VIETNAM ACADEMY OF SCIENCE AND TECHNOLOGY

ANNUAL REPORT 2016

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ABBREVIATIONS LIST

GUST	Graduate University of Science and Technology
ISI	Institute for Scientific Information
IT	Information Technology
LIDAR	Light Detection And Ranging
MOST	Ministry of Science and Technology
MoU	Memorandum of Understanding
NAFOSTED	National Foundation for Science and Technology Development
NGO	Non - Governmental Organization
ODA	Official Development Assistance
SCI	Science Citation Index
SCI-E	Science Citation Index Expanded
VAST	Vietnam Academy of Science and Technology
VNMN	Vietnam National Museum of Nature
VNSC	Vietnam National Satellite Center

CONTENTS

A MESSAGE FROM THE PRESIDENT

In 2016, which is the first year of implementation of the five year plan 2016-2020, the Vietnam Academy of Science and Technology (VAST) has achieved encouraging results, creating a premise for a new stage of development and international integration with many opportunities and challenges.

As the leading scientific research institution in the country, VAST continues to promote basic research activities, reflected through the quantity and quality of scientific publications. In 2016, VAST published more than 2,000 scientific papers, maintaining a growth rate of 15 - 25% per year. Also in 2016, two international category-2 centers for mathematics and physics under the auspices of UNESCO have been established, three VAST centers of excellence for fundamental research have started to deploy their national-level tasks. The National Physics Program up to 2020 and the National Network of Biotechnology research centers and institutes up to 2025 have also been approved by the Government.

In the context of the Fourth Technological Revolution, scientific research aimed at solving practical problems of the country has become the mission of VAST. The Tran Dai Nghia Prize was launched by VAST and awarded for the first time to honor the works that have high applicability. Particularly, in early 2016, VAST collaborated with the Ministry of Natural Resources and Environment

and the Ministry of Science and Technology to investigate the cause of fishes' dead in the provinces in the middle of Vietnam and in Hanoi's West lake.

As for other scientific and technological activities, the Tay Nguyen 3 Program and the Space Science Program have achieved remarkable results; the VNREDSat-1 is operating stably in orbit; the surveying in marine resources trip on the "Academician Oparin" ship is doing well in the territorial waters and special economic zones of Vietnam in the sea..

Regarding training activities, the Graduate University of Science and Technology has come into operation with its first enrollments. The University of Science and Technology of Hanoi has become the university under VAST.

The Youth Support Program continues successfully through institute-level projects as well as independent projects reserved for young scientists. The technology incubator project that provides accommodation for young scientists is planned to be in action in early 2017.

VAST has had a successful year in international co-operation with many joint projects and agreements signed in the field of science, technology and training.

In 2017, continuing to closely follow the VAST development plan until 2020 with orientation towards 2030, VAST is firmly determined to fulfill all the tasks, contributing deservedly to the development of the country in the new era.

Prof. Acad. CHAU VAN MINH
President of Vietnam Academy of Science and Technology

2016 VAST IN FIGURES

455 Science and technology projects and tasks at different levels with the total funding of more than 264 billion VND

392 NAFOSTED Basic Research Projects, accounting for about 30% of the total basic research projects of the country in 2010 - 2016

23 ODA projects (08) and NGO projects (15) with the total funding of more than 642.1 billion VND

>2000 Scientific publications, of which 742 were articles in international journals, increased by 26,1% compared to 2015

28 Patents (11) and Utility Models (17)

75 New species of plants and animals discovered by VAST experts

39 New books published

714 PhD students

140 Observation stations in 15 research institutes located throughout in the 35 provinces and cities

1070 Science and technology contracts with a total cost in 2016 of over 480 billion (up nearly 17% compared to 2015)

DIRECTORATE

President: Prof. Acad. CHAU VAN MINH

Responsibility: for the whole activities of VAST.

Leading directly strategy and development project, important projects, planning-financial activities, organizational and administrative activities, international cooperation management and inspection.

