NARLabs
National Applied Research Laboratories

Global Excellence, Local Impact

全球頂尖×在地價值

2013 NARLabs Annual Report

NARLabs
National Applied Research Laboratories
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Commitment • Passion • Innovation

History

2003

NARLabs is established

6 labs have become member laboratories of the NARLabs

- National Chip Implementation Center (CIC)
- National Center for High-performance Computing (NCHC)
- National Center for Research on Earthquake Engineering (NCREE)
- National Nano Device Laboratories (NDL)
- National Laboratory Animal Center (NLAC)
- National Space Organization (NSPO)

2005

2 labs have become member laboratories of NARLabs

- Instrument Technology Research Center (ITRC)
- Science & Technology Policy Research and Information Center (STPI)

2008

TORI is established

Taiwan Ocean Research Institute

2011

TTFRI is established

Taiwan Typhoon and Flood Research Institute

Contents

Message from the Chairperson

After steering Taiwan's scientific and technological development for over half a century, the National Science Council was reorganized and renamed as the "Ministry of Science and Technology" on March 3, 2014. This change signifies that Taiwan's scientific development is entering a new stage, and I am extremely honored to have been appointed the first Minister of Science and Technology. I have three visions for the future administration of the Ministry of Science and Technology (MOST): Firstly, I want the Ministry to play the role of a catalyst in Taiwan's scientific and technological development, by creating an outstanding R&D environment, thereby not only helping government agencies, but also industry, to make the foremost use of our R&D resources. Secondly, I want to clarify the order of sci-tech R&D priorities to achieve the greatest possible results within a limited budget. Thirdly, I hope to provide a focused support to academic personnel engaging in frontier research with international implications, thus allowing academic researchers to make full use of their talents. The administration of MOST will have the following four points of emphasis: to encourage excellence and innovation in research, to strengthen the link between industry and academia, to train research manpower with practical skills in order to shrink the gap between the school and the workplace, and to harmonize technology and the humanities. I sincerely hope that the promotion of these administrative focal points can effectively boost national competitiveness, facilitate economic development, and advance social harmony.

Although the global economy has not yet fully recovered, high-tech industries continue to emerge, evolve, and expand, which enables the development of an innovation-driven economy in Taiwan. The United States has recently proposed a number of far-reaching industrial policies enriched with the newest technologies, and has sketched out an exciting blueprint for industry and the economy. If Taiwan can rely on its abundant academic energies and talents, and translate research results to meet the needs of society, the economy, and industry, making the industry even more competitive at the international level, I truly believe that Taiwan will continue to thrive in any future race in the development of science and technology.

The National Applied Research Laboratories (NARLabs) is an important nonprofit organization overseen by MOST. NARLabs has striven to establish core research facilities and to serve the academic sector. NARLabs 10 research centers encompass the three major areas of earth science and environmental technology, information and communications technology, and biomedical technology, providing the research facilities that university laboratories generally cannot afford. NARLabs' unique status will play an essential role in fulfilling MOST's visions for the future development of science and technology. In view of the ever closer collaborations between industries on one hand, and universities and research institutions on the other, NARLabs can take advantage of the capabilities gained through their past service to the academic sector, adjust its direction, and assume the role of linking industry and academia. Along with the Ministry's directors and supervisors, I have great hopes for NARLabs' growth, and I look forward to the prodigious scientific and technological developments in Taiwan if everyone can move forward as a collaborative team to become the best that they can be!

Chairperson
San-Cheng Chang

Message from the President

Since its commencement, the National Applied Research Laboratories (NARLabs) had aspirations of establishing R&D platforms, supporting academic research, promoting frontier science and technology, fostering high-tech manpower, and sought to provide academic researchers with a superior research environment, ensuring that the nation's academic R&D would yield the maximal benefit. In order to accommodate the National Science Council's recent reorganization as the Ministry of Science and Technology (MOST), at a strategic planning conference held in January, 2014, a consensus was reached calling for the fine-tuning of future goals by, "Establishing R&D platforms, Leading industrial-academic collaborative research, Promoting frontier science and technology, and Fostering high-tech manpower". A small change in wording, in fact, has a profound significance.

Furthermore, the "establishment of R&D platforms, promotion of frontier science and technology, and fostering of high-tech manpower," has remained an essential part of NARLabs' missions. At a time when industry hopes that the government can invest in R&D resources to effectively lead industrial development, under the MOST's policy, I will strive to ensure that all NARLabs' colleagues contribute with full dedication and intelligence to the next wave of industrial development in Taiwan. Moving forward, NARLabs will focus its efforts on strengthening innovation and promoting cooperation between industry, academia, and research organizations.

NARLabs' past emphasis on service functions will now shift to a more active role in R&D and innovation, which creates new knowledge whilst provides industry and academic institutions with an even better service, as innovative R&D is extremely important to NARLabs' sustainable development. In the close collaboration between industry and academia that will prevail in the future, NARLabs can serve as a catalyst, taking advantage of the various platforms it has already established, as well as their capabilities, to help industry gain a better position in the midst of international competitions.

Since assuming the helm at NARLabs in September, 2013, I have become even better acquainted with the talents and excellence of everyone at NARLabs. I have also been keenly aware of the outstanding achievements of past NARLabs' presidents and their teams, which is why I have initiated an effort to establish a museum of NARLabs. A person can face the past is a mature and independent person, who will master the future. We will be celebrating the tenth anniversary of the FORMOSAT-2 satellite, as well as the 40th anniversary of the Instrument Technology Research Center, and Science & Technology Policy Research and Information Center, this year. The achievements and memories that we have accumulated over the years show that NARLabs is continuing to make progress, ensuring that scientific and technological innovations are used to protect and prosper Taiwan. NARLabs' 2013 Annual Report provides our readers with an overview of the dedicated efforts of NARLabs as well as a glimpse into the future of Taiwan as a humane and cultured island of science and technology.

President
Ching-Hua Lo

Organization

Board of Directors & Supervisors

Chairperson	San-Cheng Chang
Managing Director	Been-Huang Chiang, Shaw-Chen Liu, Tsong-Pyng Perng, Yu Wang
Director	Wen-Chang Chang, Chien-Jen Chen, Liang-Gee Chen, Tai-Jen Chen, Chung-Liang Chien, Bon-Chu Chung, Frank Shu, Huey-Jen Su
Executive Supervisor	Wen-Ji Hwang
Supervisor	Der-Tsai Lee, Chein Tai

President Office

President	Ching-Hua Lo
Vice President	Tung-Yang Chen, Jen-Inn Chyi
Secretary General	Wen-Yen Chang
Chief Operating Officer	Peter J. Sher

Headquarters | Director General

Human Resources Office	Chin-Ling Lin
Administration Office	Ying-Yun Lee
Planning & Evaluation Office	Ching-Ping Lu
Finance & Accounting Office	Tai-Ling Lian
Business Development Office	Peter J. Sher
Auditing Office	Nan-Hung Ting

Laboratories | Director General

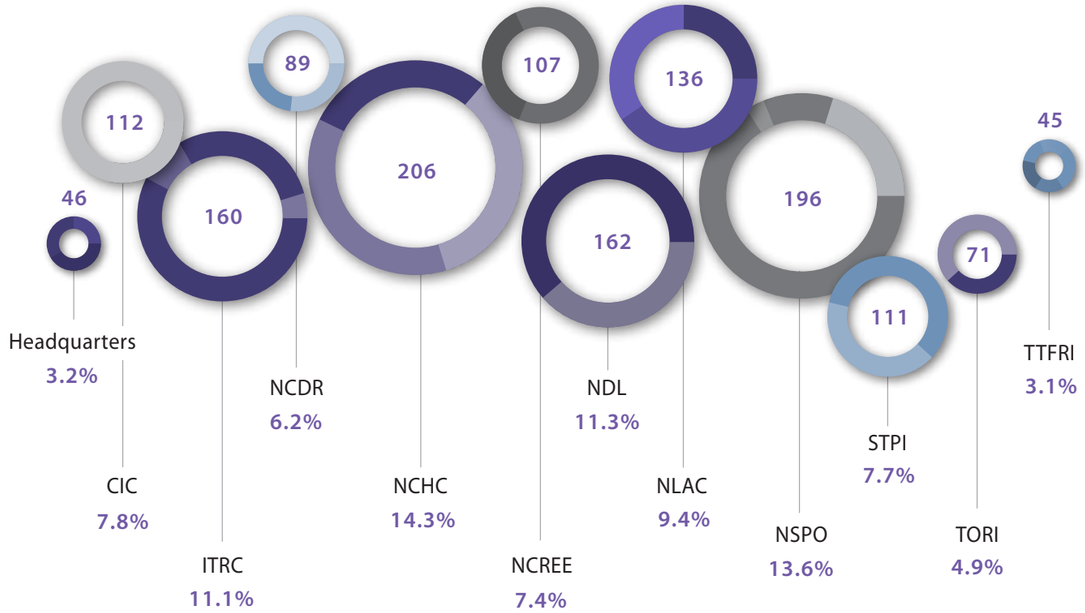
National Chip Implementation Center	C I C	Liang-Hung Lu
Instrument Technology Research Center	I T R C	J. Andrew Yeh
National Center for High-performance Computing	NCHC	Ce-Kuen Shieh
National Center for Research on Earthquake Engineering	NCREE	Kuo-Chun Chang
National Nano Device Laboratories	N D L	Wen-Kuan Yeh
National Laboratory Animal Center	NLAC	Chun-Keung Yu
National Space Organization	NSPO	Guey-Shin Chang
Science & Technology Policy Research and Information Center	S T P I	Yuh-Jzer Joung
Taiwan Ocean Research Institute	T O R I	Hui-Ling Lin
Taiwan Typhoon and Flood Research Institute	TTFRI	Cheng-Shang Lee

(Organization structure as of November 2014)

