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2012
NAR Labs
Annual Report

2012 Annual Report

NARLabs

Commitment • Passion • Innovation

History**2003** NARLabs is established

- 6 labs 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)

NCDR is established

National Science and Technology Center for Disaster Reduction

2005 2 labs become member laboratories of the 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**Preface**

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A Word from the Chairperson

Globalization has sped up the circulation of information, making knowledge innovation a key factor in determining a country's competitiveness. In response to this trend, we hope to rely on human resources, an innovative environment, and our intellectual property portfolio to encourage domestic innovation in science and technology, and uncover new opportunities for growth, making Taiwan an island of innovation and hope.

In the wake of the transformation of domestic science and technology, one of the key issues at hand is how to effectively translate innovative ideas derived from upstream academic research organizations into the products and services of emerging downstream industries. The National Science Council (NSC) has recently been promoting "Subsidized Industry-Academic Technology Alliance Projects" (Small Industry Alliances) and, in conjunction with the Ministry of Economic Affairs, "Subsidized Forward-looking Technology Industry-Academic Collaborative projects" (Large Industry-Academic Alliances) in order to foster linkage between industry, on the one hand, and academic and research organizations on the other, which will enhance the effectiveness of Taiwan's sci-tech innovation system.

Furthermore, following the 2012 National Science and Technology Conference, an even stronger consensus to promote innovative industries has emerged, and technological innovation and value creation are seen as the drivers of Taiwan's future industrial development. At this pivotal moment in time, the National Applied Research Laboratories (NARLabs) will pursue a chief mission of integrating domestic and foreign resources and capabilities, making the most of its collective experience, and transforming "innovative conceptual prototypes" developed in the academic research sector into new market niches for "innovative emerging industries," while serving as a "translation platform for industry, academia, and research organizations."

It will greatly benefit Taiwan if NARLabs can effectively help academic researchers create value for society. We hope that everyone at NARLabs will bring forth a spirit of humane concern and a sense of responsibility for the welfare of society, and work together to enhance Taiwan's technological innovation and scientific advancement!

Chairperson Cyrus C.Y. Chu



A Word from the President

The 2012 National Science and Technology Conference took "Taiwan's Scientific and Technological Transformation" as its theme, and explored how Taiwan's science and technology can promote a shift from the "efficiency-oriented" production model of the past to an "innovation-driven" economic model geared to meeting real needs. The conference engaged in many discussions of such issues connected with the new economic model as the gap between academia and industry as well as human resources training problems, which provided many opportunities for us to reflect on the role played by the National Applied Research Laboratories (NARLabs) in this time of transformation, and the challenges that it faces.

Addressing the transition to a new economic model, NARLabs seeks to meet users' needs by playing the role of a provider of the technological R&D platforms required by Taiwan's innovation economy. And with a vision of "pursuing global preeminence, creating local value," NARLabs will provide world-class R&D platforms to domestic academic researchers, and translate academic research results into innovations that benefit society and industry.

To accomplish these goals, NARLabs is actively developing national laboratories, including facilities specializing in the earth sciences, environmental engineering, information and communications technology, biomedical technology, and science and technology policy. It is promoting research platforms in such areas as sensing elements, systems integration, networks, and cloud computing, and is vigorously encouraging the industrial use of R&D results. It is also uncovering industrial needs in order to effectively pair upstream R&D results with downstream applications in government agencies and industrial enterprises. To promote the development of biomedical technology in Taiwan, NARLabs continues to supply high-quality specific pathogen free experimental animals, and assists with the implementation of various translational medicine experiments and drug trials. It is also developing biomedical electronics R&D platforms for use in applied electronics and optoelectronics technology and biomedical testing research.

Taiwan is one of a small number of countries that simultaneously faces multiple natural disasters. NARLabs has integrated various experimental observation platforms addressing the disasters that may affect Taiwan's distinctive environments, and uses satellite remote sensing and meteorological observations, marine observations and underwater exploration, earthquake engineering research and structural reinforcing, atmospheric hydrological modeling, special sensing elements and instrument development technologies to provide government with disaster mitigation decision-making assistance and support. NARLabs is thus using innovative technologies to guard the land of Taiwan.

It is said that the greatest good is like water, which nourishes the myriad living things and does not quarrel. We hope that NARLabs will serve as a hard-working "scientific and technological volunteer" by establishing R&D platforms for the country, while providing robust, dependable support for the country's future industrial development and public safety.

President Liang-Gee Chen

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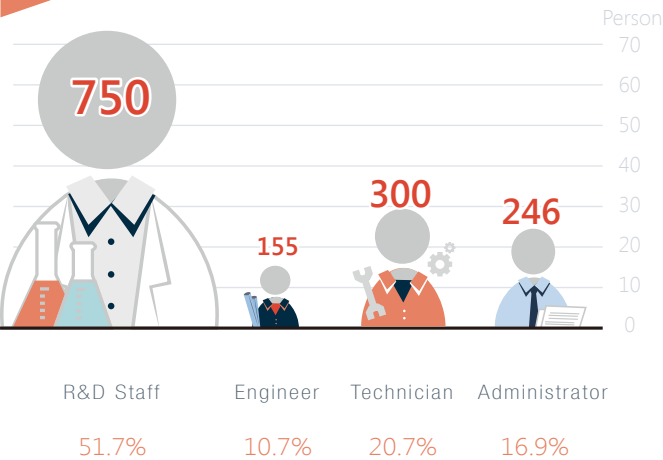
Laboratories

National Chip Implementation Center	C I C	Tzi-Dar Chiueh
Instrument Technology Research Center	I T R C	J. Andrew Yeh
National Science and Technology Center for Disaster Reduction	N C D R	Liang-Chun Chen
National Center for High-performance Computing	N C H C	Ce-Kuen Shieh
National Center for Research on Earthquake Engineering	N C R E E	Kuo-Chun Chang
National Nano Device Laboratories	N D L	Jen-Inn Chyi (acting)
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Taiwan Ocean Research Institute	T O R I	Gwo-Ching Gong
Taiwan Typhoon and Flood Research Institute	T T F R I	Cheng-Shang Lee