Vice President: Prof.Dr.Sc.
NGUYEN DINH CONG

Responsibility: for the scientific research management, planning and finance, technology application and deployment.

Vice President: Assoc Prof.Dr
PHAN VAN KIEM

Responsibility: for the organization and personnel management, inspection.

Vice President: Prof.Dr.Sc.
DUONG NGOC HAI
(Until Sep. 2016)

Responsibility: for the technology application and deployment.

Vice President: Prof.Dr.
PHAN NGOC MINH
(from Oct. 2016)

Responsibility: for higher education and postgraduate training.

MISSION

The Vietnam Academy of Science and Technology (VAST) is a government agency, earlier known as Vietnam Academy of Science, established in 1975 by Decree 118/CP dated 20 May 1975 and issued by the former Council of the Vietnam Government. The VAST is committed to

- carrying out basic research in natural sciences and technology development;
- providing objective grounds for science and technology management, for shaping policies, strategies and plans for socio-economic development;
- training high quality human resources for science and technology

VISION

The VAST aspires to be a leading national multidisciplinary research center for science and technology of world class standards recognized both regionally and internationally, to fulfil its roles and responsibilities in driving scientific, technological and social development of Vietnam and its global integration.

HUMAN RESOURCES

> 4.000 Staff members

2.425 Permanent staff members

218 Professors and Associate Professors

840 Doctors and Doctors of Science

905 Masters of Science

ORGANIZATION CHART

DIRECTORATE — **Scientific Councils**

ADMINISTRATIVE UNITS

Department of Organization and Personnel
Department of Planning and Finance
Department of International Cooperation
Department of Application & Development of Technology
Department of Inspection
Administration Office
(Representative Office in Ho Chi Minh City)

OTHER UNITS

Institute for Scientific Information
Vietnam National Museum of Nature
Publishing House for Natural Science and Technology
Center for High Technology Development
Branch: Tay Bac Center for Technology Development
Branch: Center for Environmental Technology Application and Development
Center for Informatics and Computing
Graduate University of Science and Technology
University of Science and Technology of Hanoi
Center for Training, Consult and Technology Transfer

SELF-FINANCING UNITS

Institute of Telecommunication Technology
Center for Technology and TechniqueDevelopment
Scientific Production Union of Telecommunications - Informatics Hi-Tech
Scientific Production Union of New Technology

STATE ENTERPRISE

Newtatco Company Limited

RESEARCH UNITS

Institute of Mathematics
Institute of Mechanics
Institute of Information Technology
Institute of Mechanics and Applied Informatics
Institute of Physics
Hochiminh city Institute of Physics
Institute of Applied Physics and Scientific Instruments
Institute of Materials Science
Institute of Applied Materials Science
Institute for Tropical Technology
Space Technology Institute
Vietnam National Satellite Center
Branch: Southern Centre for Space Technology Application
Institute of Energy Science
Institute of Environmental Technology
Branch: Ho Chi Minh City Center for Environmental Technology
Branch: Da Nang Center for Environmental Technology
Institute of Chemistry
Institute of Natural Products Chemistry
Institute of Marine Bio-Chemistry
Institute of Chemical Technology
Institute of Biotechnology
Institute of Ecology and Biological Resources
Southern Institute of Ecology
Institute of Tropical Biology
Institute of Genome Research
Institute of Geography
Institute of Geological Sciences
Institute of Geophysics
Institute of Marine Geology and Geophysics
Institute of Oceanography
Institute of Marine Environment and Resources
Hochiminh city Institute of Resources Geography
Nha Trang Institute of Technology Research and Application
Tay Nguyen Institute of Scientific Research
Mien Trung Institute for Scientific Research
Branch: Quang Tri Center for Scientific Research

Units established by Government
Units established by VAST President

KEY EVENTS

Deputy Prime Minister **Vu Duc Dam** *confers the* **Tran Dai Nghia** *Award to scientists (11/09/2016)*

