters, noise figure, and signal source analyzers. Also in 2008, CIC assisted local universities with 140 sensors and RF application-related design projects.

CIC also established the CMOS MEMS design platform with a library containing the material parameters extracted from 0.35μm and 0.18μm CMOS MEMS platform. The platform includes measurement systems such as vacuum measurement system, Laser Doppler Vibrometer, and accelerometer measurement system (Fig. 3). For silicon-in-package (SiP) design service, CIC developed technology that integrates the flip-chip bumper process, Integrated Passive Device (IPD) process, and TSMC 0.18μm CMOS process. The Flip-chip bumpers are used to interconnect the CMOS chips on IPD substrates. Also in 2008, several multiple RF-SiP design projects were successfully fabricated with the talents of many designers. The projects included RF passive components, mm-wave antenna embedded on an IPD substrate, and the LNA and VCO composed of CMOS and IPD circuits (Fig. 4).

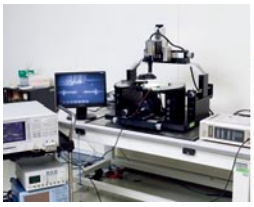


Fig. 3. Laser Doppler Vibrometer, and Accelerometer Measurement System

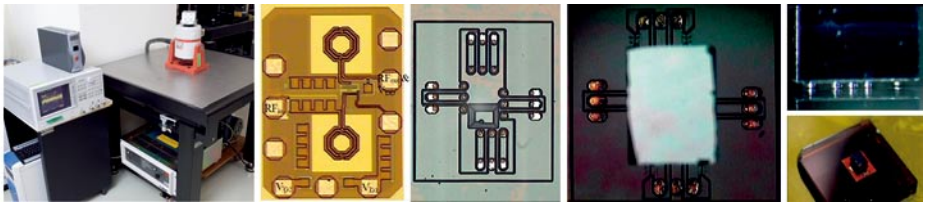


Fig. 4. UWB LNA composed of CMOS and IPD circuits

Training Courses and Activities

CIC offers several training courses on Full-Custom IC design, Cell-Based IC design, FPGA design, IC Testing, RF/MMIC design, and SoC/IP design. Most of the training courses are taught by CIC engineers. In order to comply with the CIC's "3E" policy (i.e. Economical, Effectiveness, and Efficiency), several lifelong ubiquitous education e-learning training courses were also offered. There were 11 e-learning courses offered in 2008 such as HSPICE, Full-Custom IC design concepts, VHDL, RF CMOS IC design, From Plan to Closure, What is Verification Process Automation?, Introduction to the Mixed-signal Design Environment, Demo based on PLL Design, Novas' Verdi Debug System, Laker, MMIC design, and ADS-Circuit.

In 2008, CIC co-hosted the IC Design Contest (Fig. 5) with National Cheng Kung University to encourage advanced IC design within academia in Taiwan. The final competition involved 204 teams with 408 participants. The CIC also hosted the 2008 Multi-Project Chip Workshop in May 2008 to demonstrate outstanding IC designs, increase the value of academic research, and further promote cooperation between industry and academia. Outstanding designers were invited to present their research results in the workshop.

CIC maintains close relationships with international research institutes and hosts numerous international researchers and engineers each year. Opportunities for international research collaboration and exchange can be increased by publicizing research environment and accomplishments. CIC signed Memorandums of Understanding (MOU) with Japan's VDEC, France's CMP, and Belgium's IMEC in 2008. In order to promote IC design concepts to local high schools and universities, the CIC also supports domestic IC-design summer camps.

Technological innovation and intellectual property are indispensable assets in global industrial competition. They are also the prerequisites for Taiwan to become a so-called Green Silicon Island. Engineers at CIC are encouraged to apply for international patents based on their research and, thus, transform their innovations into revenue-generating business opportunities.

Fig. 5. IC Design Contest

Instrument Technology Research Center

Successfully Restructuring and Becoming ISO 9001 and ISO 27001 Certified

"The only way to innovate and excel is to focus and upgrade." After Dr. Chen Chien-jen retired, Dr. Tsai Ding-ping succeeded him as Director General of Instrument Technology Research Center (ITRC) in March 2008. The government urgently needs medium to large-sized research institutions to help conduct mission-specific applied research and develop technology strategies. This is done in an effort to convert Taiwan's research results into applied technologies that help improve the wellbeing of the people.