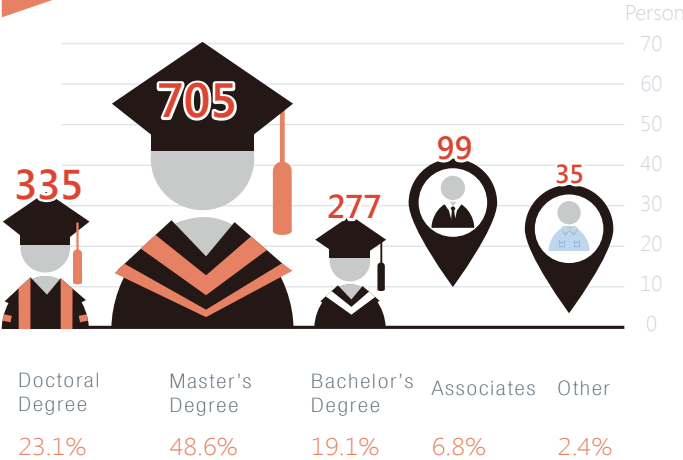
Vice President & Director General

Number of Employee 1,451

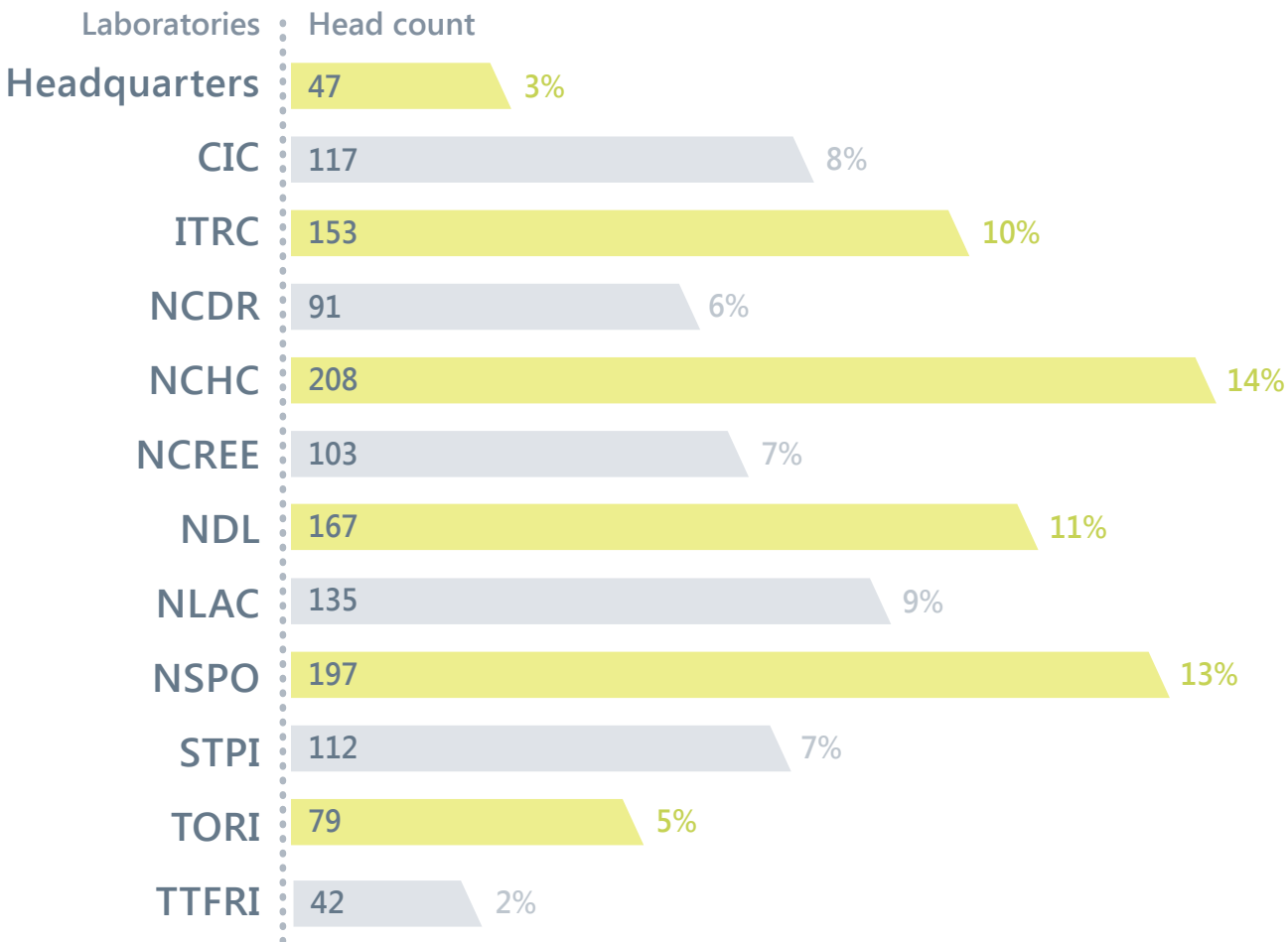
Human Resources Allocation



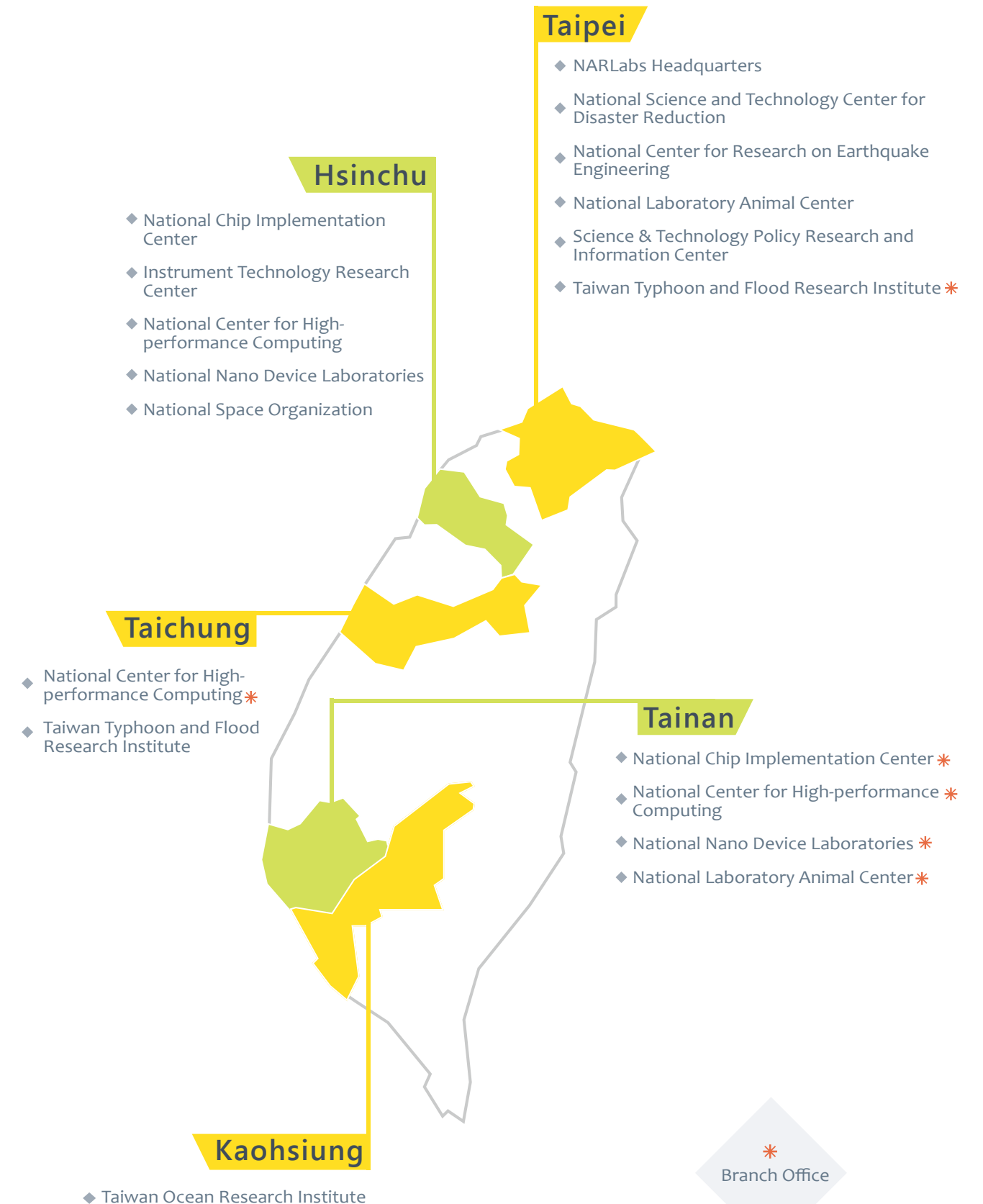
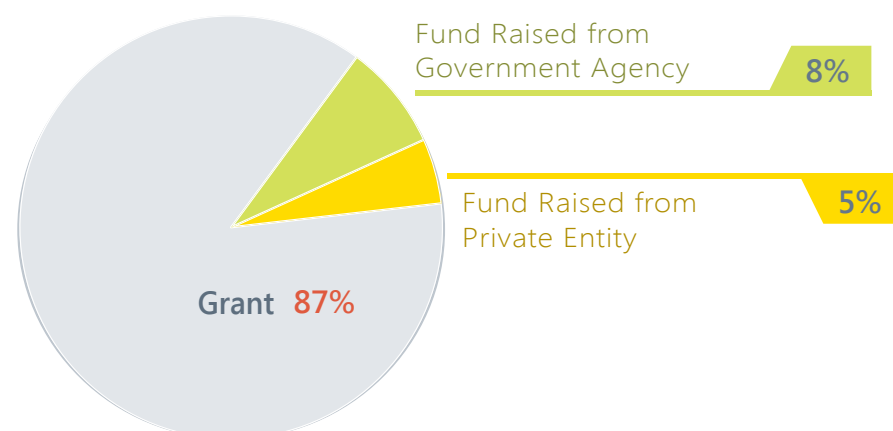
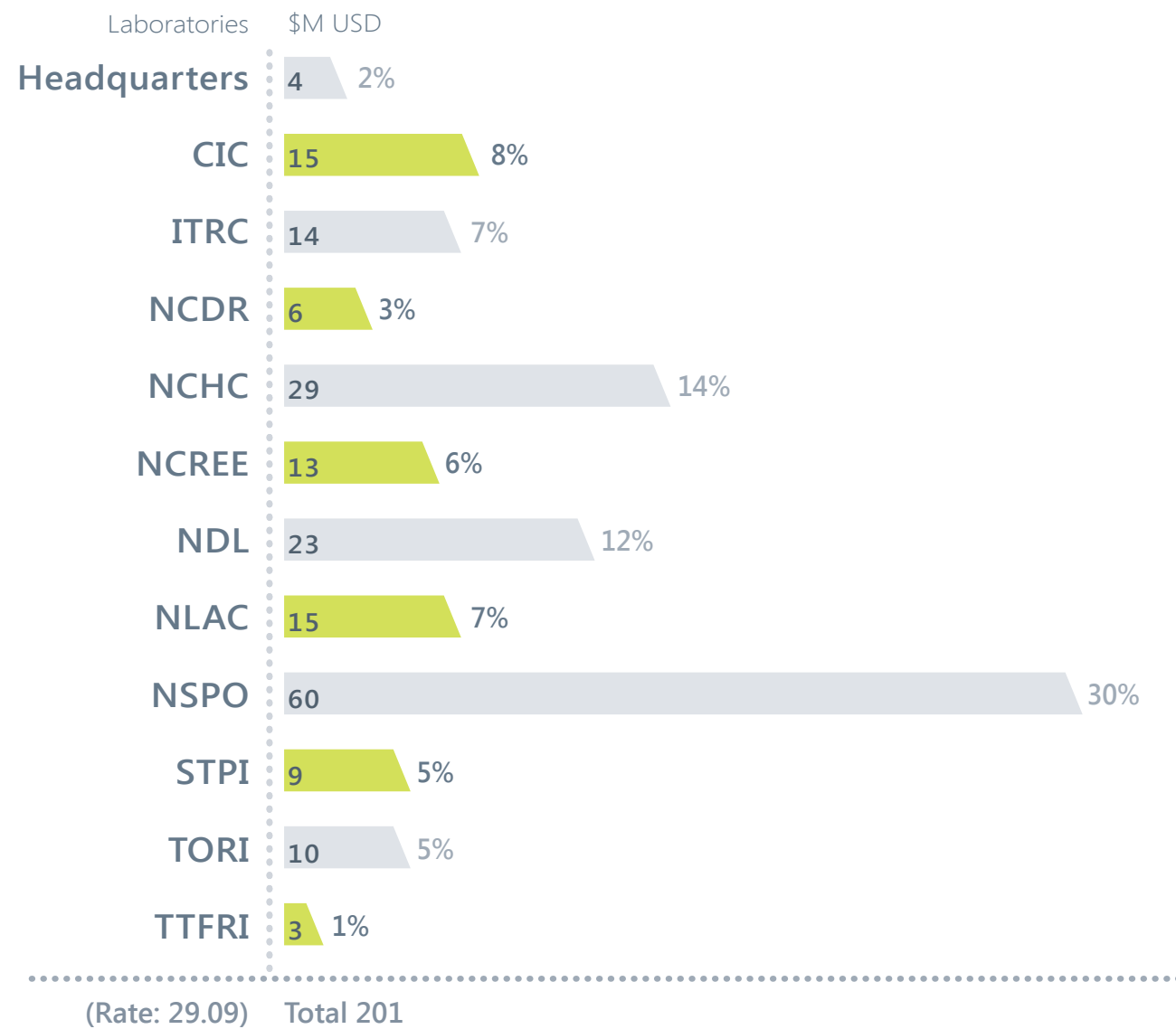
Education Qualification



Employees per Laboratory



Revenue (FY 2012)



NARLabs upholds a vision of "global excellence, local impact," and has assumed responsibility for providing the technological R&D platforms needed by Taiwan's innovation economy. In 2012, apart from relying on international collaboration channels to actively engage the world at large, NARLabs has also continued to establish R&D service platforms in Taiwan, striven to offer R&D services, and trained human resources, with a goal of fostering long-term establishment of scientific and technological capabilities in Taiwan. In order to enhance overall administrative efficiency, NARLabs has formulated performance assessment indicators, and employed various evaluation systems to promote the improvement of performance on a broad scale. The following is an overview of NARLabs' R&D and service results in 2012:

1. Scientific diplomacy and international interchange:

NARLabs is dedicated to widely establishing cooperative relationships with prominent international academic research organizations. Upholding its reputation as a national laboratory organization and commitment to international interchange, NARLabs has signed 62 cooperation agreements with research organizations in 19 countries during 2012, in addition to academic cooperation agreements with 23 universities. Furthermore, the National Space Organization has continued to support

the environmental monitoring and disaster relief efforts of international organizations such as Sentinel Asia with images from the FORMOSAT-2 satellite. The National Space Organization further allowed approximately 2,000 data users in 65 countries to freely access atmospheric and scientific data from the FORMOSAT-3 satellite constellation; these international outreach efforts have enhanced the value and international prestige of Taiwan's space program.

2. Support for the nation's scientific and technological development system:

The R&D service platforms established by NARLabs have achieved impressive results in the areas of R&D services and manpower training. For instance, in the field of electronics, information, and communications, NARLabs has helped academic researchers to perform chip design 2,307 times, and provided training to 8,655 semiconductor technology personnel needed by industry. In the field of biomedical technology, NARLabs has provided 160,190

high-quality, specific pathogen free laboratory rodents to users. In the earth sciences and environmental/disaster mitigation technology, the launch of the marine research vessel Ocean Researcher V on August 10, 2012 has fulfilled the president's vow to build a scientific research vessel in Taiwan, and will provide the country with cutting-edge oceanographic research and instrument technology services.

3. Operational reforms:

In order to realize effective performance evaluation, NARLabs has formulated performance indicators reflecting the different attributes of its research units, established a key performance indicator (KPI) information platform encompassing academic papers, patents, and R&D results at all NARLabs' laboratories, and strengthened supervisory and control mechanisms. At the same time, NARLabs has also completed the establishment of an online research result application platform that provides query services concerning various services and R&D results, including periodicals, academic papers, service items, publications, and transferable technology items, to users within NARLabs

and in society at large. Furthermore, all of NARLabs experimental research units passed the annual ISO 9001 and ISO 27001 certifications in 2012, and the number of specialized laboratory certification items at NARLabs units has reached 42. These achievements reveal that NARLabs' administrative system and information security management are fully consistent with international norms. To further enhance administrative efficiency, NARLabs will continue to establish and maintain information service systems in such areas as personnel affairs, purchasing, budget control, and planning evaluation.

In order to provide domestic scholars with world-class research platforms and ensure that research results provide real benefits for domestic society and industry, NARLabs has dedicated itself to establishing a full range of scientific research sites, integrating disaster forecasting and early warning technologies, building industry alliances, and nurturing innovative high-tech startups. The following is an overview of NARLabs' R&D directions in the three major areas of earth sciences & environmental/disaster mitigation technology; electronics, information, and communications; and biomedical technology:

I. Research and Service Achievements

Earth sciences and environmental/ disaster mitigation technology

Taiwan must face an even wider range of potential disasters than ever before because of its unique geographical environment and climate, the associated frequent natural disasters such as earthquakes, typhoons, and flooding, as well as torrential rains triggered by extreme climate. Addressing the diverse, complex natural disasters of the future, NARLabs has integrated Taiwan's environmental and disaster prevention observation platforms, and employed satellite remote sensing and weather observation, marine and underwater observation, earthquake engineering research, atmospheric hydrological modeling, and special sensing elements and instrument development technologies to develop environmental monitoring data collection and early warning systems that provide the government with assistance and support capabilities in decision-making and disaster prevention and relief. For instance, in 2012, NARLabs' has promoted the FORMOSAT-5 satellite mission, designed and

produced a satellite computer, developed a remote sensing imaging modules with high-resolution optics, used remote sensing data from the FORMOSAT-2 in land planning and natural disaster assessment, and used the FORMOSAT-3 weather satellite to perform space weather forecasting and research. Moreover, the operation of the new research vessel Ocean Researcher V will dramatically improve Taiwan's oceanographic observation and exploration capabilities. And in conjunction with key aspects of the Executive Yuan's "Disaster Prevention and Relief Technology Applications Program," NARLabs is actively promoting natural disaster prevention and mitigation applications aimed at earthquakes, typhoons, and flooding, etc., as well as structural seismic resistance and isolation applications, and is helping the government make a shift from traditional passive disaster relief to active early warning and response.

Seismic Evaluation and Retrofit of School Buildings

In the wake of the Chi-Chi earthquake in 1999, the National Center for Research on Earthquake Engineering (NCREE) has been researching and developing school building seismic evaluation and retrofit technology via laboratory structural experiments and the In Situ Experiment on Seismic Performance of School Buildings. Via a project office providing technical and administrative support, NCREE is also helping the Ministry of Education to audit

seismic retrofit measures on old school buildings at high schools, vocational high schools, junior high schools, and elementary schools nationwide. As of the end of 2012, seismic retrofit work has been completed in 2,201 school buildings, ensuring the safety of approximately 332,000 students and teachers, and making a significant contribution to the structural safety of school buildings in Taiwan.