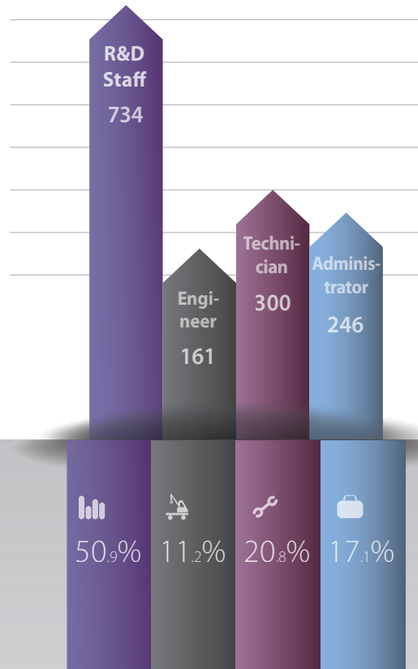
Human Resources

Employees per Laboratory

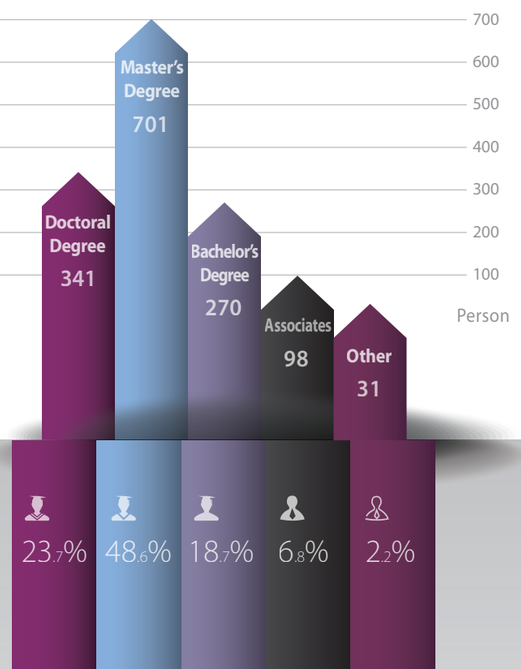
Number of Employee 1,441



Human Resources Allocation



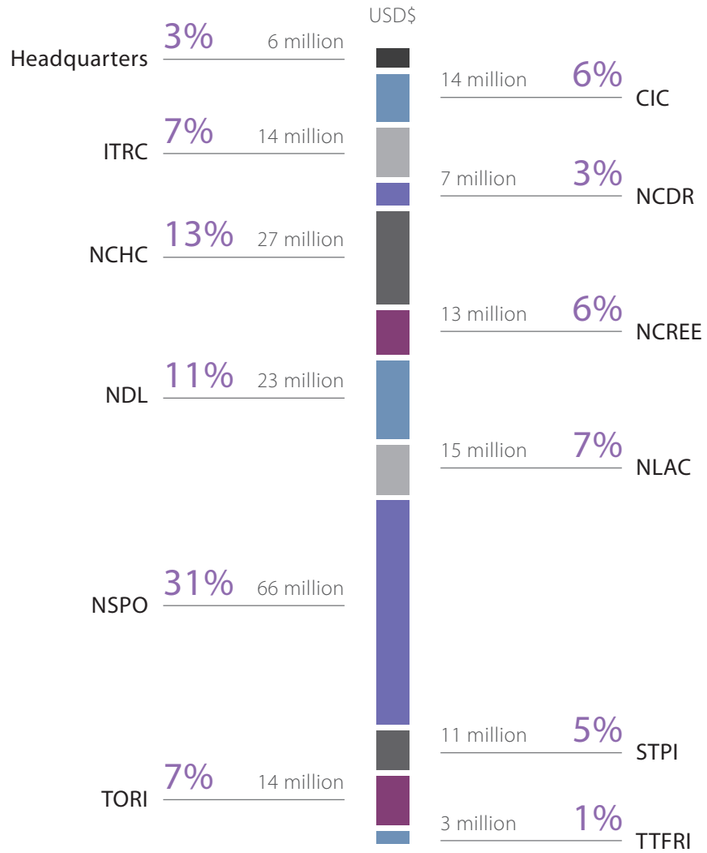
Education Qualification

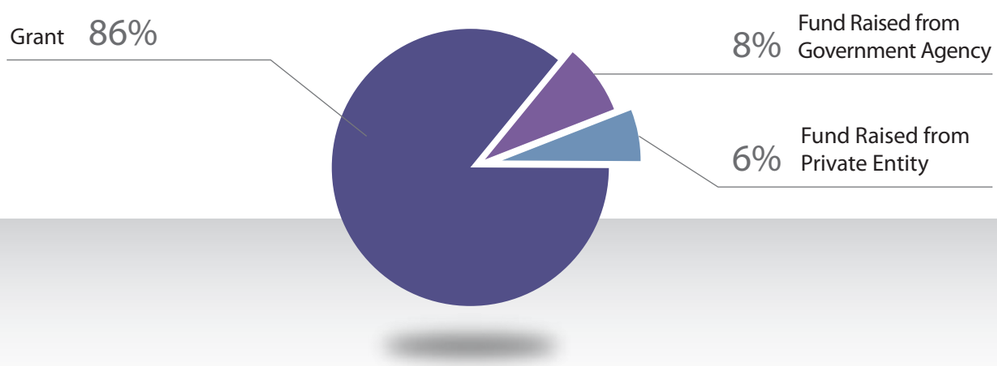


Financial Information

Revenue (FY 2013)

Total USD$ 213 million





Location

Taipei

NARLabs Headquarters
National Science and Technology Center for Disaster Reduction
National Center for Research on Earthquake Engineering
National Laboratory Animal Center
Science & Technology Policy Research and Information Center
* Taiwan Typhoon and Flood Research Institute

Hsinchu

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

Taichung

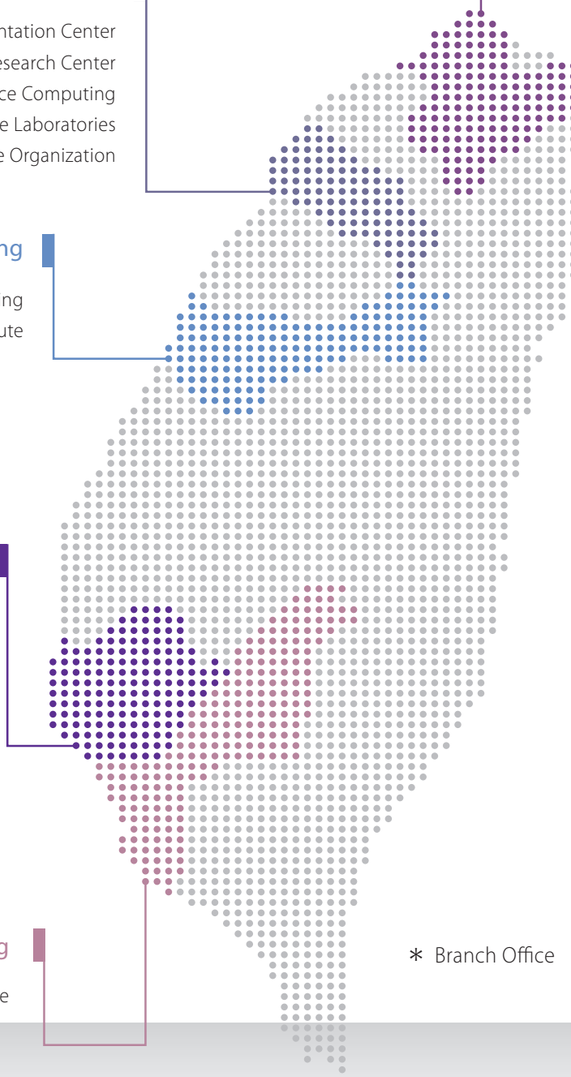
* National Center for High-performance Computing
Taiwan Typhoon and Flood Research Institute

Tainan

* National Chip Implementation Center
* National Center for High-performance Computing
* National Nano Device Laboratories
* National Laboratory Animal Center

Kaohsiung

Taiwan Ocean Research Institute



* Branch Office

R&D and Service Accomplishments

The National Applied Research Laboratories (NARLabs) strives to establish cutting-edge research platforms able to effectively connect upstream R&D results with downstream government units or industrial applications, especially when the scale of the platform and necessary funding is more than domestic universities can handle on their own (such as in the case of environmental and disaster prevention technology platforms, and information and communications technology platforms). NARLabs' large R&D platforms chiefly provide scientific and technological research services to academic researchers, and help researchers use high-accuracy, high-efficiency instruments, facilities, and software modeling systems to develop innovative, important, frontier applied technologies. By linking the R&D capabilities of industry, academia, and research organizations, NARLabs is boosting the country's R&D achievements and fostering service platform synergy.

Taiwan's First Space-qualified GPS Receiver

Development of a space-qualified GPS navigation receiver with the world's fastest cold start

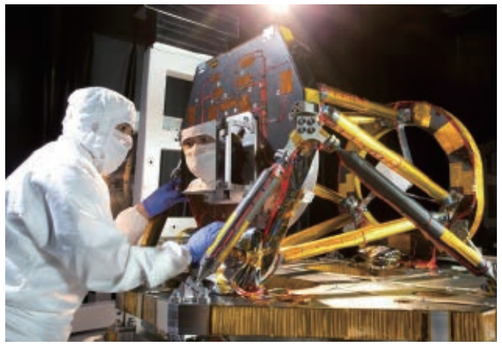
The Space-qualified GPS Receiver is developed and built by NSPO including its design, manufacture, integration and testing. The Receiver can acquire the GPS signal within a very short period of time and provide navigation information. The GPS receiver performance attributes are: position accuracy better than 8m, velocity accuracy better than 0.05m/s, and timing accuracy better than 200ns. With the high signal tracking loop dynamic performance, the GPS Receiver can be operated under the high precision, long-term operating conditions required by integrated inertia navigation systems. This receiver is designed to be flown with the FORMOSAT-7 NSPO-built satellite. Because of its excellent performance and low cost, the GPS Receiver will be equipped on the FORMOSAT-series satellites and has the potential to enter the commercial space components market.

National Space Organization

▶ Taiwa's First Space-qualified GPS Receiver

FORMOSAT-5 Stepped into the Integration and Test Phase

Satellite bus assembly reaches 65%, and optical Remote Sensing Instrument completion reaches 80%



▲ FORMOSAT-5 Stepped into the Integration and Test Phase

FORMOSAT-5 has passed all design reviews and is marching into the final stage of component manufacturing and testing. In early 2013, FORMOSAT-5 has begun the integration and test phase. The main tasks include assembly, integration, spacecraft bus and optical Remote Sensing Instrument (RSI) testing. By the end of 2013, 65% of spacecraft bus assembly will be accomplished, including environmental testing on the first set on-board computer flight model. Moreover, satellite engineering development model testing has completed normal mode operation verification and continues to validate the satellite propulsion mode. Currently, the integrated functional testing progress of spacecraft bus components has reached 80%. For the RSI, assembly and alignment of the optical and mechanical units has been completed. Then, two critical RSI's components (Electronic Unit and CMOS Type FPA) are entering the final verification stage.

National Space Organization

Successful Flight of SR-8 Science Experiments

Successful completion of H_2O_2 monopropellant propulsion and science instrument recovery capsule

The Sounding Rocket-8 (SR-8) of the National Space Organization (NSPO) was successfully launched at 15:00 on June 5 from the Gio-Pern launch site in southern Taiwan. Two science experiments, the hydrogen peroxide (H_2O_2) monopropellant propulsion and science instrument recovery capsule (RC), were conducted in the flight test. Experimental data acquired in the test were analyzed and used for design validations. These experiments represent important progress in key technology development for the satellite propulsion subsystem and a payload recovery platform.