With limited resources, the ITRC continuously strives to improve its quality of service and develop a service platform that meets the needs of Taiwan's academic and research institutions. With the objective of "aggressive innovation, focus, and improvement," the ITRC underwent organizational restructuring in 2008.

In order to provide quality professional services and a secure information environment, as well as to ensure the best R&D and service quality and information security, the ITRC became ISO 9001 and ISO 27001 certified in September 2008. In addition to being ISO 17025 certified, the ITRC's Vacuum Standard Laboratory, Electro-optical Measurement and Calibration Laboratory, Thin Films Testing Laboratory, Scanning Probe Microscopy Calibration Laboratory, and Scanning Electron Microscope Calibration Laboratory have also been certified by the Taiwan Accreditation Foundation (TAF). As a result of these professional certifications and accreditations, we will be able to provide an even higher level of quality service to our customers.

Fig. 1. Video MTF inspection instrument

Fig. 2. A butterfly's powdery scales are used to make a 3D nano-template on which the ALD technology is used to grow an even layer of aluminum oxide.

Fig. 3. Solar reflector

Developing Key Instrument Systems and Industry Technology

In 2008, the ITRC developed more than a dozen new instrument components (Table 1) including a chip defect detection system, a large FFL measurement system, a video MTF inspection instrument (Fig. 1), a 12-inch ALD system, a biomaterial inkjet printing system, a CMOS micro-molecular organism detection platform, and an optoelectronic glass system.

The large FFL measurement system is used to measure the luminance and color of backlight modules ranging from 4~50 inches. It improves monitoring speeds and lowers the costs involved in the manufacturing of backlight modules.

Regarding the ALD system, the ITRC has developed a 12-inch industrial process (Fig. 2) that meets international standards. It features high step coverage, high thickness uniformity, and atomic-scale controlled growth of membrane thickness. The technology was also successfully transferred to local industry during 2008. This technology represents a milestone in Taiwan's development of next-generation semiconductor front-end processing equipment.

Table 1: Key Instrument Systems Developed in 2008

Instrument	Field
• VCDi660 • SWIR spectrograph • 320×256 SWIR camera • Chip defect detection system • Large flat fluorescent lamp (FFL) measurement system • Video modulation transfer function (MTF) detector	Remote sensing
• 12-inch atomic layer deposition (ALD) system • Standard PLD system	Vacuum
• Biomaterial inkjet printing system • CMOS micro-molecular organism detection platform	Nano/ biomedical
• Optoelectronic glass system • Lens de-centering inspection instrument • Portable microscopic close-focusing lens inspection platform • Lens assembler	Optic machinery

Regarding the R&D of instruments for industrial and academic use, in 2008 the ITRC successfully developed more than 20 critical components including a laser beam elliptic reflector, a double-edged non-spherical cylindrical lens, a HUD lens, a visible light waveband beam shaped component, a solar reflector (Fig. 3), a cancer indicator protein molecule bionic chip component, a lotus effect mass spectra molecule biochip, and a cell growth chip component.

The cell growth chip component is able to solve biocompatibility problems by growing neural cells on directional guide chips. The cancer indicator protein molecule bionic chip component uses DNA aptamers to identify and magnify cancer indicator proteins on a chip, thus, making it a key component in the development of a cancer screening/detection platform. The technology used to make double-edged non-spherical cylindrical lenses is critical in catapulting Taiwan's optical industry into the global market.

Actively Participating in International Invention Contests

In order to promote Taiwanese inventions to the international community, in 2008, the ITRC attended several international invention conferences and exhibitions including the Taipei International Invention Show & Technomart 2008, the National Invention Awards 2008, the 60th iENA Nuremburg "Ideas-Inventions-Products," and Utechzone Machine Vision Prize. Table 2 lists the awards and prizes won by the ITRC at these contests.