On-site Earthquake Early Warning System

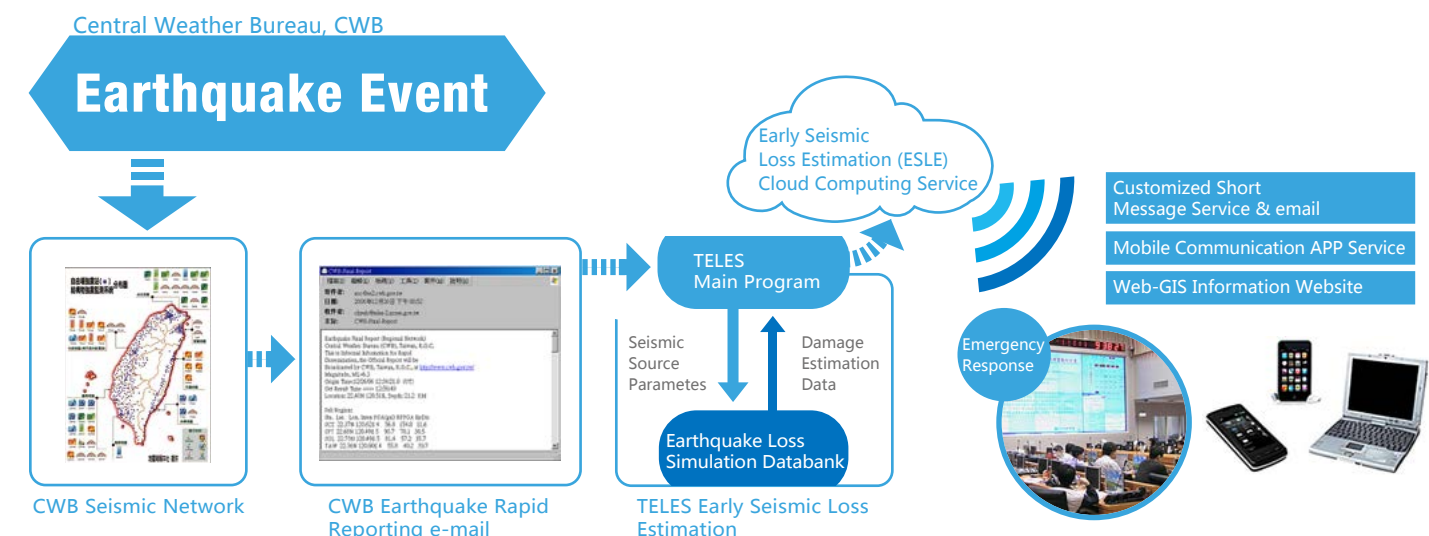
The On-site Earthquake Early Warning System developed by NCREE can provide early warning of earthquakes before they are felt. Taking the 1999 Chi-Chi earthquake as an example, residents of Taipei city could have received an early warning 27 seconds before the arrival of the first earthquake waves if this system had been available. When used in conjunction with intelligent control systems, the early warning system can enable the automatic shut-off of gas, stoppage of elevators, opening of emergency escape routes, and the activation of emergency direction

devices. This system has been tested using NCREE's triaxial shaking table, and is being used under real conditions on a trial basis at nine demonstration stations, including those located at Fanghe Junior High School in Taipei, Yilan Elementary School in Yilan, and the Hualien Railway Station, and has successfully performed the early warning function when actual earthquakes struck. The system is also being used together with school earthquake response drills, and extension and application will be accelerated in the future.

Taiwan Earthquake Loss Estimation System

The Taiwan Earthquake Loss Estimation System (TELES)—an earthquake damage simulation and evaluation program developed by NCREE—can notify relevant personnel via cell phone text messages, e-mail, or an online website of the scale and distribution of damage possibly caused by an earthquake within two minutes of receiving an earthquake report from the Central Weather Bureau. TELES can therefore provide

information to guide decisions when an earthquake first strikes and be used as a reference for emergency response measures. During ordinary times, it can also help disaster relief authorities and public and private enterprises to perform earthquake loss estimation, which can provide an important basis for the drafting of regional disaster mitigation plans, earthquake risk management strategies, and insurance rates.



Use of Welded End-Slot Buckling Restrained Braces

Buckling restrained braces are highly economical, high-performance energy dissipation devices



◆ Use of welded end-slot buckling restrained braces

that efficiently disperse seismic energy, improve the earthquake resistance of buildings, and also significantly reduce their swaying. The ends of the new welded end-slot buckling restrained braces, developed by the National Center for Research on Earthquake Engineering (NCREE), are welded directly to buildings, which enable the devices to dissipate earthquake energy all the more effectively. In addition, since the braces are made from steel and concrete, their manufacturing costs are low and installation relatively easy. As a result of their high economic value, welded end-slot buckling restrained braces are currently used in buildings throughout Taiwan.

Integration and application of disaster information

Due to Taiwan's unique geographical environment, it is highly vulnerable to natural disasters such as typhoons, torrential rains, debris flow, and earthquakes. As a consequence, one of the government's major administrative goals is to integrate the application of various types of disaster prevention information in order to enhance the country's ability to avoid and mitigate the effects of natural disasters. In line with its philosophy of "integration, service, sharing, and innovation," the National Science and Technology Center for Disaster Reduction (NCDR) in National Applied Research Laboratories helps the government

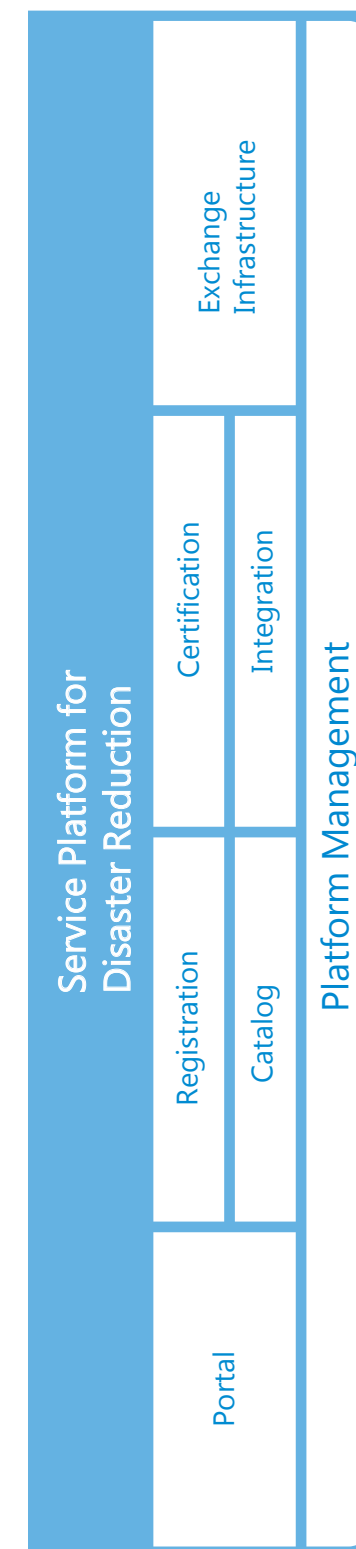
to integrate and analyze big data produced by various disaster prevention units, and transforms this data into different types of spatial and temporal images. The NCDR provides the resulting information to government disaster prevention and response units for use in routine disaster mitigation and readiness work, and decision-making and response tasks during actual disasters, via the "Emergency Operation Center Disaster Decision Support System"(EOCDSS) and "Local Emergency Operation Center Disaster Decision Support System."(L-EOCDSS)

Creation, update, and extension of disaster potential maps

The disaster potential maps produced by the NCDR in 2012 focus on vulnerability to natural disasters. These maps, specifically indicating where disasters (e.g. flooding, landslides) are likely to occur, not only depict the possible scope of the effects of disasters, but also note the locations of welfare organizations serving the elderly and disabled in units consisting of municipalities, counties, cities, towns, townships, and urban districts.

The 1,159 disaster potential maps include city- and county-level catastrophic rainfall threshold maps, flooding potential maps, and landslide and debris flow potential maps. Disaster potential maps provide basic information that can be used in disaster mitigation

and relief. For example, these maps can inform the public about areas with high disaster potential, and facilitate evacuation during the disaster relief process. The continuing compilation of disaster potential maps will enable the integration of various types of graphic data concerning disaster potential, which can be provided to the public via more diverse channels for use in value-added applications such as disaster readiness planning and disaster response uses. It will ultimately help to reduce losses of life and property due to natural disasters. The NCDR has established a webpage providing online service queries (<http://satis.ncdr.nat.gov.tw/Dmap>).



Application of Big Data Integration for Disaster Reduction

Service Action Disaster Response Decision support system



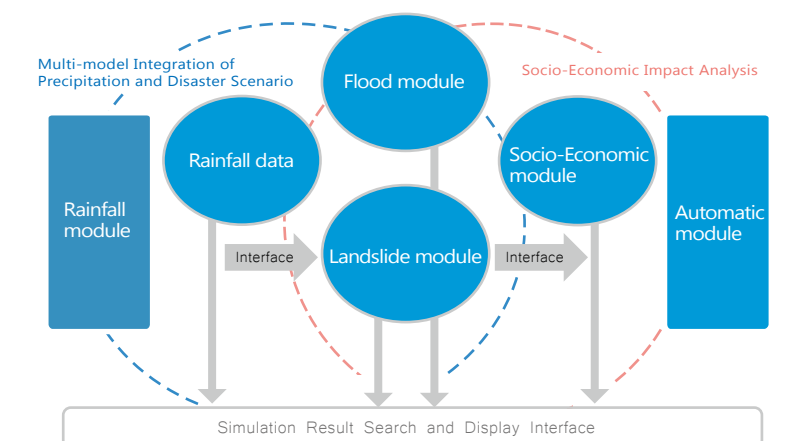
Provide a common operation map for central and local governments.



Information 5W(Who When Where What How)



Provide early warning information.



Database Basic / Monitoring / Losses / Remote sensing



- ◆ Integrate more than 20 government agencies.
- ◆ Maintain more than 120 datasets.
- ◆ Interface more than 50 different kinds of data.

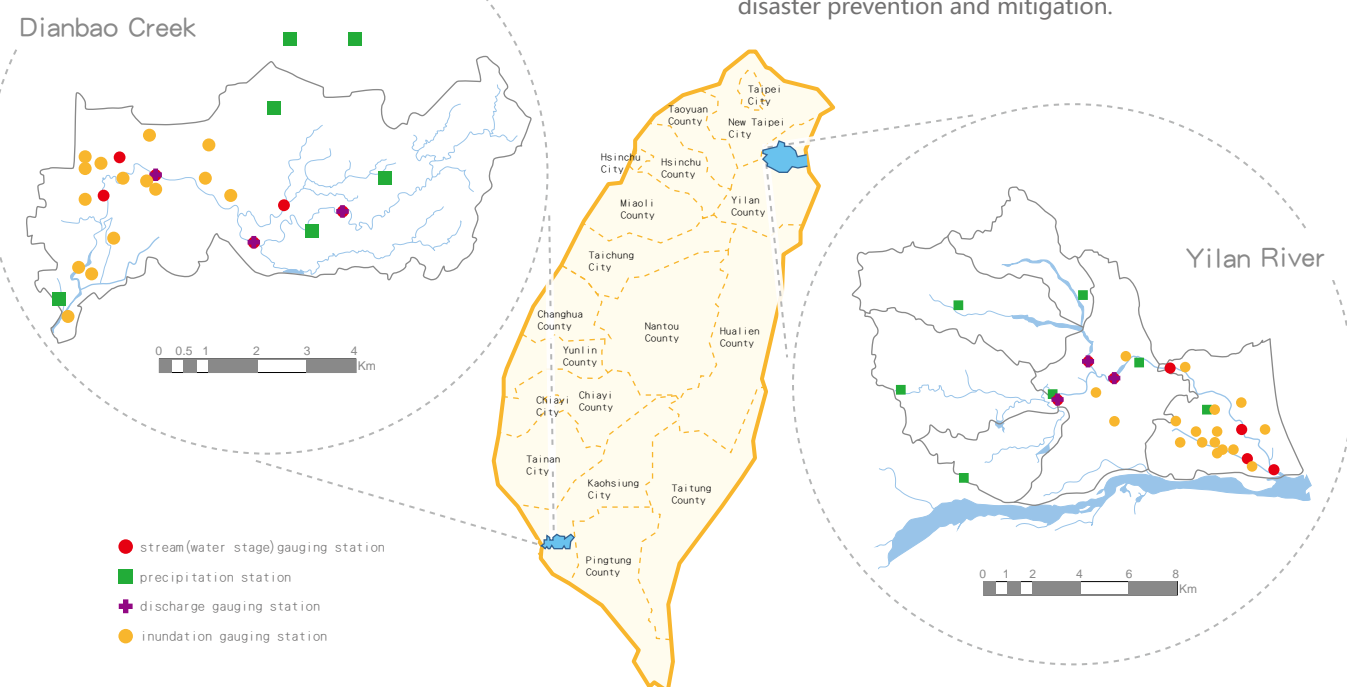


Data Sensor network / historic data

Establishment of experimental watersheds

The Taiwan Typhoon and Flood Research Institute (TTFRI) and Water Resources Agency, MOEA have collaborated to establish Taiwan's first experimental watersheds for the purpose of disaster prevention and mitigation. These experimental watersheds will be used for the long-term, full-scale monitoring, collection, and analysis of hydrologic and geographic data, which will provide localized basic research data that

can be used by academic researchers to perform watershed hydrological modeling research and verification. A total of 53 automated hydrological monitoring stations have been established along the Yilan river and Dianbao creek in 2012, and hydrologic monitoring data have been collected for three typhoon flooding events. TTFRI will continue collecting these monitoring data, which will facilitate the development of localized high-performance flood warning techniques and effective watershed management for disaster prevention and mitigation.