National Space Organization

◀ Successful Flight of SR-8 Science Experiments on June 5, 2013

The First Global Ionsospheric Weather Monitoring and Forecasting Model

Development of the world's first global ionospheric weather monitoring and forecasting assimilation model

▲ The First Global Ionsospheric Weather Monitoring and Forecasting Model

Utilizing FORMOSAT-3 ionospheric observation data, Taiwan's science team have constructed the first full three-dimensional structure of the ionosphere from which electron density variation can be observed. It is leading the world in building the first global ionospheric weather monitoring and forecasting assimilation model. It has been shown that using data assimilation of FORMOSAT-3 can improve satellite positioning error by 4%, which is equivalent to 12cm correction in vertical direction and of 10 meters in the horizontal direction. This model can be utilized to assess and improve the quality and accuracy on communication, positioning and navigation. The irregular space weather will induce an extreme change in radio wave intensity and propagation in the ionosphere. For the first time the science team has constructed a complete experienced index of global scintillation mode to provide early warning of the irregular space weather.

National Space Organization

Full-bridge Fiber-optic Monitoring System

24-hour monitoring of bridge safety

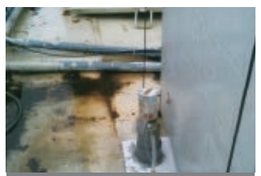
It's Taiwan's first full-bridge fiber-optic monitoring system, which can be applied to long domestic river bridges. This system can be used for 24-hour monitoring of key aspects of possibly hazardous bridges, including horizontal displacement of bridge deck sections, subsidence or tilting of bridge piers, cable tension on cable-stayed bridges, and river water level. The system can be used together with cloud technology to enable bridge safety monitoring via computers or smartphones. The system can issue real-time warnings whenever an abnormality occurs, allowing bridge management units to take emergency action insuring safety. NCREE recently assisted the National Expressway Engineering Bureau, MOTC to perform reinforcing and load testing of the Wuyang elevated section of the Sun Yat-Sen Freeway, which ensured the smooth opening of this section. This system is currently being used for long-term monitoring of that section, ensuring safe use by vehicles. The system will be applied to various bridges and elevated sections of the High Speed Rail line, highways, railways, and metro systems in the future.

National Center for Research on Earthquake Engineering

Water level indicator

Displacement transducer

Vibration sensor for cable tension measurement



Optic sensor for subsidence and tilting measurement

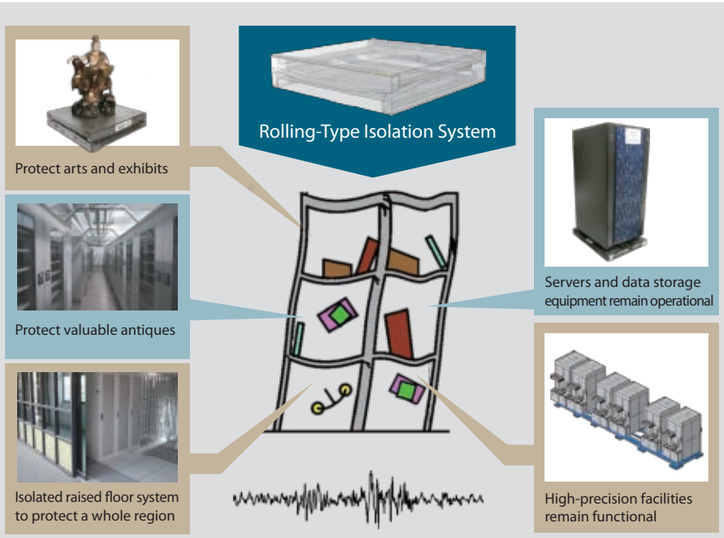
▲ On-site installation of monitoring system instruments

Rolling Base Isolation System

A new means of protecting equipment and artifacts from vibration

The use of isolation technology is currently the most feasible and effective means of increasing the seismic resistance of important equipment and facilities. The rolling base isolation system developed at NCREE offers an excellent energy-dissipation mechanism and self-centering ability, and can effectively reduce the transmission of seismic forces to upper-level structures. The system is also able to meet the seismic performance design requirements of various equipment and facilities; it can be applied to data storage and communications equipment in the high-tech, communications, and financial industries, communications facilities in hospitals, disaster relief units, and the energy industry, and important art works at museums and galleries.

National Center for Research on Earthquake Engineering



▲ Applications of rolling-type isolation systems

A New Type of High-strength Reinforced Concrete

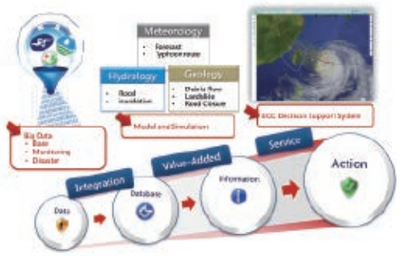
New reinforced concrete technology improving the quality of the urban environment

NCREE has recently taken the lead in promoting academic and industry R&D aimed at developing a new generation of reinforced concrete (RC) material with steel rebar and concrete strength of as high as 800 MPa and 100 MPa respectively. This will be roughly 1.8 times and 3.6 times the strength of the steel and concrete currently used in Taiwan, and will enable the construction of taller urban residential buildings. This will allow greater amounts of green areas around the buildings, provide more usable indoor space, enhance the quality of the urban environment, reduce carbon emissions, and conserve energy.

National Center for Research on Earthquake Engineering

Disaster Management and Decision-making Cloud Service

Integrates real-time information from different agencies, provides overall analysis that would have once required 2 hours, and enables real-time monitoring of various information



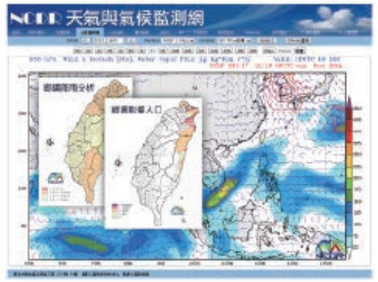
▲ Disaster management and decision-making cloud service

When a natural disaster occurs, NCDR helps response personnel monitor the situation and perform response work. In 2013, NCDR added value to CCTV monitoring video from various agencies, and relied on real-time assessment of the situation performed by its Emergency Operation Center Decision Support System (EOCDSS) to conduct overall on-site situation evaluation in real-time, instead of the 2-3 hours required in the past. The resulting information is provided for response and command personnel as a reference for deployment, while reducing the exposure of response personnel in hazardous areas during the course of rescue and relief work. Receiving favorable notice in Taiwan and abroad, the foregoing applications technology and system have been honored with the Taiwan Geographic Information Society's "Golden Map Award for Systems and Technical Services" and ESRI's "Special Achievement in GIS Award."

National Science and Technology Center for Disaster Reduction

Establishment of a User-based "Disastrous Weather Service System" to Provide Customized Service

Collection and organization of nearly 600 meteorological products to provide customized meterological disaster prevention information



▲ NCDR's weather and climate monitoring platform

A look at domestic meteorological information websites reveals that most are tailored to a specialized meteorological perspective and provide items such as weather charts, satellite images, radar images, and temperature distribution maps. However, for the general public and those who lack professional meteorological knowledge but must use meteorological information to perform analysis in special areas, it is difficult to quickly and effectively transform the displayed meteorological data into usable meteorological information. Similar problems have been found in the field of disaster prevention. In view of this, in 2013, NCDR revamped its meteorological information display methods and, with respect to each township throughout Taiwan, provides weather information relevant to the potential natural disasters that may occur. For instance, NCDR now provides rainfall information and disaster risk assessments associated with the debris flow potential for mountainous villages and flooding-risk relevant meteorological information in low-lying areas. Government agencies serving the public can quickly obtain meteorological early warnings and risk of natural disasters from NCDR's Weather and Climate Monitoring website (http://watch.ncdr.nat.gov.tw/). NCDR is currently cooperating with local governments and partner teams to introduce customized products and services, and NCDR has changed people's stereotyped impressions of weather services.

National Science and Technology Center for Disaster Reduction

Establishment and Testing of a Watershed Information Network

Preliminary collection of physiographical and hydrological data for the Zhuoshui Watershed, providing users real-time viewing and queries via the Internet.

▲ Integrated watershed management platform

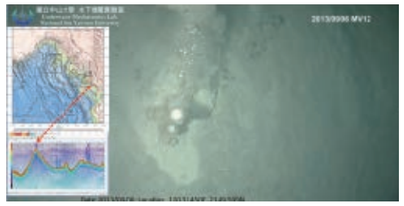
In order to integrate up-, mid-, and downstream management strategies for Taiwan's watersheds, ensure consistent design standards, and prevent repeated disasters, NCDR has developed an integrated watershed interface with visualization functions, and hopes to improve management capabilities and overall water resource management. The Watershed Information Network is the first part of NCDR's integrated watershed management interface. NCDR's goal is to enable users to obtain watershed management knowledge through observations and queries. Data and relevant articles have been placed on the website, allowing users to view and query information in real-time via the Internet. NCDR also provides relevant management handbook files for downloading for use by decision-makers as a more accurate source for reference information.

National Science and Technology Center for Disaster Reduction

Ocean Researcher V (R/V ORV) Achieves Impressive Capabilities

During 2013, the R/V ORV performed her first scientific voyage around Dongsha Atoll, conducted investigations near Scarborough Shoal (黃岩島), explored Tizard Bank (鄭和群礁) and Taiping Island (太平島). In 2014, plans call for a visit to the southernmost point of the Taiwan national territory – James Shoal (曾母暗沙).

During the first formal operational year 2013, the R/V ORV was at sea for 201 days. She made a total of 36 voyages, sailed 20,142 nautical miles, mapped 126,523 square kilometers of Taiwan's marine territory, gathered 22.46 TB of data related with the marine environment and resources, provided 4,315 person-days of training in marine technology and prospecting, and allowed 347 person-days of foreign scientific/technological personnel to participate in voyages. In 2013, R/V ORV successfully supported pioneering research in marine technology, natural resources prospecting, and maritime boundary surveying tasks. The vessel's operations included the first scientific voyage to the waters around Dongsha Atoll, exploratory surveys near Scarborough Shoal, and investigation around Taiping Island and Tizard Bank. In 2014, the first oceanographic voyage and visit is planned to James Shoal—the southernmost point of Taiwan's territory. On a September voyage, the R/V ORV employed her advanced equipment, including systems for dynamic positioning, underwater positioning, multibeam sonar mapping, and core sampler, and relied on the impressive technical skills of the TORI prospecting team, to obtain the first samples containing methane from methane hydrate deposits to the southwest of Kaohsiung.