THE FIRST TRAN DAI NGHIA AWARDS

The award, named after late professor academician Tran Dai Nghia (1913-1997), was presented for the first time this year to honor scientists for their contributions of great significance towards applied scientific discoveries. Two outstanding projects that have been honored this year included *"The technological process of making fine iron ore, steel and fire-proof building materials from red mud"* by Dr. Vu Duc Loi and Nguyen Van Tuan, as well as *"The application of advanced technology in vaccine production"* by Prof. Dr. Hoang Thuy Nguyen and the late Prof. Dang Duc Trach

Minister of Science and Technology **Chu Ngoc Anh** *confers the medal to* **Dr. Phung Van Dong** *(18/05/2016)*

TA QUANG BUU ADWARD

Dr. Phung Van Dong won the Ta Quang Buu award for young scientist with *"3-3-1-1 model for dark matter"* published in 2013.

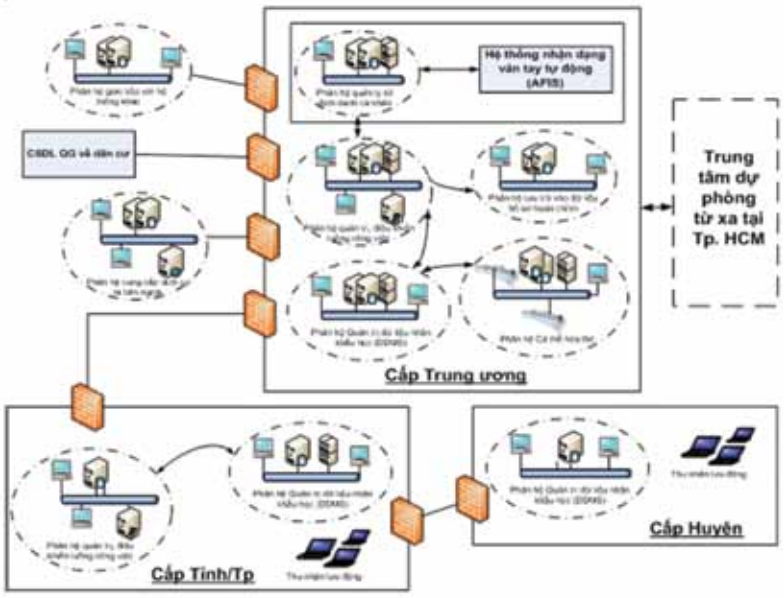
Assoc. Prof. **Dang Thi Cam Ha** *(Institute of biotechnology, second from the right) receives Kovalevskaya Award (06/03/2016)*

KOVALEVSKAYA AWARD

Assoc. Prof. Dang Thi Cam Ha (Institute of Biotechnology) receives the 2015 Kovalevskaya Award

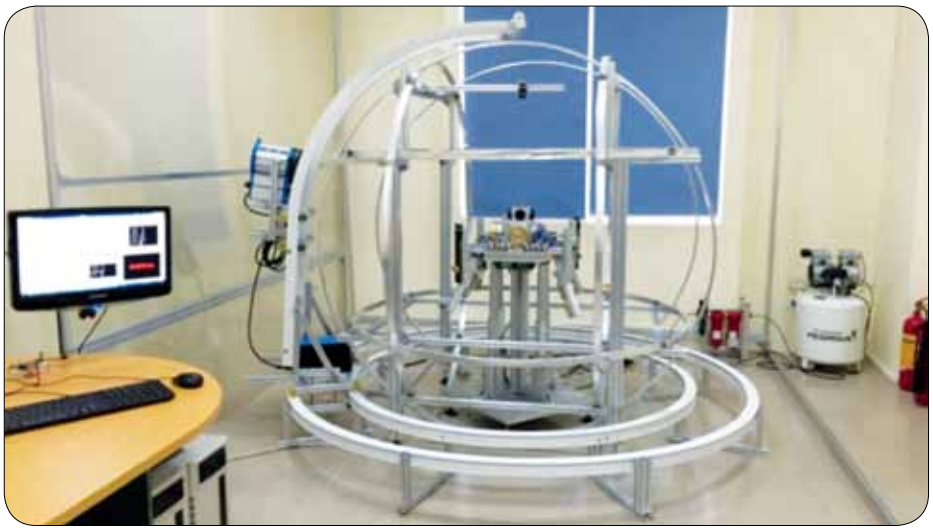
HIGHLIGHTS IN 2016

• National database management of citizen identification cards



Consultancy on setting-up projects for production investment, issuance and management of citizen identification cards with the purpose of building a national database, which allows automatic collection and management of registration data based on the infrastructure of information technology throughout the country (Institute of Information Technology).