◆ Location of Taiwan's first disaster prevention experimental watersheds.

Disaster response and intelligence assessment

In conjunction with the establishment of the Central Emergency Operation Center (CEOC), National Science and Technology Center for Disaster Reduction (NCDR) supports the command intelligence and judgment section by providing early warning information needed in response work and decision-making. In order to reduce forecasting uncertainty and enhance forecasting confidence, NCDR integrates several disaster early warning models via a forecasting score

system, where a higher number of points indicates a greater risk of disaster.

The operating interface can integrate the multiple-model result in the landslide and flooding early warning modules, such as integrated score charts and alert area maps. It can also automatically produce briefing files for staff to use in disaster response work.



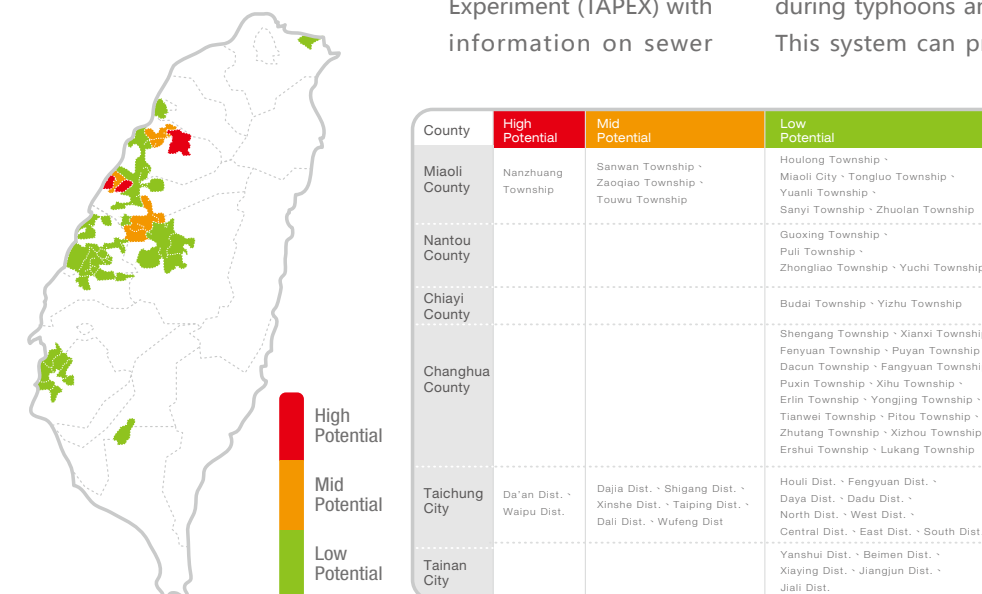
◆ Photo at Central Emergency Operation Center during Typhoon TEMBIN in August, 2012

Development of an efficient technique for urban inundation evaluation by using quantitative precipitation ensemble forecast

To enhance the value of early warning information on flooding, TTFRI has integrated the existing Taiwan Quantitative Precipitation Ensemble Forecast Experiment (TAPEX) with information on sewer

system design standards in Taiwan's urban areas to develop an efficient assessment technology capable of determining the flooding potential of urban areas during typhoons and periods of extremely heavy rain. This system can provide assessment results in real-

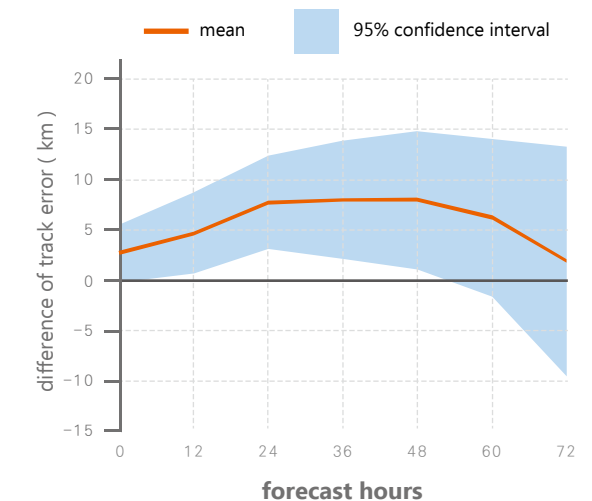
time to relevant disaster prevention units via the Internet, allowing decision-makers to make disaster relief preparations (such as deployment of pumps and disaster relief personnel, and evacuation of the public from areas with high flooding potential), and helping to reduce property losses, deaths, and injuries.



◆ The urban inundation evaluation system.

Use of FORMOSAT-3 GPS occultation data to improve severe weather forecasts

Typhoons typically form far out in the vast expanse of the Pacific Ocean before making landfall in Taiwan, and the lack of meteorological observation data for the Pacific Ocean severely affects the accuracy of typhoon forecasts. TTFRI has developed new GPS occultation data quality testing and application processes for the numerical modeling data assimilation system used by operational units so that the data from the FORMOSAT-3 satellite can be used to improve the forecasting ability of the Severe Weather System. Using occultation data from the FORMOSAT-3 can reduce typhoon track forecasting error, and the improvement is most evident when significant turnings occur in the typhoon track or the steering flow is unclear. In summary, depending on the data assimilation strategy, the assimilation of FORMOSAT-3 GPS occultation data can reduce the 72-hour typhoon track forecasting error by approximately 5-10%. This improvement in forecasting can help to determine at an earlier time the possible locations and times of a typhoon's severe wind and rain.



◆ Reduction in forecast track error at different times for 11 typhoons affecting Taiwan during the period of 2008-2011; the blue line represents the average results of 236 forecasts, and the shaded area represents the 95% confidence interval.

A powerful new marine exploration tool- Ocean Researcher V

The Ocean Researcher V, a 2,700-ton marine research vessel, was formally commissioned on August 10, 2012. The Taiwan Ocean Research Institute (TORI) bears responsibility for the use and operation of this vessel, which will tremendously broaden the scope of Taiwan's oceanography research.

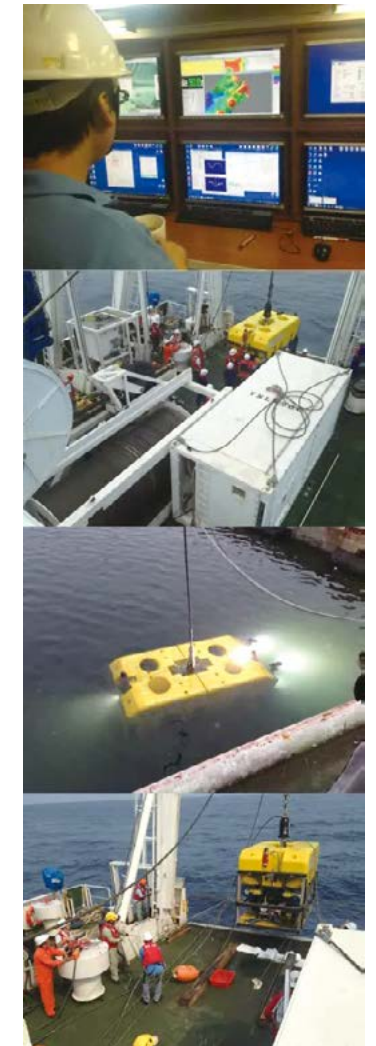
The Ocean Researcher V is equipped with many types of advanced high-tech equipment and is expected to greatly enhance Taiwan's marine research and survey capabilities; it will unravel the mysteries of the sea, perform cutting edge scientific research, and perform marine resource and conservation surveys. By enabling the creation of marine databases supporting the nation's efforts to conserve and sustainably utilize marine resources, this vessel will offer Taiwan's ocean science and technology research a way to leap ahead.



◆ Research vessel, Ocean Researcher V

Sea trial of an underwater ROV, the demonstration of deep-sea exploration capabilities

Taiwan's remotely operated vehicle (ROV), which is capable of operating at a depth of 3,000 m and in up to 3 knots of current, is mounted with nimble manipulators and high-resolution cameras for sampling and investigating in the deep-sea. In November 2012, the first ROV technology team in Taiwan successfully completed its maiden sea trial, which demonstrates the deep-sea investigation capacity of Taiwan. TORI will keep training and enhancing the ROV exploration capacity to provide better service in underwater geology and marine energy investigation, marine biology observation, and marine specimen collection.



◆ ROV sea trial

Bringing ocean education to Taiwan

In order to promote ocean science education, in 2012, TORI held the "Elementary School and Junior High School Welcoming 2020 Science Challenge and Exploration Program" in conjunction with Taipei Municipal University of Education, and conducted two sessions of the "2012 National Earth Science Teacher Professional Growth Workshop" with the Earth Basic Science Education Resource Center at Kaohsiung Women's High School.

TORI endeavors to present the usage of oceanographic instruments and their scientific method in a lively and easy-to-understand manner for these 120 participants, consisting mostly of elementary and middle school students, and high school earth science teachers, and furthermore, to demonstrate the value of the far-ranging marine science and its relevant topics.



◆ "The beauty of shell architecture"—Observing foraminifera fossils

FORMOSAT-5 On-Board Computer

The On-Board Computer (OBC) is based on the FORMOSAT-5 program that integrates NSPO's expertise in various essential engineering disciplines including Electrical, Mechanical, Product Assurance, Thermal Control, and Integration and Test. OBC is manufactured in cooperation with the specialized capability of Chung-Shan Institute of Science and Technology (CSIST). NSPO and CSIST have conducted more than 150 technical reviews, implemented 200 key item design improvements, and overcome numerous design obstacles to complete the OBC project in less than two years. The success of the FORMOSAT-5 OBC demonstrates full domestic capability to develop a high-end computer system that not only overcomes the increasing level of space technology transfers from major space nations, but also gradually pursues the national goal of a complete self reliant development of space technology in Taiwan.



◆ First indigenous satellite On-Board Computer in Taiwan

Remote Sensing Instrument Structure

FORMOSAT-5 Remote Sensing Instrument (RSI) requires customized light-weight, high-strength, and high-stability structure for space application. To meet these specific needs, the space-grade, low-hygroscopic, high-strength, carbon fiber composite material is utilized for the RSI structure. Upon delivery of the RSI structure in June 2012 by Aerospace Industrial Development Corporation (AIDC), NSPO has conducted the required verification testing that include the dynamic structural characteristic verification, sinusoidal vibration test, and random vibration test. The test results indicate that the design, manufacturing, and the I&T capability have fully met the requirements for space application. The success of the RSI structure demonstrate that NSPO along with the AIDC and other



◆ FORMOSAT-5 Remote Sensing Instrument structure

domestic partners are capable of producing an RSI structure that meets the needs for the high-resolution remote sensing payload.

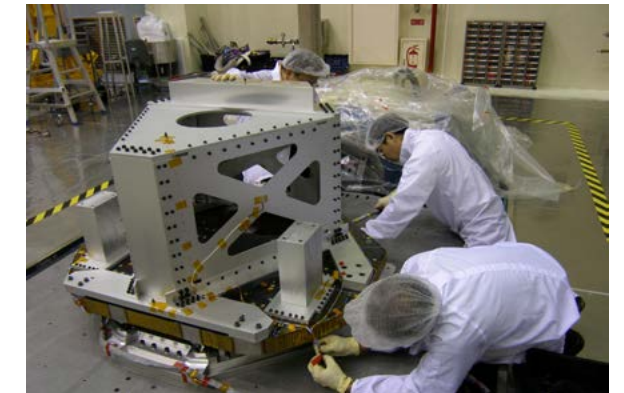
Satellite Operation System

Satellite Operation System is the core of the satellite mission control that comprises functions of satellite commanding, telemetry receiving, and satellite status monitoring, etc. The Satellite Operation and Control Center (SOCC) has successfully completed FORMOSAT-1, -2, and -3 missions and has established an integrated operation system capable of conducting multiple missions and developed self reliant capability for satellite operation and control software. In recent years, NSPO in cooperation with domestic research institutes, industries, and academia has accomplished

the development of the Cross Platform Satellite Operation Control (XPSOC) system. The XPSOC has enhanced the autonomy of commanding and receiving functions, supported various window browser systems, and is able to link to many mobile devices for easy access to monitor spacecraft state of health. The successful implementation of the XPSOC exhibits the advancements that Taiwan has made in developing a large-scale software system for satellite operation and control in the space industry.