▲ Image of methane gas rising from the seabed taken by a towed deep-sea camera

▲ In the gas hydrate potential area offshore of SW Taiwan, high concentration of methane gas in marine sedimentary cores can be ignited

Taiwan Ocean Research Institute

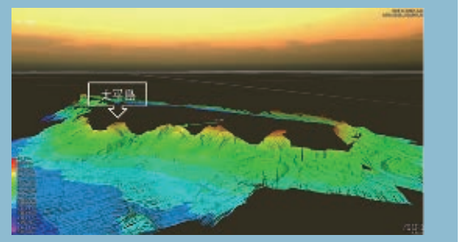
Ocean Researcher V Voyages into Southern Territory

The vessel discovered undersea volcanoes between Huangyan Island and Zhongsha Islands, and captured a new depth record for Taiwan in the South China Sea

Located in the South China Sea, Zhongsha Huangyan Island and Nansha Taiping Island are Taiwan's southernmost territory. In order to help maintain the country's territorial integrity and sovereignty, in 2013, the R/V ORV boldly performed observation missions to Zhongsha Huangyan Island and Nansha Taiping Island on May 16 and June 17 respectively, at a time of great tension between Taiwan and the Philippines. Thanks to its ultra-low noise design and advanced deep sea multibeam sonar, R/V ORV was able to successfully map over 60,000 square kilometers of the seabed from Huangyan Island to Zhongsha Islands. The many undersea volcanoes discovered on these voyages indicate that the South China Sea is tectonically active. Although buffeted by a tropical depression and Typhoon Bebinca during the June voyage, R/V ORV made it to Nansha Taiping Island, set a new depth record in the South China Sea, and successfully circumnavigated Zhenghe Reef. The vessel not only completed collecting data of water depth, seafloor topography, and hydrology/chemistry/ecology around the reef of Taiping Island, but also performed mapping water depth and seafloor topography off Taiping Island's Reef.

Taiwan Ocean Research Institute

▲ The R/V ORV undertook an observation mission to Zhongsha Huangyan Island on May 16, 2013



▲ The R/V ORV completes a survey of seafloor landforms at Zhenghe Reef, Nansha Taiping Island on June 17, 2013

Ocean Researcher V Accomplishes Goals of Maiden Voyage in the South China Sea

Extreme weather events transform the sea into a carbon dioxide super absorber: marine sedimentary cores provide material for analyses of natural gas and biogeochemistry research

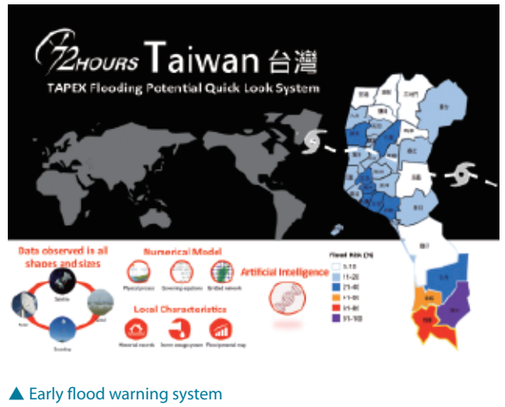
▲ Piston coring on board R/V ORV

R/V ORV 's maiden voyage, which began on February 18 and ended on March 8th, 2013, had a mission of searching for resources in Taiwan's territorial waters in the SCS. This ambitious 19-day voyage is to search for clean energy and investigate the sea's carbon dioxide absorption ability. While the R/V ORV returned to Kaohsiung harbor, the scientific team had numerous new discoveries. By using satellite-derived real-time marine meteorological images, the scientific team unraveled perplexing differences in marine ecology systems. The researchers were able to work uninterruptedly in spite of the rough weather and heavy seas during much of the voyage. The voyage made the discovery that extreme weather transforms the sea into carbon dioxide super absorber, while also increasing mixing between upper and lower water layers in the SCS. As a result, nutrient-rich deep water is upwelled to the surface, which accounts for the SCS's rich fishing grounds. Moreover, with the assistance of ultra-low noise electrical propulsion system and precision dynamic positioning system, researchers used multibeam sonar to investigate shallow undersea landforms. They discovered the existence of numerous volcanoes around the southeast of Dongsha Island, an undersea cliff extending for 60 km and having a vertical rise of more than 300 m, and pockmarked landforms. Due to the highly accurate positioning system of R/V ORV, a piston coring system obtained precise locations of marine cores. The sediment samples with abundant foraminifera and organic matter provide material for analyses of natural gas and biogeochemistry research.

Taiwan Ocean Research Institute

Development of an Early Flood Warning System Using TAPEX

To forecast flood risk in cities, towns, and townships 1- to 3-day in advance and to help local governments and cooperating units to take preventive measures



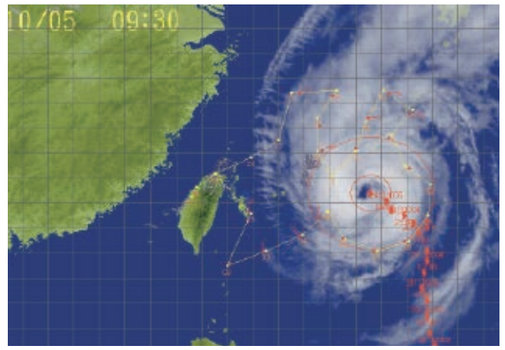
▲ Early flood warning system

TTFRI worked with the Water Resources Agency, MOEA and other relevant agencies to develop the "Early Flood Warning System" aimed at Pingtung County. This system utilizes local features to forecast the likelihood of flooding in cities, towns, and townships 1- to 3-day in advance. Unlike ordinary warnings based on observed rainfall data, the TAPEX Expert System uses rainfall data from the Taiwan Cooperative Precipitation Ensemble Forecast Experiment (TAPEX) to increase the lead time from the current 3 hours to 48-72 hours. TTFRI, the Pingtung county government, and National Pingtung University of Science and Technology have jointly applied and tested the system in Pingtung County, and achieved an accuracy of over 80 percent; the system successfully assisted the local government in preparing for the disaster. (Note: TAPEX was jointly performed by TTFRI in conjunction with the Central Weather Bureau and academic researchers.)

Taiwan Typhoon and Flood Research Institute

Implementation of Typhoon Aircraft Dropsonde Observations

Successful observation of five typhoons in 2013, and deployed 93 dropsondes



▲ Aircraft flight path and dropsonde observation points during Typhoon Fitow

A typhoon observation project involving the use of dropsondes deployed from aircraft implemented jointly by TTFRI, Central Weather Bureau, and the Department of Atmospheric Sciences at National Taiwan University was the first to use aircraft for typhoon observation in Asia. A total of 93 dropsondes with a flight time of 1,749 minutes were deployed to observe five typhoons that affected Taiwan in 2013 (Soulik, Trami, Kong-rey, Usagi, and Fitow).The data obtained from the dropsondes were relayed to the Central Weather Bureau in real-time, and from there sent to meteorological centers around the world. Apart from facilitating estimation of typhoon storm radius, these data were also incorporated in dynamic numerical models in order to improve typhoon track forecasting.

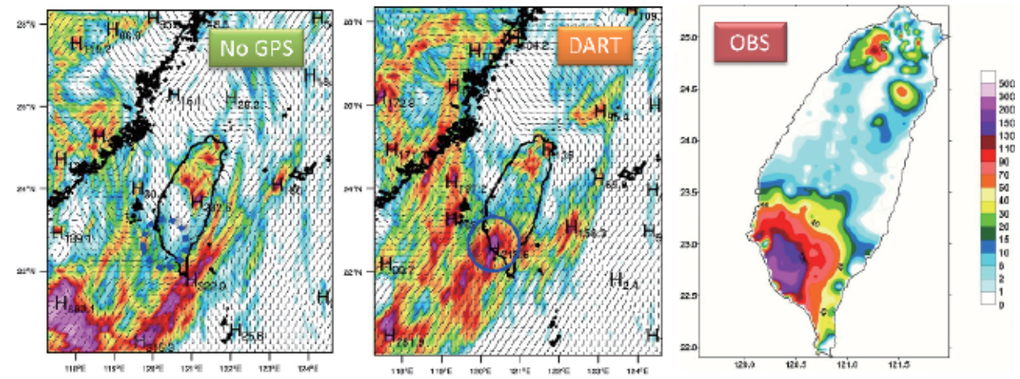
Taiwan Typhoon and Flood Research Institute

Improve Heavy Rainfall Forecasts by Using the Advanced Data Assimilation System

GPS occultation data provided by the FORMOSAT-3 satellite have compensated for the deficiencies of conventional observation data, enabling better forecasting of extreme rainfalls

TTFRI improved the quality control procedure for FORMOSAT-3/COSMIC radio occultation data in the operational data assimilation system. Meanwhile, TTFRI also introduced an advanced data assimilation system by UCAR and modified it for local needs in Taiwan. The preliminary results showed that the assimilation data provided better results in terms of spatial distribution and accumulated precipitation for heavy rainfall events. The technique will be transferred to the Central Weather Bureau in the future and help them improve extreme rainfalls forecasting in Taiwan.

Taiwan Typhoon and Flood Research Institute



▲ The 24-h accumulated precipitation of the forecast experiments for the Mei-Yu front on June 16-17, 2008. These figures represent the model forecasts without GPS RO data (left) and with GPS RO data assimilated with DART system (middle), and the observed precipitation (right).

Development of Disaster Risk Reduction Planning with a Long Term Perspective

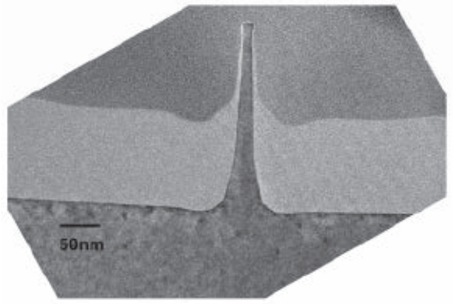
Keeping up with the emerging trends, the STPI and the NCDR have developed a model for S&T policy planning which proactively targets disaster-mitigation

Climate change, globalization, aging population, and urbanization, are creating grand challenges and inducing emerging demands on disaster prevention technology. A new planning model is thereby in urgent need. The STPI and NCDR have jointly developed a new model - Disaster Risk Reduction Planning with a Long Term Perspective. By examining external environmental changes and their implications, it is meant to explore potential needs in connection with Taiwan's disaster prevention S&T in 2030. Hopefully the model will strengthen the coordination among different agencies, and ensure key issues are addressed. Furthermore, a disaster prevention R&D program with a long-term perspective can be planned accordingly to embody sustainable development.