• High-Accuracy Attitude Determination and Control System Simulator for Earth Observation Satellites



Project: Research and Development of a High-Accuracy Attitude Determination and Control System Simulator for Earth Observation Satellites (VT/CN-03/14-15)
The air-bearing based High-Accuracy Attitude Determination and Control System (ADCS) Simulator, which simulates the operation of satellite's ADCS in space environment conditions, including frictionless, zero-gravity state, geomagnetic field, and solar radiation (Vietnam National Satellite Center)

• The health food supplement SUMGOODLY

The health food supplement SUMGOODLY supports the elimination and prevention of lead absorption, reduces the risk of dangerous diseases caused by prolonged exposure to a polluted environment (Institute of Natural Products Chemistry).

• In-vitro breeding for orchid species

The investigation and selection of developing an in-vitro breeding process for 05 of 45 orchid species received from Ukraine that are deemed to have high conservation and potential trade value (Institute of Tropical Biology).

• The tea-drying equipment SC.IES.16

The manufacture of tea-drying equipment SC.IES.16 with the capacity of 35 kg/ batch, which contributes to preservation and development of traditional flower-marinated tea in Hanoi (Institute of Energy Science).

• Finding the causes of environmental pollution, creating the legal basis for Formosa in Ha Tinh to take the responsibility

The study and evaluation of the main causes of abnormal fish deaths, creating the legal basis for Formosa in Ha Tinh to take the responsibility to pay compensation for environmental pollution incidents in four provinces in central Vietnam (Institute of Chemistry and other specialized institutes within VAST).