Certification of NSPO Vibration Testing Laboratory

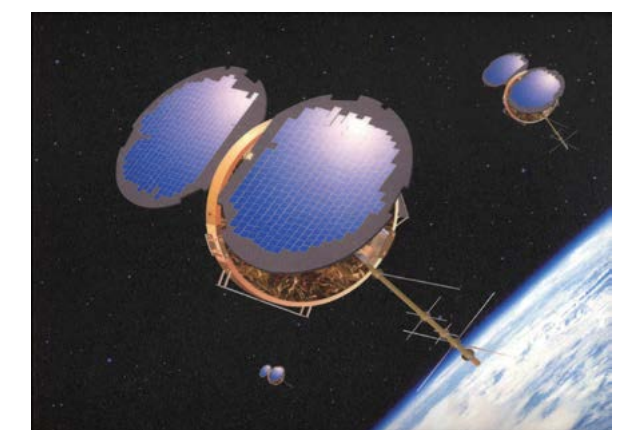
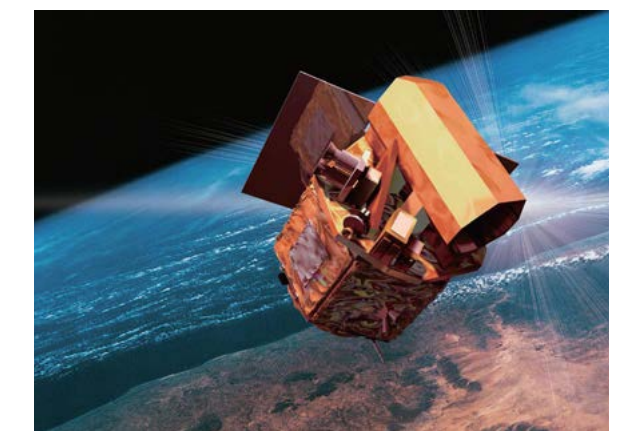
On October 23, 2012, the Taiwan Accreditation Foundation (TAF) certified that NSPO Vibration Test Laboratory has met the ISO-18025:2005 requirements. The certification for the space-grade application on spacecraft bus, payloads, and all other related complements and/or subsystems is based on all applicable ISO-18025 standards for test laboratory implementation, operating procedures, and the evidence of the operators' technical knowledge base and training records. The NSPO Vibration Test Laboratory is not only able to support NSPO's own space programs, but also able to extend the service with a high level of confidence to external institutes or industries for the required sinusoidal and random vibration test needs.



◆ Vibration testing installation tasks

Satellite Image and GPS-RO Data Services

FORMOSAT-2 is a remote sensing satellite that takes daily earth image data at 2-meter resolution in black & white and 8-meter resolution in color. The accumulated earth image data coverage since the FORMOSAT-2 satellite launch in May 2004 has mapped the entire Taiwan over 26,527 times or equivalent to over 6 times of the total earth land-mass. In 2012 alone, the FORMOSAT-2 image data has supported 39 global major disaster events, supplied valuable data to 140 institutes and 151 Taiwan government agencies for advanced spatial planning, natural disaster assessment, and the related restoration planning. FORMOSAT-2 has clearly exhibited its importance in earth observations for Taiwan and international society. FORMOSAT-3, comprised of 6 small satellites, is a global constellation observation system that provides GPS – Radio Occultation (GPS-RO) sounding data for weather forecast, climate monitoring, and space weather observations. The GPS-RO data have demonstrated their value for operational weather forecasting, hurricane forecasting, climate studies using its unprecedented accuracy, diurnal sampling coverage, and space weather monitoring. The data user community that has benefited from the GPS-RO data has expanded to over 2,000 registered users, including all major weather forecast centers in 65 countries.

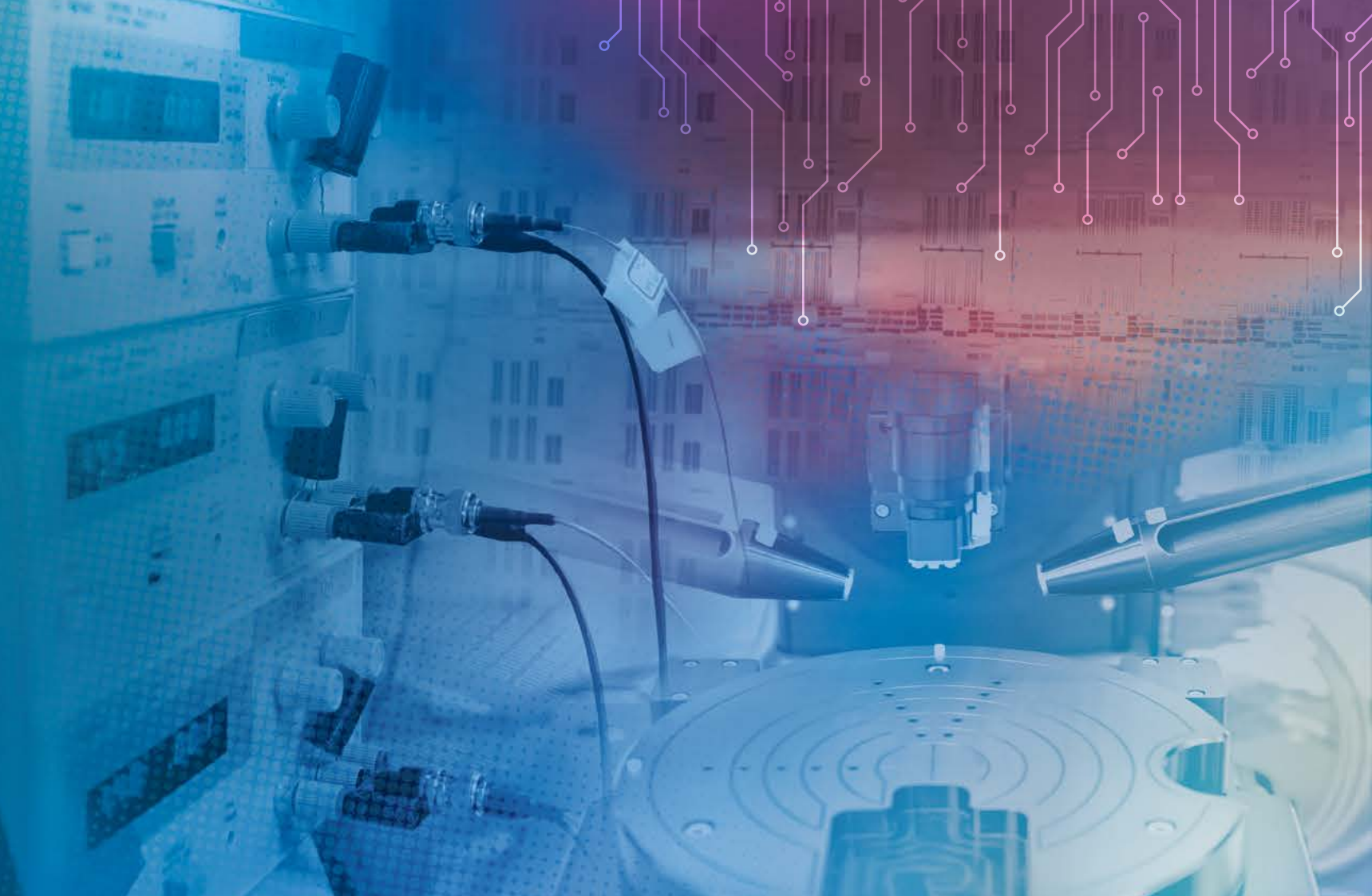


◆ Simulation of FORMOSAT-2 and FORMOSAT-3 satellites in orbit

Electronics, information, and communications

The electronics, information, and communications industries are among Taiwan's most important basic industries, and have been the main drivers of economic growth in Taiwan during the past several decades. NARLabs is taking advantage of Taiwan's strengths as it vigorously develops technologies needed to the intelligent lifestyles of the future, and is helping to create platforms needed for R&D in such areas as sensing elements, systems integration, networks, and cloud computing. Some specific efforts include the establishment of national high-speed joint-use computing and network platforms meeting researchers' high-speed computing needs and providing a "big data" service cloud computing environment; development of a chip system design and verification platform enabling the rapid integration of different chips, and shortening next-generation intelligent electronics system development time and cost; and establishment of the sole domestic experimental environment

encompassing all nanometer element processes and providing fabrication, technology, and R&D services to users in the fields of energy, micro-electromechanical systems, and biomedicine. In conjunction with the "National Program for Intelligent Electronics," NARLabs has introduced the "MG+4C" intelligent chip design and systems integration applications platform in 2012, and is continuing development of a 15-nm element technology R&D platform, organizing a nanometer element industry-academic alliance, and has embarked on research and development of key technologies and accumulation of patent portfolios. Furthermore, NARLabs is developing the Formosa series of cluster computers, cooperating with industry to establish autonomous domestic cloud technologies and applications, and promoting the development of opto-electromechanical precision instrument technology.



Deployment and Performance Tuning of the Formosa 5 Cloud Computing Platform

The Formosa series supercomputers developed by the National Center for High-Performance Computing (NCHC) have been ranked among the world's top 500 supercomputers (TOP500) since 2003. Thanks to its powerful computing capabilities driven by its graphics processing unit (GPU) cluster system and its use of stable system performance tuning technology, the new-generation Formosa 5 cluster computer, which went on line in 2012, attained a high rank of 232nd on the 39th TOP500 and an outstanding 62nd on the Green500 announced in June, 2012. The Formosa 5 also embodies many innovative breakthroughs, including a GPU computing structure achieving an optimal computing performance (Rmax) of 89.94 TFLOPS and an efficiency of 58%, ranking it third among supercomputers with the same hardware architecture. The Formosa 5 is designed to greatly reduce deployment costs and enhance energy efficiency. Using the experience it gained from building

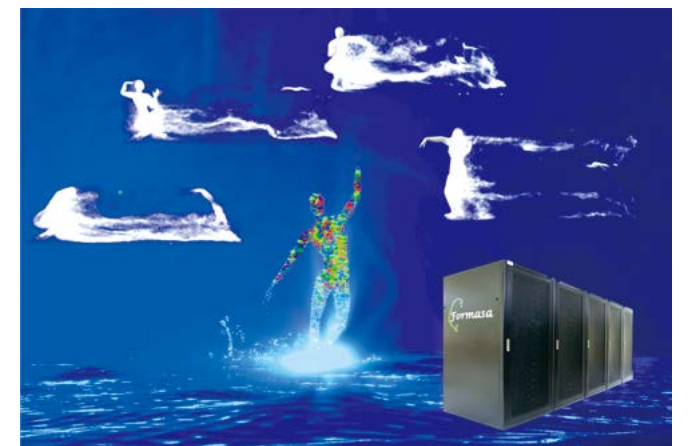
Formosa 5, the NCHC will transfer its technology in performance tuning and optimization for GPU clusters in order to disseminate high-end cluster technology in Taiwan.



◆ Located at NCHC's Tainan branch, the Formosa 5 cluster computer was ranked 232nd in the 39th supercomputer TOP500 announced on June 18th, 2012.

Taiwan's First Render Farm

NCHC has established Taiwan's first "Render Farm," a cloud computing service that aims to facilitate the cultural creative industry by seamless synergy of supercomputers and animation software, allowing creative professionals to produce vivid 3D characters, special visual effects, and scenes through Internet access. This technology has been successfully used in works including The 3rd Vision Films' "Ripples of Desire," StarQ's and Kentadip's "Tai-Chi Star Cat," and TWR Entertainment's "Hatching," which was a finalist at the SIGGRAPH 2012 computer animation festival. The Render Farm offers sufficient computing power to shorten the time required to complete a 3-minute animation from the one month needed by traditional desktop computers to only roughly one week. As a result, this cloud computing service can dramatically reduce the financial and technological thresholds needed to produce animation movies, and can accelerate the development of Taiwan's soft power on motion picture animation industry.



◆ Taiwan's first Render Farm: Helping the cultural creativity industry to save time and improve motion picture animation.

Cloud Middleware

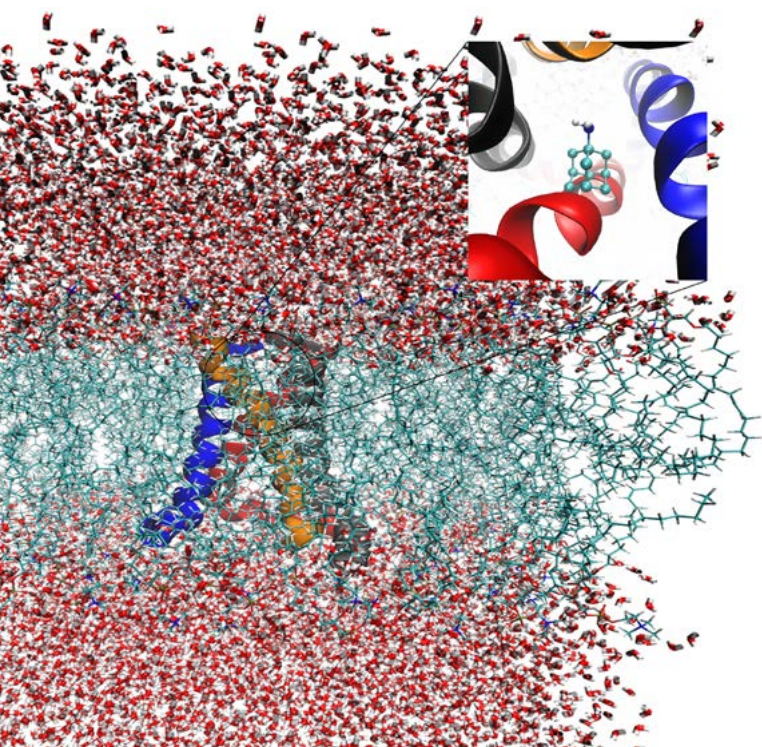


◆ The international acclaim received by Clonezilla has demonstrated Taiwan's soft power.