Science & Technology Policy Research and Information Center

A New Milestone in IC Manufacturing Technology: Fin Field-effect Transistors

"Fin field-effect transistors with different fin heights" increase the memory capacity of electronics products by 20%



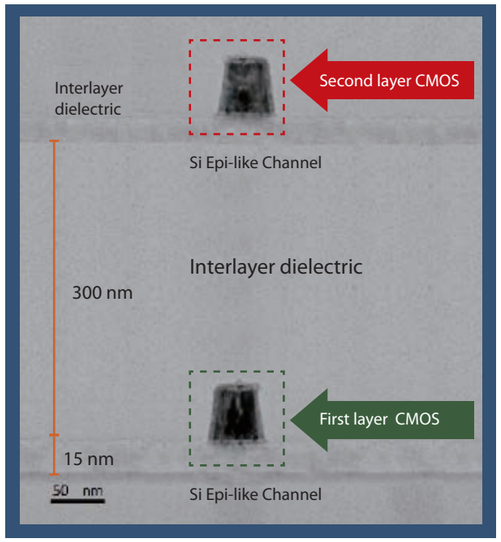
▲ NDL's non-planar elements are on a par with those from the world's leading manufacturers

Semiconductor research is basically a race in shrinking dimensions and enhancing performance. Current semiconductor mass production technology can produce approximately 100 million transistors within 1 cm^2 of silicon chip area. NDL's "fin field-effect transistor with different fin height" process technology can add approximately 20 million transistors to this same area, which is equivalent to increasing the storage capacity or reducing manufacturing costs by 20%. The results of this research were announced at the 2013 IEEE Symposia on VLSI Technology & Circuits held in Kyoto, Japan, and were also featured in a special report published by IEEE Spectrum.

National Nano Device Laboratories

Monolithic 3D-ICs Offers New Opportunities for the Portable Smart Electronics Industry

Innovative monolithic 3D-IC technology improves layer-to-layer distance by a factor of nearly 150 compared with mainstream through-silicon via (TSV)



▲ Demonstration of a sequentially processed sub-50nm monolithic 3D-IC with multiple layers of CMOS circuits.

Monolithic 3D-IC technology is a kind of three-dimensional chip stacking technology that does not require Through-Silicon Vias (TSV). This innovative monolithic 3D-IC technology developed at NARLabs and was selected as a publicity material at the 2013 International Electron Devices Meeting (IEDM), and articles by TSMC and NARLabs were the only papers from Taiwan selected, receiving considerable international media coverage. Conventional TSV 3D-IC technology achieves 3D stacking by bonding different chips together. The innovative monolithic 3D-IC technology developed at NDL improves layer-to-layer distance by a factor of nearly 150 compared with mainstream TSV 3D technology, and also yields much-improved signal transmission speed and energy consumption. In view of today's short 3C product life cycles and rapid progress in scaling semiconductor devices, this new technology will have a major impact on portable smart devices and relevant industries. This project used low-thermal budget methods such as plasma-deposited amorphous silicon, laser-crystallization, chemical-mechanical-polishing, and laser activation to create low-temperature, stackable ultra-thin channel devices that are able to resolve the problems of conventional TSV chips with poor alignment in across-chip devices, large-area metal-interconnect, parasitic capacitance, and high thermal budget issue. When used in high-speed broadband 3D integrated chips, this technology will facilitate domestic and foreign manufacturers to develop light, compact energy-efficient mobile electronics products.

National Nano Device Laboratories

Integrated Element Services and an Integrated Research Environment Ensure a World-leading Technical Service Platform

NDL makes chip process services for sub-10 nm research available to researchers

NDL is providing a wide range of technical services needed for the future development of sub-10 nm devices, and is helping domestic research teams in performing process technology development in a flexible research environment while meeting industry standards. NDL is maximizing the industrial value of academic research by promoting the translation of research results in technologies that can be used by industry. Furthermore, process development research, carried out by M.S. and Ph.D. students, is well supported to foster technological manpower needed by industry. And thereby sustain Taiwan's competitiveness. NDL plans to introduce service platforms for fin field-effect transistor technology, nano-patterning technology, and sub-10 nm RRAM (resistive random access memory) process technology. Among these, the "non-planar device service platform", i.e. fin field-effect transistor service, is the world's first open process technology service of its type.

National Nano Device Laboratories

Expanding Industry-academic Cooperation, Enhancing High-frequency Technologies

NDL supports high-frequency related research, and promotes technology transfer to industry, enhancing industrial competitiveness

NDL supports the Antarctic Impulse Transient Array and Askaryan Radio Array projects in the Ministry's Science Vanguard Research Program, "High Energy Cosmic Neutrino Research in the Antarctic", A key low-noise amplifier for the neutrino detector has been jointly completed with the LeCosPA team at National Taiwan University. NDL also had transferred high-frequency characterization software to industry, boosting the product competitiveness of semiconductor equipment companies.

National Nano Device Laboratories

Establishment of a Chip System Design Environment

Putting the world's most comprehensive design software and element library at the service of academic teaching and research

CIC has acquired chip system design software, element libraries, silicon intellectual property, and chip system platforms currently in use by industry, and has established design processes provided to academic researchers engaging in pioneering chip system design R&D. In order to enhance service quality, CIC employs a single-window mechanism to provide technical consulting services and resolve hardware and software use and design problems. In 2013, CIC provided 89 types of design software and element libraries to 19 firms. A total of 326 instructors used research applications software, and 109 instructors used instructional applications software, while design software downloads totaled 25,125. Furthermore, CIC provided technical consulting services in 2,771 cases.

National Chip Implementation Center

Forward-looking Process Chip Realization Service

CIC provided 14 processes, including CMOS, MEMS/BioMEMS, GaAs, IPD, and high-voltage processes, helping academic researchers to produce roughly 1,700 chips

In 2013, CIC provided 14 types of chip implementation services, including mainstream 0.35 μm, 0.18 μm, and 90 nm CMOS processes, special-purpose BiCMOS and pHEMT processes, and MEMS, BioMEMS, IPD and high-voltage processes that can be used in heterogeneous systems. These services can meet the needs of pioneering academic research, patent development, and prototype implementation. In 2013, CIC helped academic researchers complete more than 1,800 chip design projects. To support pioneering academic research, CIC continued to provide the world's most advanced CMOS process mass production technology to researchers. Furthermore, CIC, along with the United States' MOSIS (Metal Oxide Semiconductor Implementation Service), is one of a small number of organizations able to provide the TSMC 40 nm CMOS process for academic use.

National Chip Implementation Center

Chip System Measurement Service

CIC provided measurement services for various types of machine, and helped users perform chip measurements in 1,287 cases

CIC also provides industry, academia, and research organizations superior chip system measurement services. CIC's highly-skilled personnel stationed at Hsinchu and Tainan can use programmable instruments to provide users with fast, precise, highly-accurate measurement services. CIC's measurement services include measurement of broadband signals up to 67 GHz, measurement of high-speed time domain signal source parameters, measurement of high-frequency large and small signal element circuit parameters, and measurement of high-end analog and mixed signals. In order to satisfy customer needs, CIC has established a high-frequency modulated signal measurement system and X-parameters measurement system able to perform system circuit and nonlinear parameter measurement. CIC's laboratories at Hsinchu and Tainan completed a total of more than 950 chip circuit and system measurements on behalf of industry, academia, and research organizations in 2013. The Advantest V93000 PS1600 mixed signal automatic testing machine acquired by CIC in April 2013 provides a high-speed and high pin number testing environment that includes 128/256/512 digital channels and can measure speeds of up to 1600/533/200 Mbps separately. This machine also provides high-resolution, high-speed signal sources and measurement terminals for use in analog measurements, and can be used in testing and debugging of digital and mixed signal system chips and performance analysis. Testing services using this machine were provided to 39 instructors in 24 departments, and digital and mixed signal IC measurement services were provided in 71 cases. The machine was used in a total of 266 cases.

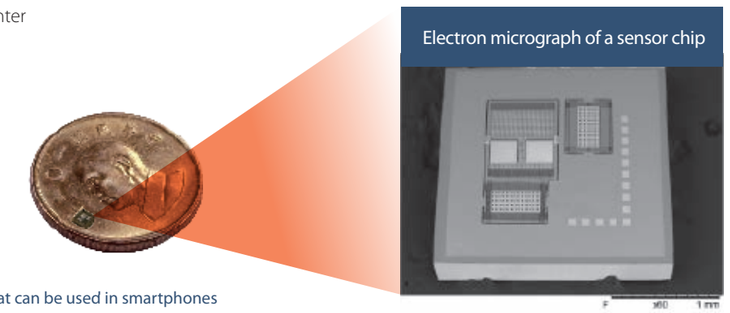
National Chip Implementation Center

Intelligent Single-chip Sensing Technology

The world leader in intelligent sensor chip development; can help academic researchers and industry develop sensor chip elements, enhancing Taiwan's industrial momentum

In recent years, sensors have played vital roles in our lives through their use in smartphones, consumer electronics, motor vehicles, and biomedical applications. CIC has used the strengths of Taiwan's semiconductor supply chain to development world-leading "intelligent single-chip sensing technology," which integrates vibration-sensing micro-mechanical structures in ordinary CMOS chips. This technology, which possesses the advantages of low cost and ultra-miniature size, can help academic and industrial researchers develop key sensor chip parts, and promote the introduction of integrated 3C, biomedical, and green energy system products. By fostering linkage among academia, industry, and research organizations, CIC is sustaining Taiwan's IC industry momentum.

National Chip Implementation Center



▲ Integrated motion-sensing IC chip that can be used in smartphones

Space-qualified Optical Thin Film Patterned Multispectral Assembly

The average transmittance of the space qualified patterned multispectral assembly above 90 % for the multispectral assembly, with a rejection transmittance of less than 0.5 % in the 350–1100 nm spectral range.

In order to stand up to long-term use in space, primary and secondary optical mirrors and bandpass filter arrays must be produced using high-precision film coating technology. ITRC uses the electron-beam evaporation method in conjunction with ion-beam assisted deposition (IAD) to enhance the film deposition rate and film compactness. ITRC also uses a real-time deposition monitoring system to precisely control the thickness and refractive of each film layer. Recent research results have yielded an average bandpass transmittance above 90%, and an average stop band transmittance of under 0.5%. In addition, ITRC has met the requirements of ISO 9211 in characteristic analysis for adhesion and surface roughness, and simulated space radiation damage (using 35 krad, 1 Mrad radiation from Co60), thermal cycle, and humidity testing.

Instrument Technology Research Center

Aerospace-grade Lens Polishing and Testing

ITRC completed a 6" i-line spherical lens with a surface form error under λ/10, establishing key localized alternative element production techniques in Taiwan

After completing polishing three primary and secondary mirrors used in the FORMOSAT-5 remote sensing system (the primary mirror has an aperture of 466 mm and a precision of RMS 10 nm), ITRC has begun applying its large aperture aspherical polishing technology to optics for the semiconductor manufacturing industry. ITRC has now completed 6" spherical i-line lenses with a surface form error under λ/10. ITRC has also established relevant standard fabrication procedures, and developed a new type of mirror fixture that resolves the unmolded deformation problem. ITRC's technical team is continuing to perfect its large aperture short-wavelength aspherical lens production and testing technology. By developing high accuracy projection lenses for lithography system , the team can achieve the localized production of key elements for the semiconductor industry.

Instrument Technology Research Center

Ru and TaN Plasma-enhanced Atomic Layer Depositions for the Back End of Line (BEOL) Process

With the breakthrough in PEALD process, ITRC can provide leading-edge material process to domestic semiconductor manufacturers.