Table 2: Awards won at International Invention Contests 2008

Contest	Award-winning invention
National Invention Awards	A drop detection device and method used to make the device – Gold Award
Taipei International Invention Show	Chip Defect Detection Device and Detection Method – Gold Award
	Single and Continuous Periodic Waves High Voltage Signal Generator – Gold Award
	Color Recognition Device and Method – Gold Award (Fig. 4)
	Lens Measurement Device and Method – Gold Award, Bronze Award
iENA Nuremburg "Ideas-Inventions-Products"	Optoelectronic Smoke Detector Sensitivity Adjustment Device – Silver Award
	Luminous Body Detection Device and Method – Silver Award
Safe Product Creative Design Contest	Energy-Saving Thin Electromagnetic Wave Safety Warning Color Change Device – 2nd Place
Utechzone Machine Vision Prize	Large FFL vision measurement device – Outstanding Work

Fig. 4. Color recognition device and method (i.e. Optoelectronic glasses)

Adding Value to Intelligence and Transferring Technology to the People

To safeguard instrument resources and improve their efficiency, the ITRC is involved in the commissioned making and R&D of instruments. In 2008, the ITRC sponsored a total of 2,711 academic research projects including the National Taiwan University (NTU) Sirius Project. Also during 2008, the ITRC collaborated with 85 manufacturers, 22 academic institutions, and 12 research institutions in the design and manufacturing of instruments.

In terms of technology transfer, the liquid precursor oxide ALD technology, far-infrared base materials, and smoke scattering strength simulation device have all been transferred to the private sector.

Regarding commissioned collaborative research, the ITRC is involved in more than ten projects including the development of a CO_2 laser optic system as applied to the cutting of artistic glass, a chip defect detection module development project, and the design and manufacturing of non-spherical telecentric objective modules for the purpose of machine vision. These projects, among others, helped the ITRC to achieve its objective of "Adding value to intelligence and transferring technology to the people" in 2008.

Since education is crucial to improving a nation's global competitiveness, the ITRC provides local professionals with courses in the areas of ultra-precision engineering, optoelectronic technology, vacuum technology, micro-electromechanical technology, and instrument application and R&M. In 2008, the ITRC trained 1,396 high-tech professionals in such areas.

Additionally, in an effort to train the research manpower required by the country's high-tech industries, the ITRC is aggressively implementing the "Graduate Students Participating in Research Program". In 2008, the ITRC selected 103 graduate students from 15 colleges and universities nationwide to participate in this program. These students are awarded a master's degree or a Ph.D. for their successful completion of this program.

Furthermore, in order to promote "Science and Technology Diplomacy" and establish Taiwan as a leading nation in instrument technology development, the ITRC hosts various international scientific instrument technology workshops. So far the ITRC has provided training in nano/micron biomedical technology to 26 R&D personnel and science/technology executives from member states of the Association for Science Cooperation in Asia (ASCA) including India, Vietnam, Thailand, Indonesia, and the Philippines.

In order to provide industry, academia, and research institutions with a comprehensive understanding of scientific instruments and educate them on their correct usage and maintenance, the ITRC published six issues of "Instruments Today" in 2008. These six publications covered special topics such as Nano Silicon Germanium Optoelectronic Components, 30 Years of Magnetic Resonance Imaging, Industrial Applications of Lasers, CMOS MEMS Sensors, Nano Device Technology, and Astronomical Instruments.

Science & Technology Policy Research and Information Center

Sci-Tech Policy Research

The Science & Technology Policy Research and Information Center (STPI) develops Sci-Tech Policy Planning and Management Methodology, R&D, Programs Evaluation Methodology, and Sci-Tech Development Strategy Methodology in order to support government's Sci-Tech decision-making system (Fig. 1) . The STPI's major achievements in 2008 included:

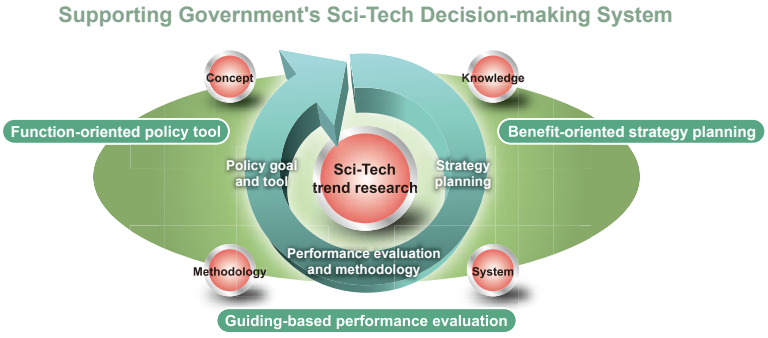


Fig. 1. STPI's Sci-Tech policy research framework structure

- Assisting Taiwan's National Science Council (NSC) to implement performance evaluation of policy implementation and a reorganization plan for national Sci-Tech organizations. During 2008, The STPI was involved in the preparatory study on the topics and issues for the 8th National Science and Technology Conference. For its part in this program, the STPI provided the planning and composition of conference publications including "Expanding the Scale of Sci-Tech Resources and Encouraging Investment in Private Sectors," "Establishing a Sci-Tech Policy Decision Support System– Advancing Sci-Tech Policy Planning and Resource Utilization," "Developing Sci-Tech Foresight, National Programs," and "Promising Industry Advancements."

  Additionally, the STPI collaborated with the National Center for High-Performance Computing (NCHC) to develop the "Global Trend Analysis of Technology Development on High-Performance Computation (HPC)" program, the results of which were used as a reference for Taiwan's 8th National Science and Technology Conference.

- Assisting Taiwan's Council of Agriculture (COA) to further research agriculture Sci-Tech development, including Sci-Tech development strategy planning and performance evaluation, common mechanism operation planning on agriculture commercialization platforms, and academic-industry cooperation mechanisms. For its part in this project, the STPI built demand-oriented agriculture Sci-Tech development models and evaluation methodologies as references for the COA to promote agriculture transition and policy implementation.

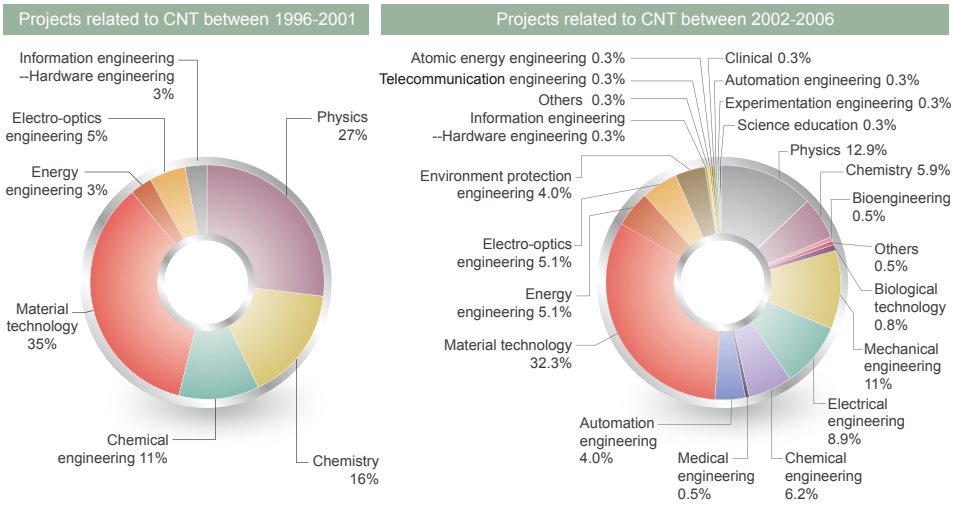


Fig. 2. Carbon Nanotubes (CNTs) related research fields obtained by GRB

- Providing research and technology development trending information for energy production from oceanic waves, carbon nanotubes, and agro-biotechnology. This information was used as reference material for determining governmental Sci-Tech development direction and R&D resource investment.

- Building trend analysis methodology for Sci-Tech development, exploring trans-disciplinary performance evaluation methods and policy research analysis systems, and conducting text mining research. In 2008, the STPI developed the core competences and environment for domestic Sci-Tech policy research and promoted research efficiency.

- Strengthening the construction and activation of R&D resource. During 2008, the STPI constructed and maintained 12 databases including, among others, the Government Research Bulletin (GRB), the National Profiles of Human Resources in Science and Technology (NPHRST), and the DataBase of Research and Innovation Capacity (DBRIC). In support of academic research and Sci-Tech policy planning, the STPI also provided databases retrieval services and statistical data sets.