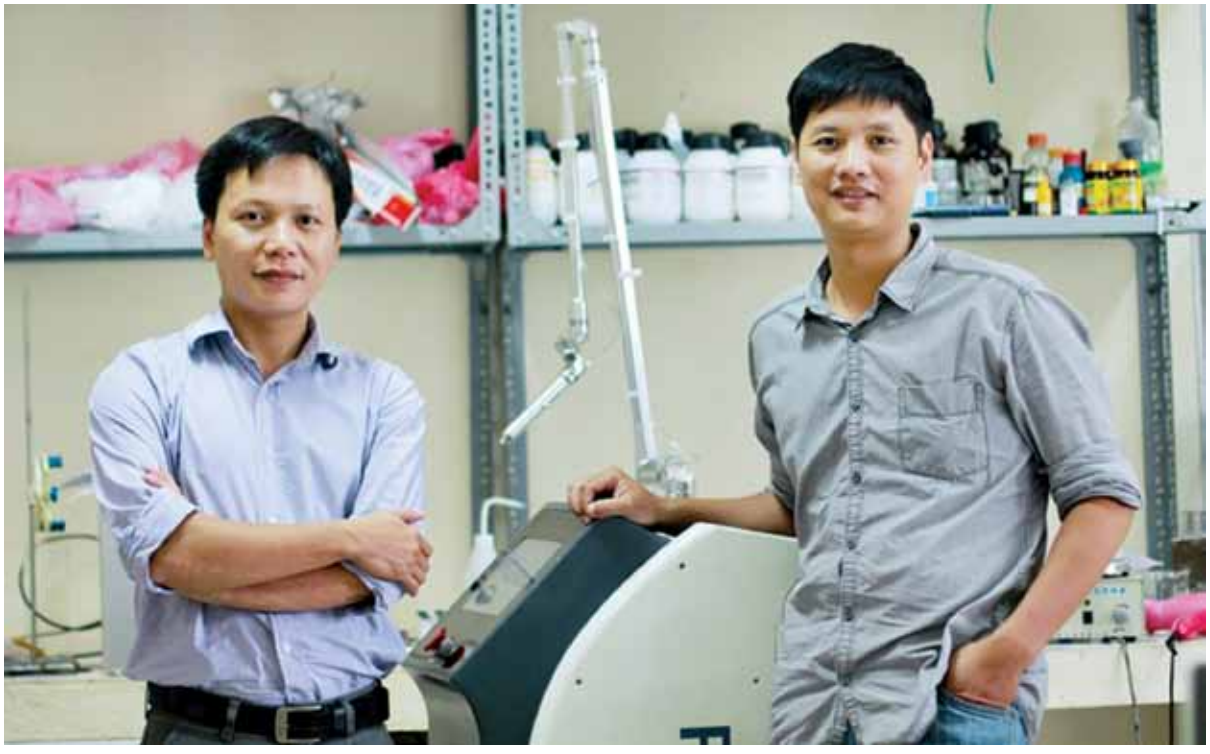
• Nano FGC complex

Nano FGC complex contains three main active elements - Curcumin from Curcuma Longa, Fucoidan from seaweed and Saponin NotoGingseng from NotoGingseng.

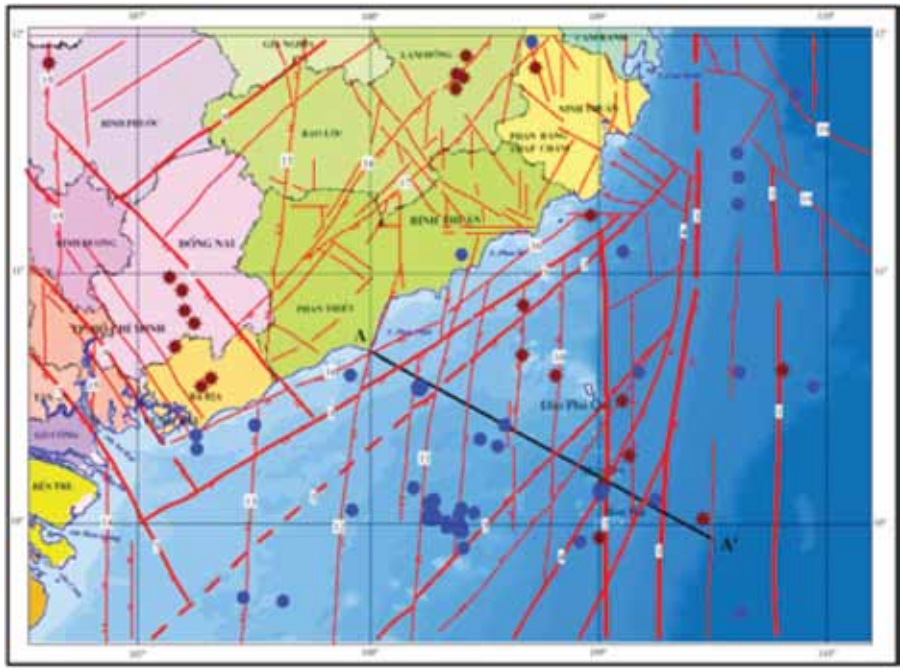
The product has been tested on cancer cells of breast, lung, liver and throat cancers, and have shown encouraging results in reducing the size of tumours, inhibiting the development of cancel cells, and boosting some immune cells. (Institute of Materials Sciences)

• PlasmaMed - cold plasma technology

Successful application of cold bactericidal plasma, which helps open wounds heal quickly, even when the patient is resistant to all antibiotics. The product, named Palsma Med, has been examined and clinically tested in many major hospitals, and the Ministry of Health has issued a certificate of registration for its circulation as a medical equipment. The product has been honored among the 10 most outstanding scientific and technological events in 2016 (Institute of Physics).