In recent years, cloud computing has been increasingly recognized as a pivotal technological trend that will play out over the next five to ten years. NCHC has developed many cloud-related programs, including Ezilla, Crawlzilla, Haduzilla, DRBL, and Clonezilla. Among these, Clonezilla has been downloaded more than 6.7 million times in over 80 countries with multi-language versions. It offers high operating efficiency, low hardware requirements, free installation or rack servers, and can be used immediately by employing bootable media. Apart from such tributes as being named "One of the Best Free Software" two years in a row by PC Magazine, Clonezilla received numerous honors and awards including the title of "Best Free System Restore Tool" given by the prominent US software intelligence website "Lifehacker" in 2012. Not only has Clonezilla significantly simplified the complexity of cloud deployment, but it has also enhanced Taiwan's global visibility in the development of free and open source software.

Development of Molecular Dynamics Simulation Software

Scientific discoveries and technological breakthroughs depend on theory, experimentation, and modeling. Nowadays, growing attention is being paid to the role of computer simulations in science. The molecular dynamics simulation software technology service platform developed by NCHC aims to provide unique services for Taiwan's academic and research communities to solve complex problems in the realms of materials science, physics, chemistry, and biology. This service platform offers molecular dynamic simulation tools such as molecular potential libraries and customized force field modules, enabling users to perform high-speed computation in solving demanding science and engineering problems. The service platform has been applied to the investigation of such topics as metallic glass alloys, the transmembrane protein of the SARS virus, and scientific explorations. This technology platform can not only help add value in new-generation high-tech industries, but also offers even greater future development potential.



◆ The development of molecular dynamics simulation software service platform helps solve complex problems in the realms of materials science, physics, chemistry, and biology.

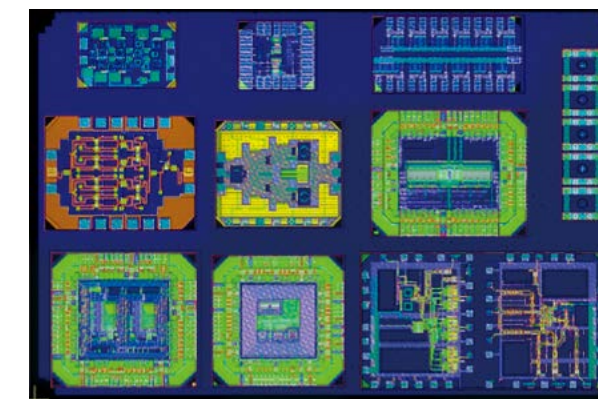
Establishing and Providing IC/System Design Environment

The National Chip Implementation Center (CIC) has acquired many of the electronic design automation (EDA) tools, standard cell libraries, IPs, and chip system platforms currently used by industry, and has established and integrated comprehensive chip design processes; these processes are provided via a resource sharing approach to academia in Taiwan engaging in advanced chip system design R&D. In

order to enhance service quality and performance, CIC uses a single-window service model to provide design consulting services, and helps users to resolve hardware and software usage problems. In 2012, CIC offered 92 EDA tools from 21 vendors, and completed 2,274 design consulting applications from 422 professors of 70 universities.

Advanced Chip Fabrication Service

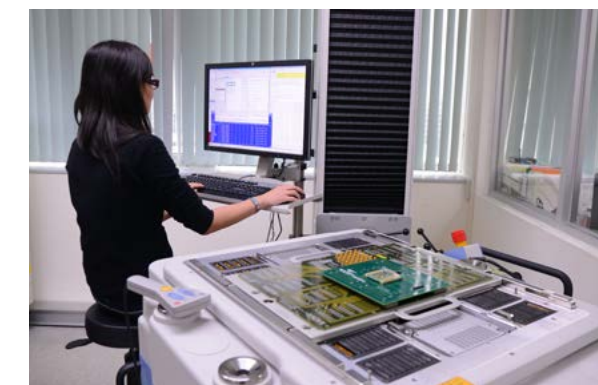
CIC provides chip fabrication services involving 12 processes to academia in Taiwan. Process types include mainstream 0.35 μ m and 0.18 μ m CMOS processes, special-application BiCMOS and pHEMT processes, and MEMS, BioMEMS, IPD, and high-voltage processes used in heterogeneous system integration. These services meet the forward-looking chip implementation, patent development, and product prototype realization needs of academia, and CIC has helped academia to complete more than 1,600 chip design fabrication cases in 2012. In addition, CIC has also continued to provide world-class mass production-type CMOS process services to university researchers, and is one of a small number of organizations worldwide able to provide the TSMC 40nm CMOS process.



◆ Layout of TSMC 40nm chip

Establishing and Providing chip measurement service

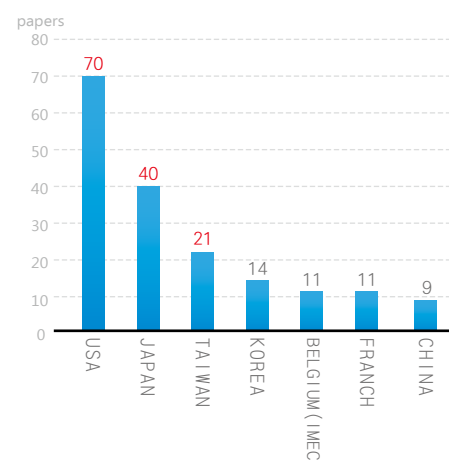
CIC introduced The Advantest V93000 PS1600 automatic testing system in 2012 which provides a faster testing environment for chips with a greater number of feet. This system offers 512 digital channels, can achieve speeds of 1600/533/200Mbps, and provides high-resolution, high-speed signal sources and measurement terminals for use in analog measurements. The system enables academic researchers to perform digital and mixed signal system chip testing, debugging, and performance analyzing. Over 180 chip testing cases were completed in 2012.



◆ Advantest V93000 PS1600 Automatic Test System

Participation at IEDM

◆ Top-seven countries of mos selected IEDM papers



The IEEE International Electron Devices Meeting (IEDM) is the world's most important semiconductor element conference, and is often considered the "Olympics of microelectronic elements." A total of 21 papers from Taiwan were chosen for presentation (10% of the total) at the 2012 IEDM, including five each from the National Nano Device Laboratories (NDL) and Macronix, four each from TSMC and National Chiao Tung University, and one each from the Industrial Technology Research Institute, National Taiwan University, and National Tsinghua University. Among the topics of the selected papers on memory, the "Sub-10 nm Resistive Memory" forward-looking research project being conducted by NDL together with Macronix and National Chiao Tung University, with support from the National Science and Technology Program in Nanotechnology, is expected to lay a solid foundation for memory research cooperation between industry, academia, and research organizations as the semiconductor industry enters the 10 nm era.

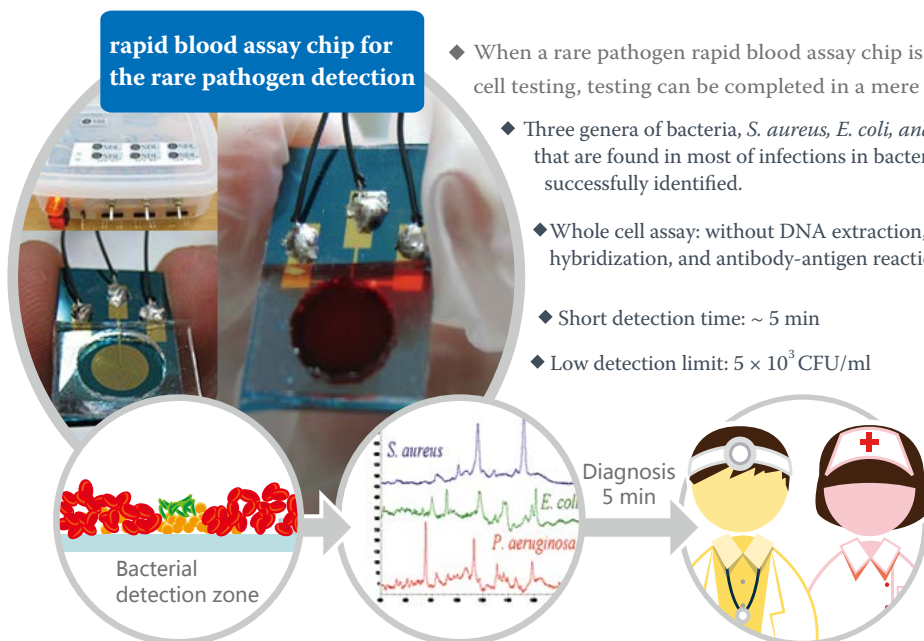
A nano-biomedical diagnosis chip: Achieving fast detection of pathogen

The "rapid blood assay chip for the rare pathogen detection" developed at NDL requires only 5 minutes to perform whole cell detection for microbial pathogens, while also eliminating the need for time-consuming and costly processes such as antibody modification, biochemical reactions, or the rupturing of cells to perform DNA identification. Simplifying the traditionally complicated processes, the chip requires only a small voltage source to isolate and concentrate the target pathogens (in approximately 3 minutes), producing a high-density clump of bacteria. It then takes a "spectral fingerprint" of the target bacteria and performs comparative identification (in less

than 2 minutes). The whole detection process is thus completed in less than 5 minutes. Following successful testing, the chip has been shown to distinguish three of the most common types of bacteria causing bacteremia and septicemia (*Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *E. coli*) based on their detected spectral fingerprints. Effective detection can be performed as long as each milliliter of blood contains several thousand bacteria. The R&D team in this project won the 9th National Innovation Award in the category of academic research for this groundbreaking device.

rapid blood assay chip for
the rare pathogen detection

- ◆ When a rare pathogen rapid blood assay chip is used to perform whole cell testing, testing can be completed in a mere 5 minutes.
- ◆ Three genera of bacteria, *S. aureus*, *E. coli*, and *P. aeruginosa* that are found in most of infections in bacteremia were successfully identified.
- ◆ Whole cell assay: without DNA extraction, amplification, hybridization, and antibody-antigen reaction
- ◆ Short detection time: ~ 5 min
- ◆ Low detection limit: 5×10^3 CFU/ml



Environmentally-friendly solar cell technology

A nontoxic no-cadmium copper indium gallium selenium (CIGS) thin-film solar cell developed at NDL features environmentally-friendly technology (3D⁺ Optoelectronic Elements, published in 2012 IEDM "Novel Hybrid CIS/Si Near-IR Sensor and 16% PV Energy-Harvesting Technology"). NDL is currently cooperating closely with academic and industry

partners including National Taiwan University, National Tsinghua University, and AU Optronics to continue the development of these solar cells. Operating a consortium servicing CIGS-PV equipment/material vendors, PV manufacturers and research teams will be our main mission.

Monolithic 3D⁺ ICs

Monolithic 3D⁺ ICs will potentially offer the advantages of reduced chip area, high speed, high density, low power consumption, lower cost, and better integration of heterogeneous structures. Researchers at NDL have used cutting-edge low thermal-budget thin film technologies including low-defect plasma films and green-light nanosecond laser

spike annealing to demonstrate a novel 3D NVM/CMOS Hybrid Chip. The team's R&D results were recognized at the IEEE International Electron Devices Meeting (IEDM). (3D⁺ Electronic Elements, published in 2012 IEDM "3D Ferroelectric-like NVM/CMOS Hybrid Chip by sub-400°C Sequential Layered Integration")

New breakthroughs in triangular germanium fin transistors

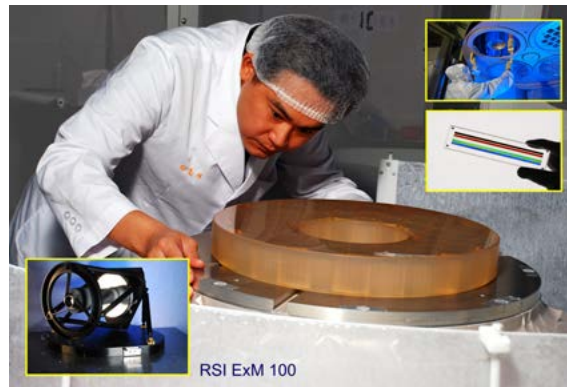
Researchers at NDL have used high-speed germanium to more than double chip processing speed (the "111" face was used to increase the current by a factor of over two). This breakthrough is expected to greatly benefit 3C products. The NDL

team uses selective etching to achieve nearly defect-free germanium channels, which is used to fabricate a triangular Ge gate-all-around (GAA) FinFET on a SOI substrate. The resulting new triangular structure can boost the current in an n-type germanium device.