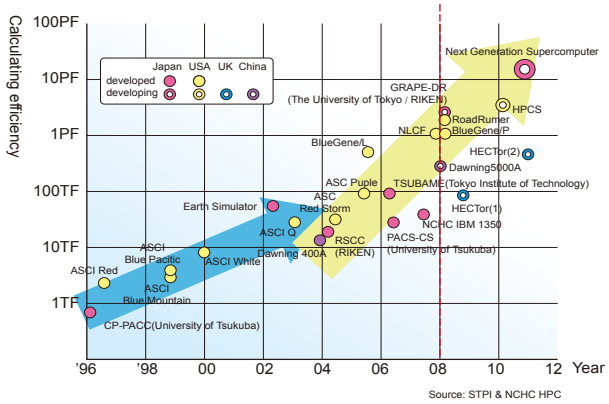


Fig. 3. Analysis for HPC performance development in different eras

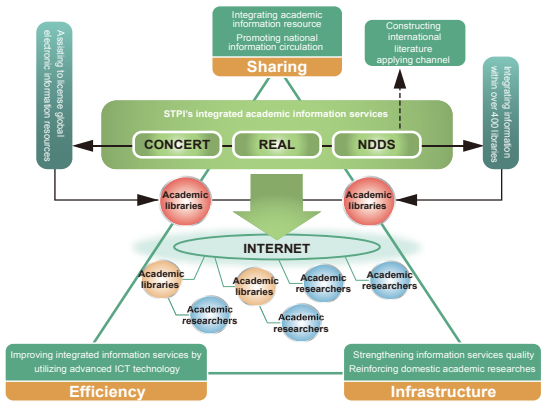


Fig. 4. The STPI's integrated academic information services framework

Sci-Tech Information Services

Knowledge is gained from experience, thus, gathering complete and high quality references is a requirement of proper academic research. During 2008, the STPI provided the following three very important service programs to researchers in order to assist them with their research: 1) the Consortium on Core Electronic Resources in Taiwan (CONCERT[1]), the Nationwide Documents Delivery Service (NDDS[2]), and Research All in One (REAL[3]).

- CONCERT is a consortium formed by domestic universities, colleges, government agencies, and research organizations. Its mission is to license global electronic resources for use by Taiwan's academic community. In 2008, there were a total of 210 consortium members, including 169 universities and 41 government agencies and research organizations. In total, 110 databases from 41 systems from around the world were licensed through the negotiation and coordination of CONCERT. CONCERT had more than 14,000 electronic journals available for access in 2008 with a total of 2,459 annual trainees. CONCERT saved the government an estimated USD $8.6 million in 2008.

- NDDS is a nation-wide inter-library loan system that integrates Union Lists of Serials from over 400 domestic libraries and other bibliographic databases. It facilitates the researchers' requests to photocopy articles and borrow books from Taiwan's libraries as well as overseas information providers like the British Library. The total number of the requests for 2008 was 146,000. The turnaround time for a full-text request was, on average, two days. The NDDS service obtained ISO 9001 certification in 2008.

- REAL is an integrated digital archive retrieval system which contains the data that researchers need to perform their research. Over 600 R&D resources and 84 Open Access databases are included. Sci-Tech information service is critical to Taiwan's R&D infrastructure. For this reason, the STPI continues to enhance its service quality, improve information equipment, and operate in a more secure and efficient manner. REAL provides domestic researchers with the best possible research environment. REAL was also ISO 27001: 2005 certified in 2008.

The STPI is dedicated to strengthening the quality of the Sci-Tech information and policy research services it offers. This dedication will help to ensure a better future for Taiwan's Sci-Tech community.

[1] (Consortium on Core Electronic Resources in Taiwan), http://www.stpi.org.tw/fdb/index.html ◦

[2] (Nationwide Documents Delivery Service), http://ndds.stpi.org.tw ◦

[3] (Research All in One), http://real.stpi.org.tw ◦

National Science and Technology Center for Disaster Reduction

Promotion of Typhoon/Flood Forecasting and Simulation

Accuracy Improvement of Early Warning Technology

Using radar and satellite-based precipitation estimates, NCDR developed several meteorology models to help forecasts the coming of natural disasters such as typhoons and floods. Using these models, NCDR was able to provide accurate rainfall indexing data to Taiwan's Central Emergency Operation Center (CEOC) which was then used to accurately forecast typhoons and other natural disasters.