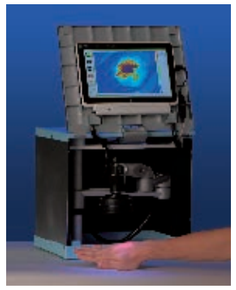
▲ PEALD system developed by ITRC

Plasma-enhanced atomic layer deposition (PEALD) is regarded as an enabling tool for semiconductor device miniaturization due to advantages, such as low processing temperature, high film density, and low impurity level, and good coating step-coverage. Reaction chamber, plasma source, precursor delivery, and PC-based control interface are developed and integrated by ITRC for the PEALD system, which can be applied to grow ruthenium and tantalum nitride films. With the breakthrough in PEALD process, ITRC can provide leading-edge material process to domestic semiconductor manufacturers.

Instrument Technology Research Center

Portable Epithelial Tissue Imager

This device can quickly and accurately diagnose patients' skin pathologies, and has received DOH medical equipment certification. This is a fine example of advanced medical equipment developed successfully in Taiwan.



▲ All-in-one portable epithelial tissue imager

ITRC has cooperated with Kaohsiung Medical University Chung-Ho Memorial Hospital in the development of a skin pathology detection instrument combining medical and optoelectronic technology. This instrument illuminates the skin with 405 nm UV light, which can penetrate the skin to the basal layer at a depth of roughly 3 mm, enabling epithelial pathologies to be clearly seen. A spectral leveling lens developed in-house is mounted in front of the lens assembly, allowing photography of the main areas of skin cancer distribution. The instrument can be used to perform auxiliary positioning prior to photodynamic therapy at a wavelength of 660 nm, ensuring that cancerous pathologies receive application treatment. Developed over a period of three years, the instrument has obtained TFDA approval to be sold in the Taiwan market.

Instrument Technology Research Center

3D Special Effects and Cloud Rendering

A key technology needed to upgrade the movie industry, cloud rendering has been used in the movies "Zone Pro Site" and "Mida."

Since Taiwan's first Cloud Render Farm was established by the National Center for High-performance Computing (NCHC) in November 2011, it has actively developed simulation techniques for 3D special effects such mist and waves. NCHC was therefore invited to produce 3D scenes for movies such as "Ripples of Desire," "Zone Pro Site," "Mida," etc., and it has tangibly aided the development of the domestic movie industry. Moreover, NCHC has developed a new fisheye cloud rendering system that can be used in the "i-Ride" developed in Taiwan to create 4K contents.

National Center for High-performance Computing

Responsible for TWAREN Operation and SDN Advanced Network Technology R&D

TWAREN has reached 99.988% availability, which is comparable to other advanced research networks. NCHC's malware knowledge base has boosted information security in Taiwan.

▲ Malware knowledge base

NCHC manages and maintains the TaiWan Advanced Research and Education Network (TWAREN), which supports the Ministry of Education, Academia Sinica, and other academic and research organizations nationwide with network services needed. In 2013, TWAREN served approximately five million users with an overall availability of 99.988%, which is comparable to other advanced research networks. In terms of network technology, NCHC has vigorously pursued R&D in information security and software defined network (SDN). In 2013, NCHC launched Taiwan's first malware knowledge base which actively searches for and captures malware. It is available for public use in order to enhance domestic information security and network defense capabilities. In terms of developing Taiwan's first SDN testbed, NCHC has cooperated with America's International Global Environment for Network Innovations (iGENI) and Japan's Japan Gigabit Network eXtreme (JGN-X), and held several SDN-related forums and seminars.

National Center for High-performance Computing

Establishment of a Superior High-performance Computing R&D Platform

NCHC provides industry, academia, and research organizations with 200 Tflops computing capability and over 5 PB storage capacity.

NCHC's superior high-performance computing (HPC) and storage facilities support Taiwan's research and innovation. In 2013, NCHC provided about 200 Tflops of HPC capability and over 5 PB of storage capacity for nearly 3,000 users in 754 research projects. To boost quality of the service, NCHC develops an open HPC simulation platform (simPlatform) to meet the computing and storage needs of research in the fields of structural dynamics, hydrodynamics, and materials science. Moreover, its user-friendly interface allows users to share modules in different research fields. NCHC hopes that this will encourage new generation of users to perform innovative research and facilitate more efficient use of its HPC cloud services.

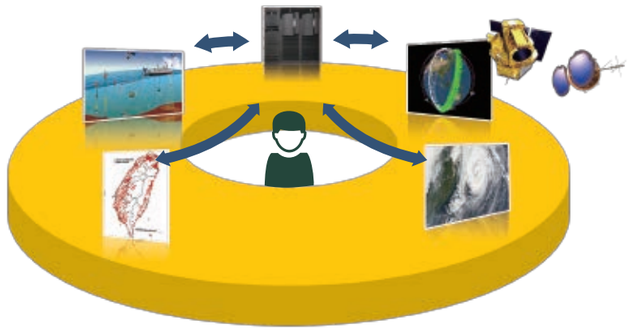
National Center for High-performance Computing

▶ NCHC's HPC simulation platform (simPlatform) provides common modules used in different areas of research, changing the way of using high-performance computing resources.

Establishment of an Earth Science Database and Disaster Prevention Data Management Platform

Protecting Taiwan with integrated space, marine, atmospheric hydrology, and seismic geology data

Today, big data computing has become a new benchmark for international high-performance computing research institutes. In order to strengthen technology synergy capability, NCHC has promoted the development of big data technologies and value-added applications in the fields of environment, disaster-prevention, and biomedical science. In particular, NCHC's Earth science and disaster prevention database incorporates NARLabs' space remote sensing, oceanography, atmospheric hydrology, and seismic geological data. It uses big data search and 3D visualization technologies to develop a disaster prevention management platform meeting the needs of government and academia. Some real examples during 2013 included helping make damage claims for environmental pollution and damage to stone fish weirs after the oil tanker Seatank ran aground near Penghu. In the future, NCHC will continue to cooperate with government agencies and academia and strive to contribute towards the public welfare in such areas as weather forecasting, climate change, greenhouse effect, and marine environmental changes.

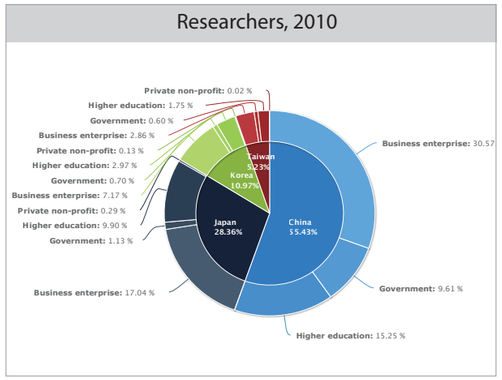


▲ NCHC's earth science and disaster prevention database incorporates NARLabs' space remote sensing, oceanography, atmospheric hydrology, and seismic geological data.

National Center for High-performance Computing

Numbers Can Tell-PRIDE Makes Data Easier to Interpret

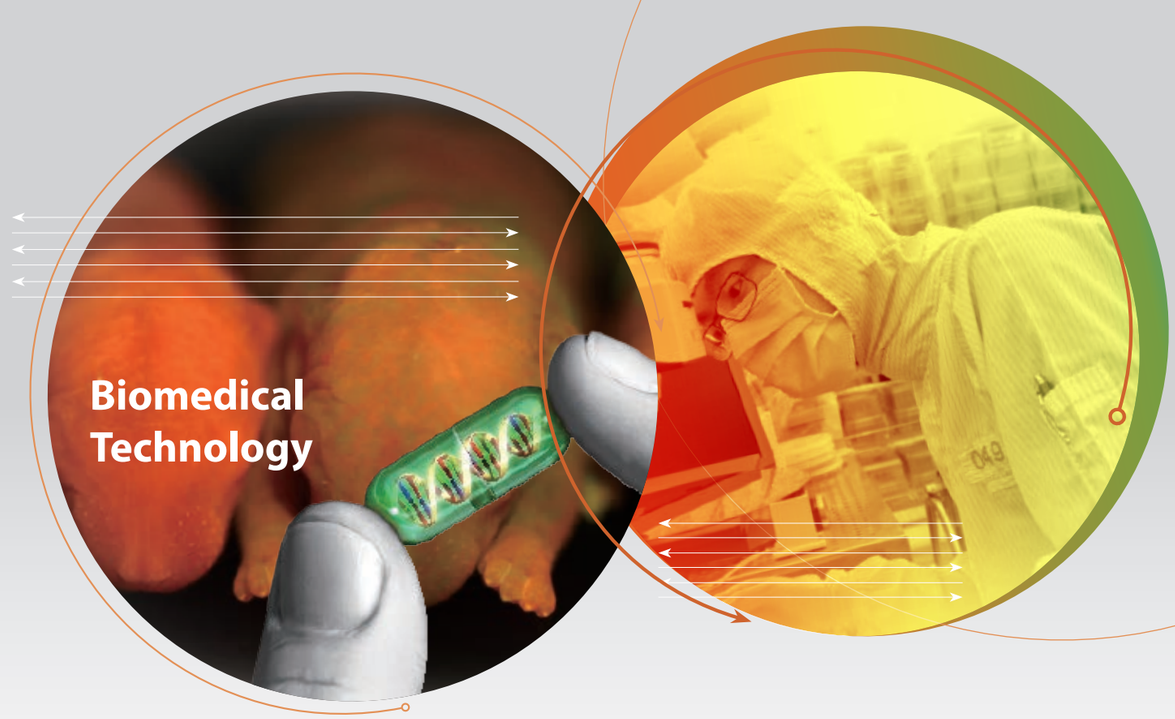
Can compare statistics and rankings in such areas as national population, economics, fiscal status, education, energy, environment, labor, government effectiveness, quality of life, and S&T



▲ Online chart generated from the Policy Research Indicator Database. (Source: OECD. Generated by STPI's PRIDE indicator database)

The Policy Research Indicators DatabasE (PRIDE) is STPI's newly-developed numerical database service system. It collects and integrates statistical indicators from Eurostat, OECD, WEF, and World Bank. PRIDE provides indicators for query and download, graphing, and chart presentation for individual data. Chief characteristics include its wide range of indicators and its powerful graphing functions. Its ability to present complex data in graphic forms can facilitate interpretation and enrich research content. PRIDE will become one of the most useful tools for S&T policy research in Taiwan in the future.

Science & Technology Policy Research and Information Center



Received AAALAC Accreditation

NLAC actively promotes the welfare of laboratory animals, so that they are treated in a humane way; The assurance of humane procedures and facility management both comply with international standards

NLAC has promoted the welfare of laboratory animals for several years. Under the spirit of humane care and systemic management, the quality of animals is ensured. NLAC received accreditation from the Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC International) since 2007; it is the only accreditation recognized by US NIH, which proves that the humane care and facility management of NLAC meet international standards. In 2013, both NLAC facilities in Taipei and Tainan renewed their accreditation without any shortcoming - "full accreditation".