Taiwan's breakthrough in large-aperture aspherical lens technology

The larger the aperture of a lens, the higher the resolution, and the farther and clearer it reaches. Large-aperture aspherical lenses are widely used



◆ The first meter-scale aspheric mirrors ever made autonomously in Taiwan, and the first fully self-made satellite optical remote sensing payload experiment assembly (inset).

in precision measurement and processing equipment, astronomical telescopes, satellite remote sensing payloads, and precision microlithography equipment. The Instrument Technology Research Center (ITRC) has established standard operating procedures for meter-scale (1,000 mm) mirrors fabrication and coating processes, and has successfully produced high-accuracy aspherical lenses with a surface error of less than 1 part in 100 million. This groundbreaking accomplishment benefits the industry of Taiwan in precision measurement and processing equipment, and helps encourage the establishment of its own systems, progressively building up its capability. It is expected to be able to gaze directly at the landscape in southern Taiwan from the north through large-aperture aspherical lenses in the near future.

Atomic layer deposition system (ALD) developed 100% in Taiwan

How can we arrange atoms in a line? How can we create structures like the scales on a butterfly's wings? One powerful tool for creating these kinds of microstructures is an atomic layer deposition (ALD) system. ITRC has been developing ALD technology since 2003, and has already created an ALD system capable of producing high-quality nitrogen oxide film and metal nanometer particles. Its technology is on a par with the most advanced systems in

other countries; it can control the thickness of thin film within the height of a single atom (0.1 nm), and will provide the industry and the academia with a means of producing next-generation nanometer elements. ITRC has also established a domestic ALD equipment platform and materials supply chain, and its R&D team involved in this project has won the 2012 Microsystem and Nanotechnology Industry Contribution Award.

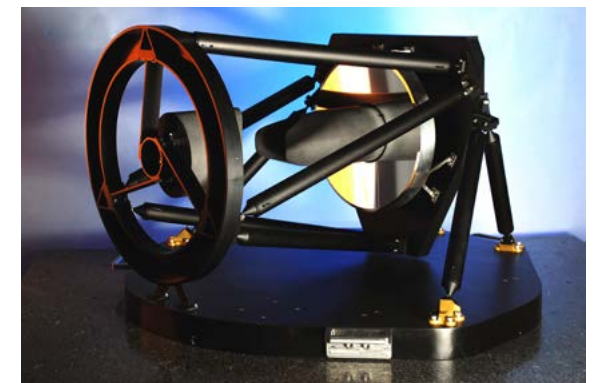


◆ Development of Atomic Layer Deposition System at ITRC

Taiwan's first self-made satellite remote sensing instrument

How do satellites see the earth from outer space? What is a satellite eye? The answer is a space camera, which is also termed as an optical remote sensing instrument (RSI). ITRC has been participating in the FORMOSAT-1 and FORMOSAT-2 projects throughout the recent decade, and has developed considerable expertise in airborne optical remote sensing instrument technology. Starting in 2008, ITRC has also been taking part in the FORMOSAT-5 remote sensing instrument project. Apart from being light weight, a satellite eye must be able to withstand the intense vibration during launch and the high-energy radiation in space. In addition, in spite of the tremendous temperature swings in space, the instrument's temperature must be allowed to maintain no more than 4° C. Only an instrument that can overcome these challenges is capable of capturing clear images and

transmitting them to the ground. The FORMOSAT-5 satellite's remote sensing instrument is currently in the assembly stage, and the satellite is scheduled to be launched in 2015.



◆ Remote Sensing Instrument Experiment Model 100

Build up Design of indicators for assessing the impact of academic knowledge on innovative applications

The intellectual property citation index (IPCI) is a means of calculating and analyzing the number of times an academic or reference paper is cited in patents approved by the US Patent and Trademark Office. The IPCI is used to assess the impact of an academic research organization's innovative research results or a paper from a specific periodical on R&D. A major trend in today's knowledge economy age is the use of academic research results to benefit industry,

the economy, and society. While the existing SCI/SSCI periodical impact factor is only able to assess the academic influence of specific papers in the literature, the IPCI can further express the degree to which academic research impacts technology/industry, which makes it even more suitable for the needs of the current time. Since this index was proposed, it has been recognized and adopted by numerous prominent foreign universities.

Establishment of a fast, integrated patent retrieval and analysis platform—Patent and Paper Search (PP Search)

A comprehensive and fast method of analyzing reference information can be a powerful tool for enhancing the quality of science and technology decision-making and responding to the fast-changing world situation. In order to achieve this goal, the Science & Technology Policy Research and Information Center (STPI) has gathered and integrated patent and periodical information, and established a "patent retrieval and analysis platform" based on many years of research and development. The integration of retrieval with functions such as statistical analysis of

basic indicators, and use of an intuitive and easy-to-use operating interface, ensures that the system can quickly provide information such as priority rights, patent families, analysis citing/cited, assignment information, and international cooperation. This can greatly shorten the time needed to obtain and analyze decision-making reference information concerning patents and periodical articles, while effectively enhancing the integrity and precision of information analysis.

Biomedical technology

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the academic influence of specific papers in the literature, the IPCI can further express the degree to which academic research impacts technology/industry, which makes it even more suitable for the needs of the current time. Since this index was proposed, it has been recognized and adopted by numerous prominent foreign universities.

Completion of a global portfolio of genetically modified rodent resources

Genetically modified (GM) rodents are essential tools for connecting R&D to clinical applications; they are key resources for strengthening the bond between R&D results and industry. The National Laboratory Animal Center (NLAC)'s Rodent Model Resource Center (RMRC) has been part of the world's major rodent repositories since 2006. Through rodent resource deposits, sharing, and distribution, other than sustainably preserving Taiwan's valuable R&D results,

RMRC also employs cryopreservation and resource sharing to reduce laboratory animal use and maximize the application of the rodent use. NLAC has completed a portfolio of GM rodent resources in 2012, and has connected to the world-class repository database containing more than 23,000 strains GM rodents and over 200,000 strains of embryonic stem cells (ES cells) from GM mouse embryo. As a result, NLAC provides local researchers with abundant GM rodent resources.

Total **22** repositories > 23,000 genetically modified mouse strains
> 200,000 embryonic stem cell lines

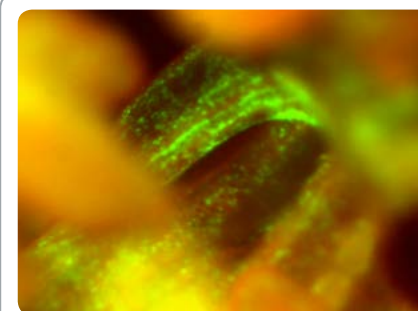
◆ LAC has completed a portfolio of GM rodent resources, and helps local researchers to acquire GM rodents from around the world. At the same time, NLAC presents strains developed in Taiwan on the international stage, which increases the visibility of the local R&D capabilities and provides more opportunities for international collaboration.

Twelve GM mouse strains developed

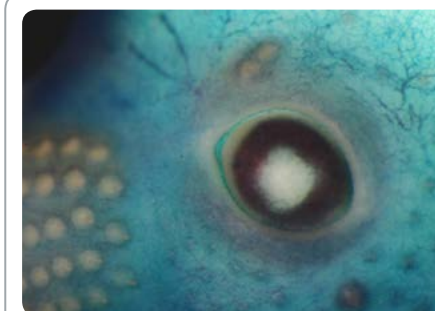
Based on a nationwide demand survey, NLAC's genetic modification (GM) technology team supports local biomedical R&D needs by developing clinically important animal models using transgenic technology. During 2012, NLAC has developed five conditional knock-out mouse strains, two controllable Cre tool mouse strains, three transgenic rat strains, and two fluorescent mouse strains. NLAC has also employed

its unique bacterial artificial chromosome (BAC) large-fragment genetic design and construction technology to accelerate the development of high application value GM rodents in Taiwan; as a result, the quantity and quality of GM rodents for local researchers are improved, the translational medicine R&D power is enhanced, and the biomedical development is accelerated.

◆ NLAC successfully developed BAC Cre tool mouse, which shows vascular endothelial cell-specific expression when it is induced by drugs; it may be useful for cancer research:



◆ Tek-Cre mouse expresses Cre protein in blood vessels of the umbilical cord (using a fluorescent Cre reporter).

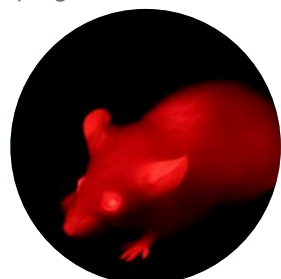


◆ Tek-Cre mouse expresses Cre protein in capillaries of the skin and eyes (using a LacZ Cre reporter).

Providing new and diverse laboratory rodent resources

The fast advancing biomedical research and pharmaceutical R&D increases the demand for mouse models and tool mice year by year. Other than supplying general strains, NLAC has also started to provide diverse laboratory rodent resources, including old age, pregnant, and GM rodents to fulfill the needs of the biomedical field. NLAC currently provides four old age mouse strains and two strains for various ages of pregnant mice and nursing pups (including the

nursing mothers). NLAC raises, breeds and reproduce those special rodents, so that researchers may focus on their innovative studies without worrying about the animal breeding space and animal caring personnel. At the same time, NLAC provides more useful laboratory animal resources by developing innovative models of germfree mice with inducible human inflammatory bowel disease, GM mice, fluorescent mice, and Cre mice.



Red fluorescent mouse
(BALB/c strain)



Blue fluorescent mouse
(BALB/c strain)



Green fluorescent mouse
(BALB/c strain)



Green fluorescent mouse
(BALB/c nude mouse)

◆ The fluorescent mice developed in-house by NLAC can be used in organ transplant, tumor research, and bone marrow transplant experiments; the fluorescent feature makes tracking and identification by the naked eyes feasible.

Expanding the Animal Hotel service of Tainan Facility

To fulfill research demand, NLAC Tainan Facility offers Animal Hotel service for mice using a standardized facility; in 2012, new experimental service has been introduced. The professional staffs may administer drugs (via intravenous injection, abdominal injection, subcutaneous injection, or oral administration), perform blood/serum biochemical analysis, use metabolic cages, and perform pathological analysis according to the customers' request. The new mouse blood

pressure monitoring service employs a non-invasive blood pressure monitor to stably measure the blood pressure of a mouse, providing a good blood pressure assessment platform for Animal Hotel customers. Apart from resolving the problems of insufficient space and lack of professional animal caretaker in various research units, the professional service of NLAC may accelerate R&D results by reducing time and resource wastes due to the unfamiliarity of technical procedures.

Training Taiwan's Medtech Innovator and Entrepreneur

Stanford-Taiwan biomedical fellowship Program is a 7-year project which aims to connect Taiwan with resources in Stanford University and Silicon Valley communities to foster entrepreneurship in medical device industry. The successful experience in the innovative medical device industry brought from the Bay Area to Taiwan is expected to upgrade Taiwan's medical device industry to a new phase. We hope to train the next generation of medtech innovators/entrepreneurs and build-up the Medtech innovative ecosystem in Taiwan.

As of the end of 2012, 27 STB scholars have been selected and 7 innovative medical device "unmet need" oriented start-ups have been established. Compactcath has been featured on CNN money "3 inventions trying to change the world." Furthermore, a domestic training program was executed from 2009 to 2012 to expand the STB influence on high-value medical device innovation in Taiwan. Its goal is to create a Biodesign-like environment to train our young medtech innovators as seed talents and entrepreneurs. Over 100 fellows have finished the training course, which has led to 1 spin-off company.