Application Integration of Early Warning System

The NCDR's early warning system uses referential indexing to help provide disaster assessment. The early warning system is used to assess the probability that a natural disaster will occur as well as to reduce the geographical/topographical impact that it has. In particular, the early warning system focuses on typhoon track, rainfall prediction, and flood/landslide warning.

Post Disaster Social Survey and Household Damage Assessment

NCDR collects post-natural disaster statistical data to develop social and economic loss assessment models which are then used to support policy making. The goal of this research is to develop a typhoon and flood loss assessment model that can be used at the household-level. This loss assessment model includes details regarding loss of life and property (home, furniture, vehicles, etc.).

Suggestion Support on Emergency Response

During 2008, NCDR supported CEOC in the operation management of the following typhoon-related floods: 0602 Heavy Rainfall, 0616 Heavy Rainfall, 0618 Heavy Rainfall, Typhoon Kalmaegi, Typhoon Fung-Wong, Typhoon Nuri, Typhoon Sinlaku, Typhoon Hagupit, and Typhoon Jangmi (Fig. 1).

CEOC

NCDR

Fig. 1. Disaster potential assessment meeting for typhoon/flooding hazards

Leading Study on Earthquake Early Warning System

The development of technology on earthquake monitoring, earthquake locating, and the application of the Earthquake Early Warning (EEW) system has gained remarkable achievements for NCDR in recent years. However, more effort is needed to improve the immediate warning technology and to promote the EEW system itself.

A new project, "The Preliminary Study on the Application and Promotion of the Earthquake Early Warning System," was initiated in 2008. This project was a joint collaboration between the National Applied Research Laboratory's (NARL) member laboratories, the NCDR, the National Center for

Research on Earthquake Engineering (NCREE), and the National Center for High-Performance computing (NCHC). Experts from the Central Weather Bureau and other governmental agencies were invited to make suggestions regarding the project. The planning and promotion of the EEW system was completed during 2008. The resources from government, academia, and the private sector will be integrated into the system to further develop its core technologies (Fig. 2).

Fig. 2. Earthquake early warning system applications

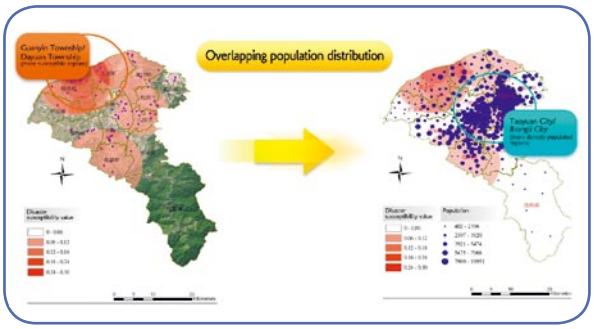


Fig. 3. Overlapping risk map of toxic release accidents and population distributions in Taoyuan County

Toxic Accident Risk Analysis and its Decision Support System

The goal of this research is to develop a toxic release accident risk analysis system and to create an accompanying decision support system to be used in the event of an emergency. NCDR demonstrates the potential risk map from calculated risk value by multiplying consequences of toxic release (distance of hazard) probability of accident, and the mitigation strategy of local plans for disaster protection and reduction of regional area as a reference for plan-making. NCDR develops and offers technology of risk analysis and the assessment by collecting background maps including population, locations of fire departments, equipment for rescue, and special protection units (Fig. 3).

Policy Evaluation, Application, and Promotion on Science and Technology of Disaster Reduction

The collaborating mechanism of academic institutes that provide professional disaster mitigation and emergency response services to the local governments had several outstanding achievements. This service network has drastically improved local government's disaster prevention and response capabilities. As an example, the collaborating institutes supply local meteorological information, rainfall predictions, flood risk assessment, and maps of potential landslides to local governments so that they can act quickly when disasters strike. The NCDR's innovative mechanism has received the reward of the First Prize from NARL of Science and Technology Service in 2008.