National Laboratory Animal Center

Supporting Vaccine and Pharmaceutical Testing, Providing High-quality Guinea Pigs

NLAC has expanded the breeding capacity in order to supply nearly 5,000 guinea pigs, which support the local medical testing and protect the public's health

Guinea pigs play indispensable roles in vaccine and drug safety testing. Nevertheless, Taiwan has lacked quality laboratory guinea pigs for years, hindering the preclinical development of drugs and medical devices and vaccine tests. In order to fulfill the research demand for laboratory guinea pigs, NLAC expanded and doubled production capacity in 2013; with nearly 5,000 guinea pigs supplied by NLAC to support the local vaccine, medical device and drug testing.

National Laboratory Animal Center

Joining the International Mouse Phenotyping Consortium

By strengthening the local research power and connecting to the international biomedical industry, NLAC accelerates the clinical application of animal models and leads Taiwan to the front line of the global resource

Through genetically-modified rodents, some secrets of human diseases were unlocked; connecting the research discovery to clinical applications has become a global trend. NLAC uses high-efficiency genetic modification technology to successfully join the International Mouse Phenotyping Consortium (IMPC), making it the 16th member of the team and enabling the crossnational cooperation with the National Institutes of Health (NIH) of the US, National Institute for Medical Research and Welcome Trust of the UK, Riken BioResource Center (BRC) of Japan, the University of Seoul in Korea, and Nanjing University in China. Members of IMPC establish genetically-modified rodent resources needed for biomedical research worldwide. After joining IMPC, Taiwan's research power and international cooperation opportunity have been improved; the clinical applications of animal models are accelerated, leading Taiwan to the front line of the global resource.

National Laboratory Animal Center

Promoting Cross-strait Experimental Animal Interchange, Promoting Biotech Development in Taiwan

Overcoming difficulties on the importation of genetically-modified rodents and laboratory dogs from China to make breakthroughs in the local research

Due to insufficient laboratory animal resources in Taiwan, the local biomedical industry relies on overseas providers of preclinical tests for drugs and vaccines; the high cost greatly lowers the competitiveness of Taiwan's new drug development. In order to strengthen the development of biotechnology, NLAC promotes laboratory animal resource exchanges between China and Taiwan, advancing the local biomedical industrial development. NLAC currently helps local biomedical academia and industry with the importation of genetically modified rodents and dogs from China in customized ways. Meanwhile, NLAC is working on the importation of other animal species. The exchange of resources between China and Taiwan enhances the qualification and knowledge of the researchers, and also creates more breakthroughs on the existing bottlenecks. A win-win outcome may be achieved.

National Laboratory Animal Center

Creating New Opportunities for Taiwan's MedTech Industry

24 STB scholars have completed their training program, and have started up 5 new companies

Stanford-Taiwan Biomedical Fellowship Program (STB program) is a 7-year project which aims to serve as a bridge to link the global network and resources in Stanford University and Silicon Valley to Taiwan, to train the next generation of medical technology leaders and to create an innovative Med Tech platform in Taiwan. To date, 24 STB scholars have completed their training and 5 startups were emerged from STB program, on which one firm raised its capital to NTD$200 million in 2013.

Science & Technology Policy Research and Information Center

Accelerating the Translation Process for Taiwan Biomedical and Medical Device Research Projects.

The SPARK Taiwan program help anchor universities in establishing on-campus translation mechanisms, to accelerate biomedical academic research into applicable product development.

▶ Inaugural ceremony for the SPARK Taiwan training program (June 13, 2013). Shown here are Prof. Daria Mochly-Rosen professor (3rd from left) of Stanford University's SPARK Program, NSC Deputy Minister Sun Yi-han (4th from left), Dr. Soo Whai-jen, managing director to the Supra Integration and Incubation Center (5th from left), and National Taiwan University President Yang Pan-chih (4th from right) while jointly conducting the ceremony of National Taiwan University SPARK Program.

The SPARK Taiwan program is bringing the biomedical product commercialization concept of Stanford University's SPARK Program into Taiwan. The SPARK Taiwan Program is aiming to establish the translational research mechanism in Taiwan universities. This means that the universities have to be flexible for their internal funding, acquiring industrial experienced consultants, establishing technology commercial related training courses, etc. The program was announced in 2013, and National Taiwan University and National Cheng Kung University were the first two demonstrated anchor universities. They are devoted to allocating school owned funds, manpowers, and facilities for this program. Furthermore, the Supra Integration and Incubation Center and the program office at NARLabs provide additional resources in actively supporting the anchor universities in the commercialization of school's acdemic research projects. This program is believed to accelerate the translational research into value-added applications in Taiwan.

Science & Technology Policy Research and Information Center

Promotion of Domestic Development of a High-end MRI System

Promoting domestic MRI system and element technology, and encouraging the application of MRI systems to basic biomedical science, animal models, preclinical research, and translational medicine

▲ President Kung Hsing-chien of the National Health Research Institute (left), NARLabs President Ching-Hua Lo (center), and National Taiwan University President Yang Pan-chih (right) sign a memorandum of understanding for the "MRI System R&D and Imaging Service Platform."

The NARLabs, National Health Research Institutes (NHRI), and National Taiwan University (NTU) signed a memorandum of understanding on Dec. 19, 2013 for the joint establishment of a "MRI System R&D and Imaging Service Platform (MRI Platform)" at the Hsinchu Biomedical Science Park (HBSP) Biomedical R&D Center. In conjunction with the Executive Yuan's "Taiwan Biotech Take-off Diamond Action Plan," the three parties have actively promoted the budding high-end medical imaging industry. Medical imaging is currently an important non-invasive clinical diagnostic tool, and MRI equipment has particularly great development potential. High-quality MRI images are of great help to physicians performing diagnosis, and greatly reduce the waste of medical resources by uncovering the hidden causes of sickness. This jointly established MRI Platform will provide services to medical research sectors to develop high-end MRI systems, and will assist with extension of MRI applications. It is hoped that the project will stimulate biomedical research in Taiwan and promote the development of clinical applications; while enhancing domestic MRI system R&D capabilities, establishing autonomous system and development abilities in hardware and software, training product development, certification and manufacturing experience, driving the establishment of an MRI industry chain to encourage industrial upgrading, and making the HBSP a center of biomedical imaging R&D and applications in Asia.

Fostering of Scientific and Technological Manpower

In the global competition among countries, manpower is the most valuable resource. The toughest challenge facing Taiwan in its struggle to promote industrial upgrading and transformation is perhaps the cultivation of human resources. During the coming wave of globalization, S&T manpower will not only affect the competitiveness of individual companies, but also the competitiveness of entire nations. "Training scientific and technological manpower" is one of NARLabs' four major strategic goals; during the past year, NARLabs has served Taiwan's society using service platforms to link professors and graduate students with companies, and also sponsoring international manpower exchanges.

Learning about Scientists' Little Helpers

People and animals have always had an inseparable relationship, Laboratory animals are extraordinarily helpful to scientists. Almost all medicine and therapeutic treatments for humans were developed with the help of animals. The National Laboratory Animal Center, National Applied Research Laboratories and Taipei Zoo teamed up to hold a "Scientists' Little Helpers" activity, which combined concepts from life education with hands-on popular science. The event showed children aged 5-15 the great contributions of small animals at the zoo, and taught the kids to respect and take good care of animals.

The content of this activity included interactive lectures in the Panda House, exhibitions, and hands-on activities, plus a multi-station program at the Children's Zoo, letting children get in close contact with scientists' little helpers. The kids learned the way to prepare a comfortable living environment for little helpers, the feeling of stroking rats and mice, and the heart rates of animals. Children of all ages were able to answer these questions after participating in this activity. Parents and children from the Taiwan Children Liver Foundation, Formosan Diabetes Care Foundation, and Han Ru Foundation were specially invited to the activity; the little warriors found out that there are many little helpers contributing to the development of various medical treatments, and they are not alone in fighting illnesses!

NLAC teaches children about laboratory animals, and makes them appreciate the contributions of laboratory animals on the development of medicine

▲ Certificates of appreciation was presented: (Left to right) Zoo Director, Chin Shih-Chien; Special Assistant to the President of the Han Ru Foundation, Chen Yen-Jou; Taiwan Children Liver Foundation Director, Tan Chi-hsin; Formosan Diabetes Care Foundation President, Tai Tung-Yuan; NLAC Director General, Yu Chun-Keung

Holding the "NARLabs Talks" to Promote Dialogue between Entrepreneur Volunteers and Technologists

Initiated in 2013, the "NARLabs Talks" sought to foster dialogue between entrepreneur volunteers and technologists. The talks attempted to inspire the participants' technological creativity through sharing entrepreneurial experiences and concepts, and encourage participants to think of forward-looking technological application ideas in keeping with the global industrial development context. The many entrepreneur volunteers invited to these events have included the Silicon Valley entrepreneur Bob Lin, President Yen Chang-Shou of the Alliance Cultural Foundation, Honorary President Cheng Chung-Hua of Delta Electronics, and Digitimes President Huang Chin-Yung. These volunteers explored such topics as "technological innovation," "creation of value," and "social welfare."

Seeking to foster dialogue between entrepreneur volunteers and technologists.

April 9—Digitimes President Huang Chin-Yung is invited to talk on the topic of "e-Taiwan's International Forays."

June 4— Honorary President Cheng Chung-Hua of Delta Electronics is invited to talk on "The Original Purpose of Entrepreneurship: Helping People Solve Problems and Meet Human Needs.

July 2—President Yen Chang-Shou of the Alliance Cultural Foundation is invited to talk on "Public Interests Platforms and Technological Volunteers."

July 30—Bob Lin, founder of Silicon Valley's Acorn Campus incubation center, is invited to talk on "New Reflections on Creating Value and Standing Out."

Taiwan Tech Trek

The Taiwan Tech Trek program is for 18-30 year-old second-generation overseas Taiwanese students, including young people who accompanied their parents overseas as small children, and grew up overseas. Participants spend 50 days of their summer vacation taking part in internships in Taiwan, and their internships are variously performed at government agencies, nonprofits, research organizations, private companies, and universities. A results presentation conference is held after the conclusion of the internships, and awards are given to individuals with the greatest achievement.

The participants in the Taiwan Tech Trek program are like birds flying over several thousand miles to return to their native place—Taiwan.

Although, in the past, some participants were coaxed and pushed by their parents into taking part, and went to Taiwan very unwillingly, many of these later expressed that their 50 days in Taiwan was the best 50 days of their life. Apart from learning a great amount of practical experience, they also got a chance to see their parents' homeland close up, and came to appreciate Taiwan's vitality and enthusiasm. According to many participants: "When I go back to my adopted home after the conclusion of the internship, I will remember that Taiwan will always be my home."