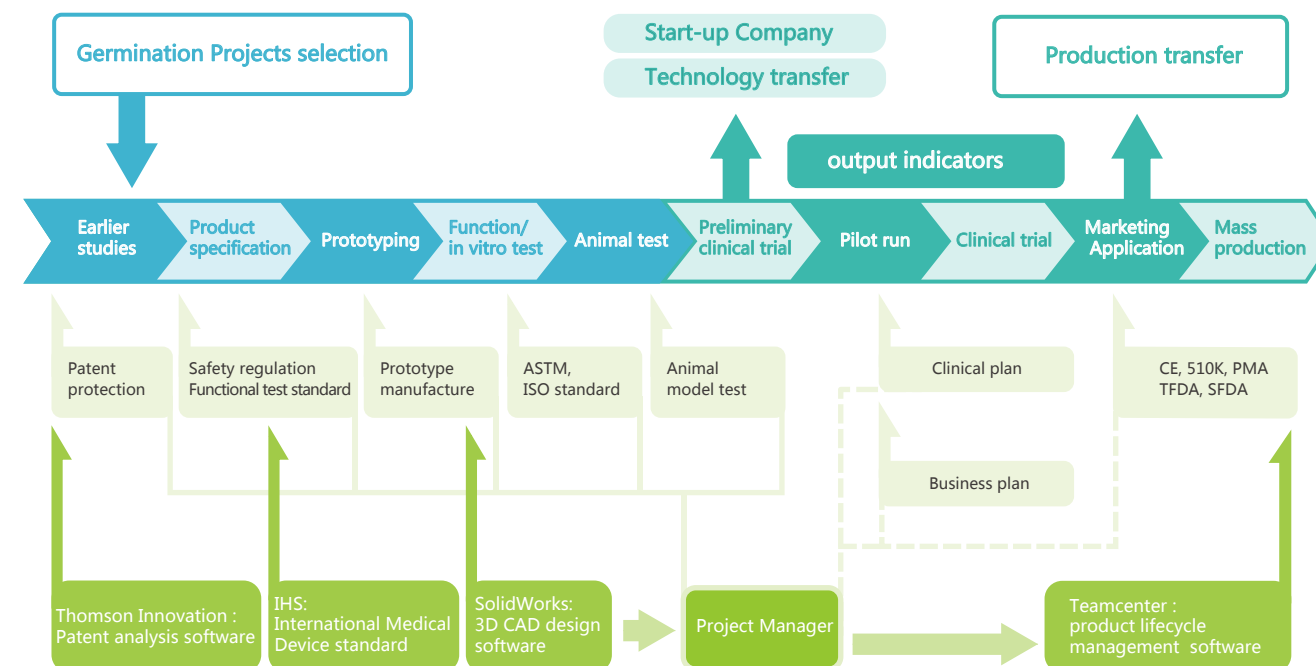
Results of the "Biomedical Technology and Product R&D Assistance Consulting Project"

Since September 2011, NARL has implemented the "Biomedical Technology R&D Product Consulting Project," which is a subproject of the NSC's "Biomedical Technology and Product R&D Program." The other five subprojects receiving assistance are listed as follows:

- ◆ "Power-assisted Rehabilitation Device with Electrical Stimulation," headed by Prof. Chen Jia-Jin of National Cheng Kung University
- ◆ "Technique of Spinal Epidural Space Detection and Development of Disposable Needle with Optical Fiber," headed by Prof. Chang Yin of National Yang Ming University
- ◆ "Wireless EEG System and its Application on Depression," headed by Prof. Lin Chin-Teng of National Chiao Tung University
- ◆ "Pilot Run of MRI-Guided HIFU Treatment System for Uterine Fibroids," headed by Dr. Chang Hsu, Director of National Health Research Institutes
- ◆ "High Frequency Implantable Stimulator for Pain Relief-Gimer System," headed by Prof. Lin Chii-wann of National Taiwan University.

The goal of this project is to establish supporting platforms for R&D teams to develop medical devices, and to accelerate the translation and commercialization of their R&D achievements.

The "Medical Device Product R&D Software Service Platform" established by NARL provides R&D teams with a superior R&D support environment, and includes a quality management system necessary to comply with ISO 13485 regulations concerning medical devices development processes, technological patent portfolio analytical software for protecting R&D results, a detailed document search system for international medical device regulations and standards, computer-aided design software for medical devices design and manufacturing, as well as a historical document management system for medical equipment development projects. In addition, a project manager is especially assigned to help R&D teams obtain assistance from NARL, interested companies, research institutes, and inspection and testing centers. With the assistance from the project manager, it is expected to surmount the hurdles of prototype manufacturing, safety testing, clinical trial application, and sales licensing application, effectively expediting the product realization process. This project's operating model has accomplished several achievements. Two R&D teams have successfully performed technology transfer to manufacturers. Two teams are in the process of establishing start-ups. Another one has begun trial production of its product, which has been marketed in Taiwan and abroad.



Establishment of a Procurement Tracking and Management System

The development of this system was implemented in order to meet the needs of tracking and management of procurements above the announced amount; the system can reduce manual tasks, lessen the rate of human errors, avoid repetitious manual updating, and provide real-time procurement progress information, while ensuring that all procurement information is disclosed.

Starting in 2013, information for procurements over the amount announced during that year will be incorporated in the system; this information

covers procurement plans, implementation, and changes, helping relevant personnel to monitor the state of implementation in real-time, and enhancing procurement implementation efficiency. The system can also subsequently provide reference information to guide purchasing strategies. The system has automatic links to the e-form approval system, bid request announcement system, budget control system, and financial accounting system, and can comprehensively record and present procurement information in real-time.

Manpower Training: 2012 Summer Internships for Master's and Ph.D. Students

NARLabs implemented a summer internship for the first time in 2012, and allowed domestic master's and Ph.D. students to apply for summer internships at NARLabs. A total of 20 graduate students from domestic universities took part in these internships. Extending from August 1 to September 15, the internships gave students opportunities to operate advanced equipment at NARLabs' central laboratories and gain knowledge and experience they could not get at school. For instance, students worked on various physical and numerical simulation platforms at the National Center for Research on

Earthquake Engineering, used the supercomputer Formosa 5 at the National Center for High-Performance Computing, and worked in nanometer clean rooms, etc. The participants felt that the internships provided a very rewarding opportunity to get a better understanding of the R&D process, experience life in the workplace, and expand their horizons. Due to the enthusiastic response to the program, NARLabs plans to increase the internship quota during 2013, and thereby hopes to provide even more chances for students to participate in research work at Taiwan's national laboratories.

Encouraging Employee Innovation: Establishing a Proposal Reward System

To encourage employees to actively pursue innovation, NARLabs began implementing a proposal reward system in October 2012, and personnel have responded enthusiastically to the introduction of this system. As of the end of December 2012, during a mere three-month period, 14 branch-level proposals and 20 center-level proposals were received from NARLabs' six centers. The content of these proposals encompassed a wide range of aspects, and displayed colleagues'

creative thinking ability and expectations about how NARLabs should operate. The proposals were implemented after review and assessment by the relevant offices and departments, and their effectiveness were tracked. We expect that this system will enable NARLabs' core values of "commitment, enthusiasm, and innovation" to be realized in its work, enabling it to provide even better scientific and technological service platforms.

II. Management and Integration

International Cooperation



◆ NARLabs-KRCF Signed Collaboration MoU

The National Applied Research Laboratories (NARLabs) has a vision to pursue global excellence and local impact. It is expected that its individual research centers will establish internationally-competitive indicators in their respective areas as targets, and will join forces with the country's research leaders to create values for social benefits and emerging industries. At the same time, NARLabs has been actively promoting interchange and cooperation with various prominent academic research organizations of international renown, sharing of research results, and enhancement of technological R&D capabilities through conduction of joint research projects, utilization of major research facilities, technological cooperation, sharing of resources, and exchange of researches and information.

◆ FORMOSAT-7/COSMIC-2 Space Program
Achieved SDR Milestone

On June 15 of 2012, NARLabs, represented by President Liang-Gee Chen, and the Korea Research Council of Fundamental Science & Technology (KRCF), represented by Chairman Keon Kim, signed an umbrella Memorandum of Understanding (MoU) in Taipei (see Fig. 1). NARLabs and the KRCF are national-level science and technology organizations. Both parties will collaborate in areas of S&T policy research, instrument technology, computing and network, biomedical, nano, and space technologies. NARLabs will form an alliance with KRCF and draw on the R&D capabilities of local industry and academic institutions to establish international collaboration platforms, and promote bilateral exchanges of high-tech manpower.

In 2011, the Taipei Economic and Cultural Representative Office in the United States (TECRO) and American Institute in Taiwan (AIT) signed a technology cooperation agreement to jointly develop the FORMOSAT-7/COSMIC-2 satellite constellation. NARLabs-National Space Organization and National Oceanic and Atmospheric Administration (NOAA) were authorized to jointly implement this major international collaborative project. Based on the success of FORMOSAT-3/COSMIC program, this follow-on project calls for Taiwan and the US to collaboratively develop a meteorological, ionospheric, and climate observation satellite constellation. After completion of deployment, the constellation will continue to make impacts on global weather forecasting and climate observation. The satellite System Design Review, a major milestone, was smoothly completed in 2012 (see Fig. 2).

NARLabs grants Distinguished Award for Outstanding Contributions in Science and Technology and Distinguished Service Award

In order to enhance technology R&D capabilities and service quality, reward R&D, service, and cultivation of human resources, upgrade internal service procedures, and reward employees who have made outstanding contributions, NARLabs

established the Distinguished Award for Outstanding Contributions in Science and Technology and the Distinguished Service Award in 2007 and 2010, respectively. The projects that won these two awards in 2012 are as follows:

6th NARLabs Distinguished Award for Outstanding Contributions in Science and Technology (Award of Excellence)

Technology development: "Environmental, Biomedical and Inertial Sensing IC Technology"
—National Chip Implementation Center

Technology service: "MorFPGA-Modularized FPGA System Development Platform"
—National Chip Implementation Center

3rd NARLabs Distinguished Service Award

Distinguished Award: "Integrated Online Platform for Laboratory Animal Resources and Services"
—National Laboratory Animal Center

Award of Excellence: "Overall Improvement of NARLabs Health Checkup Quality and Satisfaction"
—Instrument Technology Research Center

Award of Excellence: "Service contributions and R&D results connected with the Comprehensive Network Security Management System"
—National Space Organization

NARLabs Newsletter builds partnerships and boosts team spirit


The NARLabs Newsletter was born toward the end of 2012. The NARLabs Newsletter is an internal publication that belongs to all employees, and is also a pluralistic platform for cultural interchange, learning, sharing, and dialogue within NARLabs. NARLabs possesses 11 research centers encompassing a wide range of research areas. As such, NARLabs recognizes that bringing together different cultures

and ways of thinking can provide an important basis for interdisciplinary innovation. Because of this, President Liang-Gee Chen has actively called for the establishment of a working atmosphere fostering partnership. The NARLabs Newsletter will enable colleagues to regularly observe, learn from, and respect each other from different perspectives, communicate achievements and honors in various

fields, share experience with clients, engage in international interchange, and disseminate management or service insights. As a result, the NARLabs Newsletter will constitute a positive force within the organization, and help build a corporate culture promoting joint innovation, learning, and sharing, in which every colleague will be NARLabs' ideal strategic partner.



◆ The first issue of NARLabs Newsletter



NARLabs always believes that, apart from sci-tech R&D, it should actively contribute to society and use its resources where they would have a positive effect. With the spirit and passion of a "sci-tech volunteer," environmental protection and disaster mitigation and response have been the keynotes of NARLabs's social participation.

Leaving the laboratory to serve as environmental volunteers

On November 3, 2012, NARLabs' researchers heeded the appeals of President Liang-Gee Chen by bringing their families, rolling up their sleeves, and setting to work cleaning Taiwan's beaches. Along Hsinchu's beautiful 17-kilometer seashore, these hard-working volunteers joined forces to show their determination to protect the environment and cherish their homeland.

To promote awareness and conservation of the marine environment, NARLabs mobilized "sci-tech volunteers" from its 11 national laboratories in a

series of trash pick-up campaigns targeting beaches in northern, central, and southern Taiwan. By taking part in the beach clean-up and trash classification process, participants came to realize that the first step in protecting marine environments is to understand how human activities are polluting the sea, realize how our lives are closely linked to the cleanliness of the sea, and make small but important changes in product design, choice of materials, waste recycling and disposal, and in environmental engineering.

Helping Taiwan's search and rescue team perform international humanitarian missions in earthquake-stricken areas

As for participation in international relief activities, National Center for Research on Earthquake Engineering (NCREE) of NARLabs has been invited to the newly-formed "technical teams" to enhance the safety and effectiveness of Taiwan's international humanitarian search and rescue missions. This will ensure that Taiwan's search and rescue team will have the personnel needed to provide an even broader range of vital skills, and can better comply with international certification requirements. Looking ahead to the future, NCREE will send personnel to accompany the Special Search and Rescue Team to earthquake-stricken areas around the world. Apart from using special instruments and equipment to monitor aftershocks and ensure the safety of buildings, the NCREE personnel can also provide their professional opinions concerning strategies for excavating buildings in order to rescue persons trapped within. The NCREE participants thus hope not only to protect the lives and safety of the search and rescue team, but also to enhance rescue effectiveness and realize the use of technology in rescue operations.

Furthermore, NCREE also assists the project through the training and compilation of teaching materials concerning building and disaster site safety assessment. In particular, NCREE teaches trainees how to promptly assess site safety when working in collapsed buildings, allowing them to decide search and rescue team strategies. This work is boosting the ability of search and rescue team personnel to save more lives, and will ensure that personnel can perform their missions in safety after a large-scale earthquake strikes. NCREE has sent out a call for its personnel to serve in a "technical team" accompanying the search and rescue team in international humanitarian missions, and will send prospective technical team members in batches to attend international humanitarian rescue training classes, where they will take part in realistic simulated drills with search and rescue team personnel, ensuring that the technical team can play an extensive role in actual missions.

III. Social Activities