International Collaborations

International collaborations allow NCDR to learn from other countries that are also affected by natural disasters. Through these collaborations, NCDR is able to gain valuable knowledge regarding other countries' vulnerability assessments, policy making procedures, and strategic formulation implementation at both the national and local levels. The NCDR's goal is to establish multilateral interactions with other countries that suffer frequent natural hazards and, in so doing, help to ensure improved prevention capabilities against future disasters.

In 2008, NCDR participated in APEC's activities by experience sharing with the support from National Science Council and Ministry of Foreign Affairs who hosted the Workshop on Large-Scale Disaster Recovery in APEC, members of 16 economies, broadening the international participation as an information and experience-sharing platform of disaster management. The result was well recognized in the conference of declaration of dual Ministries and senior offices. Ambassador Patricia Haslach, the U.S. Senior Official for APEC, Bureau of East Asian & Pacific Affairs, and the U.S. Department of State commented on the workshops as a "very, very excellent workshop."

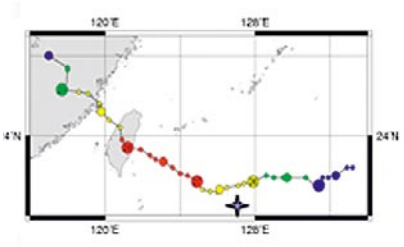
Taiwan Ocean Research Institute

The Taiwan Ocean Research Institute (TORI) was established on July 11th, 2008. As a newly-formed ocean research organization in Taiwan, TORI provides technical support and services for ocean science community in the following fields: long-term ocean observation and modeling, marine resources and hazard mitigation, national ocean database and information networking, ocean exploration technology development, and biological oceanography research. TORI is also in charge of the Oceanographic Research Vessel Building Project, which is contracted to the Jong Shyn Shipbuilding Group, and will be responsible for the operations and management of the ship.

Real-time Meteorological Data Observation

The deployment of the Autonomous Temperature Line Acquisition System (ATLAS) moorings is one of the sub-projects of the Taiwan Long-Term Environmental Observation Service Platform program. The ATLAS moorings measure ocean surface winds, air temperature, relative humidity, and sea surface temperature. The research team deployed two meteorological moorings in the Western Pacific Ocean in 2008 (Fig. 1). The mooring sensors recorded and transmitted the data back in real time when typhoon Fung-Wong passed through on July 26th, 2008 (Fig. 2). The buoy was capable of surviving typhoon force winds after all.

Fig. 1. The deployment and recovery of the ATLAS moorings.



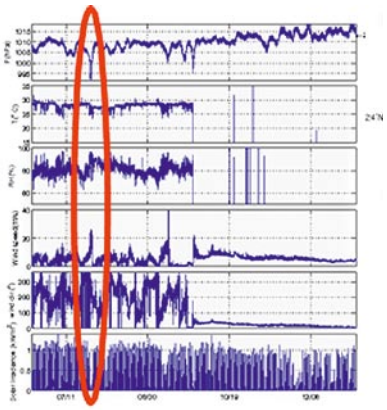


Fig. 2. The surface meteorological data transmitted from the ATLAS moorings when typhoon Fung-Wong passed through.

Establishment of Self-owned R&D Technology

In 2008, TORI made progress in underwater vehicle technology development through the design and engineering of the Deep-Sea Remotely Operated Vehicle (ROV). TORI completed the system design for 3,000 meter deep-sea ROV and developed a computer control board used on small observation vehicles. This control board possesses low power (0.5W) and small size (8.5 cm x 6 cm x 0.6 cm), and that became a core technology to help TORI win the Aqua Robot Competition at the OCEANS'08 MTS/IEEE KOBE-TECHNO_OCEAN Conference and Exhibition. TORI AUV-1 (Fig. 3) was an autonomous underwater vehicle developed by a team of TORI engineers. Having

the advantage of smaller size and light weight, it demonstrated outstanding cruising, line tracking, way-point traveling, and image signal recognition performance during the contest. TORI also signed a Memorandum of Understanding with the Woods Hole Oceanographic Institution (WHOI) and planned to cooperatively develop a new generation ROV (Fig. 4) through technology transfer.

Fig. 3. The TORI AUV-1

Fig. 4. The design prototype for TORI self-developed ROV: JASON II by WHOI.