The program first began on a trial basis in 1994, and had only room for 50 participants at that time. More recently, as many as 181 persons have participated. As of 2013, the Taiwan Tech Trek had been held for nine years, and a total of 2,287 participants had taken part, including individuals from the United States, Canada, and the U.K. These participants have been involved in six areas of study, including the humanities and engineering, etc.

The chief purpose of the Taiwan Tech Trek program is to induce professional manpower to return to Taiwan and put down roots there, and encourage second-generation overseas youths to return to their native land for study and service. Through contact with professionals and peers in Taiwan, the participants learn about Taiwan, identify with Taiwan, and come to love Taiwan. One day they may also speak out on behalf of Taiwan in the international sphere.

▲ Taiwan Tech Trek trainees gather at the Tianhou Temple in Lugang while taking part in group training

Encouraging Entrepreneurship Adding Value to Society

453 startup proposals submitted
447 entrepreneurs trained
12 startups founded by entrepreneurial teams

The MOST's "From IP to IPO" program, which started from March 2013, was the first time in Taiwan that the resources of heavyweight companies, international venture capital firms, and government were enlisted for the purpose of providing an entrepreneurship support mechanism for the innovations and ideas of scientists and young researchers. The first session of the program received 242 startup proposals, nearly 300 people participated in startup lectures and consulting activities, and 16 prototype products emerged after two in-depth training workshops. These prototypes were displayed at an EXPO intended to pair the teams with angel investors, and this event attracted almost 100 companies and representatives of venture capital firms. At the end of the program, five teams received startup potential awards, and another five teams received outstanding startup awards; ten teams were considered to have products with considerable commercial promise. The second session of the program attracted even greater attention, and received 211 startup proposals. The five-year "From IP to IPO" program will continue to offer entrepreneurship support resources and the accumulated entrepreneurial experiences for the participant teams, and will encourage academic researchers to embark on technological startups adding value to society as a whole.

▲ This photograph shows teams winning NT$2 million startup grants in the first phase of the "From IP to IPO" program in 2013, together with Vice President Wu Den-Yi, NSC Deputy Minister Sun Yi-Han, and Stan's Foundation President Stan Shih.

First Promotion of National Research Service Platform

Actively promoting cooperation among industry, academia, and research organizations, fostering innovative collaboration in interdisciplinary fields.

In order to strengthen ties between various academic fields and NARLabs, and promote interdisciplinary integration and innovation, NARLabs held explanatory meetings in Taipei, Hsinchu, and Tainan, and invited NSC discipline chairpersons, discipline review committee members, discipline managers, neophyte researchers, and current NARLabs service platform users to attend. The meetings established a harmonious vision for the future, and portended great success in 2014! These events featured introductions to each center's service mechanisms and results, and were accompanied by tours of NCREE, CIC, NDL, NSO, ITRC, and NCHC. The meeting agenda focused on the sharing of successful cases and two-way discussion, and the meetings ensured that participants gained familiarity with NARLabs. Looking ahead to the future, President of NARLabs, Ching-Hua Lo, believes that NARLabs must take a proactive and customer-oriented approach to industry and academia. NARLabs will therefore continue to promote its service platforms, and hopes to create more opportunities for interdisciplinary, collaborative research. During 2014, NARLabs will focus on the promotional efforts, and place emphasis on encouraging collaboration within industry, academia, and research organizations.

Social Participation and International Cooperation

With regard to social participation, NARLabs has relied on innovative science and technology to protect Taiwan, and its personnel have dedicated themselves to Taiwan's technological innovation in the spirit of technological volunteers. In the face of natural disasters aggravated by climate change, NARLabs' disaster prediction research results have made major contributions to the protection of Taiwan in recent years. In the area of international cooperation, NARLabs' long-term exchanges with international research organizations have become the most important international interchange platform for academic R&D in Taiwan.

NARLabs' 10th Anniversary Charity Concert

Apart from the activities held on June 15 to celebrate the National Applied Research Laboratories' 10th anniversary which included the anniversary celebration, a technology forum, and a popular science education show. National Applied Research Laboratories (NARLabs) also held a first charity concert which was jointly organized by the NARLabs Department of Personnel Affairs and the Hsinchu NARLabs Facility Welfare Committee.

The organizers first invited the Ju Percussion Group to play percussion music for the concert audience. The avant garde Ju Percussion Group is highly experimental and its novel performing methods have a hypnotic appeal. It is a new-generation group offering professionalism, passion, appeal, and a style fusing East and West, as well as a very youthful ambiance. Its pieces and performing format are extremely free and untrammeled.

Apart from giving our colleagues and their families a chance to celebrate NARLabs' 10th anniversary, approximately 66 families who received assistance from World Vision Taiwan (Hsinchu branch) were invited to attend the concert. NARLabs hopes that this feast of music inspired by love and caring will encourage more colleagues and members of the public to reach out and help the disadvantaged in society.

A happy mood prevailed throughout the evening's program, as the performers enthusiastically interacted with the audience. The satisfied expressions of the young and old listeners confirmed that this spectacular charity concert was indeed a fitting climax to NARLabs' 10th anniversary festivities, as well as providing an unforgettable midsummer's night for NARLabs'people.

▲ The Ju Percussion Group plays at NARLabs' 10th anniversary celebration

NARLabs' NCREE Receives the Contribution Award in the 2013 National Invention and Creation Awards

The National Center for Research on Earthquake Engineering (NCREE) received the Contribution Award from the "National Invention and Creation Awards" on October 9, 2013. This honor gives well-deserved recognition to NCREE's long-term efforts and contributions in the areas of seismic engineering and damage prevention technology and applications research and development.

NCREE integrates various types of earthquake and disaster mitigation research in order to meet the needs of pre-earthquake preparedness, emergency response, and post-earthquake reconstruction. Thanks to NCREE's dedicated efforts, it has received 64 domestic and foreign patents and obtained more than NT$35 million in technology transfer income. Taking NCREE's buckling-restrained brace technology—which is widely used in domestic earthquake-resistant structural systems—as an example, not only has NCREE relied on technology transfer to promote the development of relevant domestic industries, but also helped Taiwan to reduce foreign exchange outflows by more than NT$1.0 billion.

Apart from generating income, applications of NCREE's earthquake damage-reduction technologies are effectively reducing losses from earthquake damage. For instance, NCREE's school building seismic resistance assessment and retrofit work, which began in the wake of the devastating 921 earthquake, has helped confirm the seismic safety of close to 10,000 school buildings, safeguarding more than a million students and teachers. In addition, NCREE has helped the Ministry of the Interior and the Ministry of Transportation and Communications to revise building and bridge seismic codes, which will enhance the ability of domestic buildings and bridges to resist earthquake damage. NCREE's work has made immense contributions to the safety of people's lives and property that cannot be assigned a monetary value.

▲ Vice President Wu Den-Yih gives a cup to Director Chang Kuo-Chun of NCREE

NARLabs' Laboratories Open their Doors to Visitors

To celebrate the 10th anniversary of the establishment of its establishment, the National Applied Research Laboratories (NARLabs) opened its various laboratories, including Animal, Earthquake, Space, Computing, Nanotechnology, Chip, and Instrument Technology centers, to the public. Among the laboratories, the National Laboratory Animal Center (NLAC) opened its facilities in southern Taiwan, including its quarantine area, electrical and mechanical facilities, commissioned animal raising area, and experimental and dissection classroom. For its part, the National Center for Research on Earthquake Engineering (NCREE) displayed its three major earthquake simulation systems, which include a vibrating platform, reaction wall and strong floor, and multi-axial testing system. The NCHC, CIC, ITRC, NSPO and NDL, all of which are located in the Hsinchu area, jointly conducted a science carnival, with sightseeing buses taking visitors between the various laboratories. Beyond giving the public a good look at the world of nanotechnology, semiconductors, photovoltaics, and chip, as well as at ITRC's vacuum and optical technologies, the event also includes a number of fun hands-on activities. For instance, NSPO launched water rockets, and NCHC held a 3D scientific results exhibition and gave people the experience of flying. In addition, for the first time ever, NCHC also let visitors see one of its supercomputers close-up, which let them appreciate the powerful computer's mysterious aura. This activity attracted over a thousand participants. Usually cloaked in a veil of mystery, the laboratories assumed a carnival atmosphere full of fun and artistry on the day of the event.

Establishing International Cooperation Platforms; Boosting Taiwan's Technology R&D Capacity

In order to realize a vision of global excellence, and benefit Taiwan's society and industry, NARLabs has signed cooperation agreements with important international organizations, and relies on joint international research projects, shared major research facilities, and international technological cooperation, etc. to continue to expand research platforms, and develop promising, frontier new areas of research. Furthermore, in order to establish cooperative relationships with prominent academic research organizations worldwide, NARLabs signed 68 cooperation agreements with research organizations in 19 countries during 2013, which revealed NARLabs' extensive international interaction and burnished the image of its national laboratories. During 2013, NARLabs signed a cooperation MOU with the Kuwait Institute for Scientific Research (KISR) during May in Taipei, and also signed MOUs or letters of intent with the Siberian Branch of Russian Academy of Sciences; Swartz Center for Computational Neuroscience, University of California San Diego; National Center for. Computational Hydroscience and Engineering, University of Mississippi; National Research Council of Canada; Commercial Satellite Center, Kongsberg Satellite Services, Norway; Space Research Centre, Poland; Woods Hole Oceanographic Institution, United States; Optilab Company, United States; Remote Sensing Technology Center of Japan; American University Corporation for Atmospheric Research; Thailand's GISTDA space center; the institutes of engineering, mathematics, and physics at Britain's University of Exeter; NASA; and Silicon Valley's Plug and Play Tech Center.

As for interchange with leading foreign research organizations, NARLabs sent delegations to visit the branches of the University of California at San Diego, Irvine, and Los Angeles; University of Southern California; German Aerospace Center (DLR); Jülich Supercomputing Centre; Germany's Center for Marine Environmental Sciences (MARUM); GFZ German Research Centre for Geosciences (GFZ); GEOMAR Helmholtz Centre for Ocean Research; the SURFsara National Supercomputing and e-Science Support Center, the Netherlands; Royal Netherlands Institute for Sea Research (NIOZ); the Royal Netherlands Meteorological Institute (KNMI); Institute Francais de Recherche pour l'Exploitation de La Mer (IFREMER); the French national High-Performance Computing Organization (GENCI); and the Japan Agency for Marine-Earth Science and Technology (JAMSTEC). NARLabs also participated in a Taiwan-Poland bilateral materials symposium, a bilateral symposium with Kuwait, and a first international technological interchange workshop with the Korea Research Council of Fundamental Science and Technology (KRCF); this symposium sought to boost sharing of technological experience in the areas of the earth sciences, environmental/disaster prevention technology, and electronics/information/communications technology, and enhanced NARLabs' integrated project applications and development capabilities.

▲ NARLabs President Ching-Hua Lo visits the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) at the head of a Taiwan delegation

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