Promotion of Ocean Scientific Knowledge and Education

In July 2008, TORI hosted an exhibition of all four of Taiwan domestic ocean research vessels and their on-board precision instruments in Kaohsiung Harbor (Fig. 5). The four research vessels were respectively from the National Taiwan University, National Taiwan Ocean University, National Sun Yat-sen University, and the Fisheries Research Institute respectively. Various types of precision instruments and on-board ocean observation and exploration equipments were provided by the Marine Instrument Center, NSC. The display included the "Underwater ROV" which has been used in several shipwreck rescues, and the self-developed "geothermal heat probe at seabed", "marine radar" used for internal wave detection, and the "ATLAS buoy" used for real-time marine meteorological data transmission in the Western Pacific Ocean.

Fig. 5. All four domestic research vessels were in Kaohsiung Harbor for the exhibition: OR-III from the National Sun Yat-sen University, OR-II from the National Ocean University, OR-I from the National Taiwan University, and FRI-I from the Fisheries Research Institute, Council of Agriculture.

Contact Information

Headquarters

3F., 106, Hoping E. Rd., Sec. 2,
Taipei 106, Taiwan, R.O.C.
TEL: +886-2-2737-8000
FAX: +886-2-2737-8044
http://www.narl.org.tw

National Chip Implementation Center

7F., 26 Prosperity 1st Rd., Hsinchu Science Park,
Hsinchu 300, Taiwan, R.O.C.
TEL: +886-3-577-3693
FAX: +886-3-577-4064
http://www.cic.org.tw

National Nano Device Laboratories

26, Prosperity 1st Rd., Hsinchu Science Park,
Hsinchu 300, Taiwan, R.O.C.
TEL: +886-3-572-6100
FAX: +886-3-572-2715
http://www.ndl.org.tw

Instrument Technology Research Center

20 R&D 6th Rd., Hsinchu Science Park,
Hsinchu 300, Taiwan, R.O.C.
TEL: +886-3-577-9911
FAX: +886-3-577-3947
http://www.itrc.org.tw

National Laboratory Animal Center

128, Academia Rd., Sec. 2,
Taipei 115, Taiwan, R.O.C.
TEL: +886-2-2789-5506
FAX: +886-2-2789-5588
http://www.nlac.org.tw

Science & Technology Policy Research and Information Center

16F., 106 Hoping E. Rd., Sec. 2,
Taipei 106, Taiwan, R.O.C.
TEL: +886-2-2737-7657
FAX: +886-2-2737-7258
http://www.stpi.org.tw

National Center for Research on Earthquake Engineering

200, Hsinhai Rd., Sec. 3,
Taipei 106, Taiwan, R.O.C.
TEL: +886-2-6630-0888
FAX: +886-2-6630-0858
http://www.ncree.org.tw

National Science and Technology Center for Disaster Reduction

9F., 200, Beisin Rd., Sec. 3, Sindian City,
Taipei County 231, Taiwan, R.O.C.
TEL: +886-2-8195-8600
Fax : +886-2-8912-7766
http://www.ncdr.nat.gov.tw

National Space Organization

8F., 9, Prosperity 1st Rd.,
Hsinchu Science Park,
Hsinchu 300, Taiwan, R.O.C.
TEL: +886-3-578-4208
FAX: +886-3-578-4246
http://www.nspo.org.tw

Taiwan Ocean Research Institute

3F., 106, Hoping E. Rd., Sec. 2,
Taipei 106, Taiwan, R.O.C.
TEL: +886-2-6630-0612
FAX: +886-2-6630-0600
http://www.tori.narl.org.tw

National Center for High-performance Computing

7 R&D 6th Rd., Hsinchu Science Park,
Hsinchu 300, Taiwan, R.O.C.
TEL: +886-3-577-6085
FAX: +886-3-577-6082
http://www.nchc.org.tw

Taiwan Typhoon and Flood Research Institute (Preparatory Office)

No.22, Keyuan Rd., Central Taiwan Science Park,
Taichung City 407, Taiwan, R.O.C.
TEL: +886-4-2460-8822
FAX: +886-4-2462-7733

國家實驗研究院
National Applied Research Laboratories

http://www.narl.org.tw

ISSN1560-6708
00080
9 771560 670002