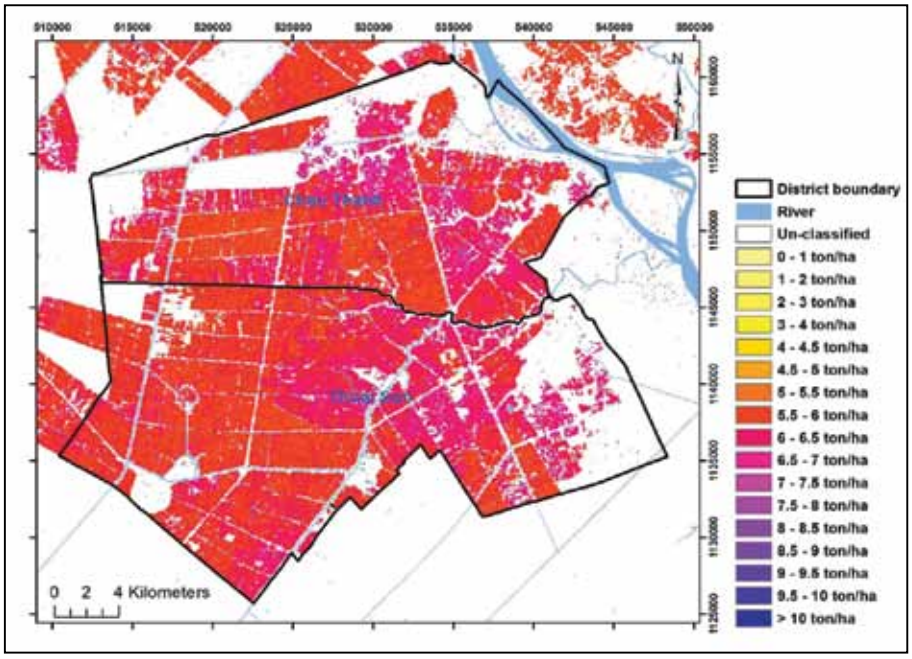


• Mapping of fault distributions in coastal areas along the South-Central coast of Vietnam



The mapping of fault distributions in coastal areas along the South-Central coast of the country, with the scale ratio 1: 200,000. The map provides a relevant database for investigating, surveying, forecasting and warning of the risk of geological hazards in coastal areas and continental shelf of the southeastern part of Vietnam (Institute of Geology and Marine Geophysics).

• The mapping of rice productivity



The mapping of rice productivity estimates based on satellite data (Ho Chi Minh City Institute of Geographical Resources)

PRIORITY DIRECTIONS IN SCIENTIFIC RESEARCH AND TECHNOLOGY DEVELOPMENT

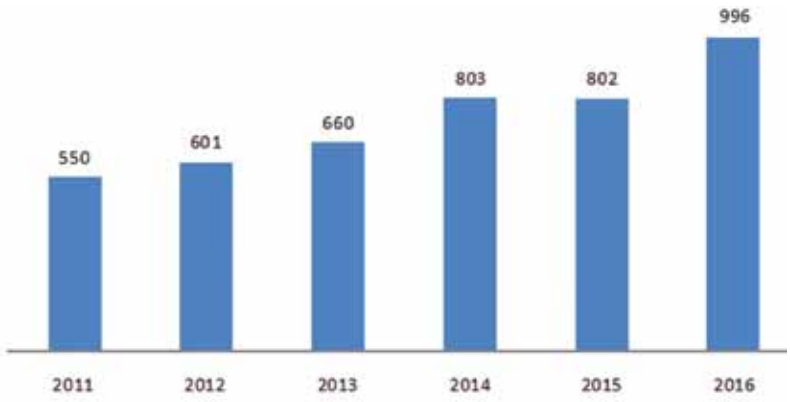
FUNDAMENTAL RESEARCH

In 2016, the VAST published a total of 2,000 scientific works. The total number of international articles in 2016 was 996 articles, an increase of 24.2% compared to 2015. The number of articles published in prestigious international journals with ISI standards (SCI and SCI-E) has increased to 742 (which is 26.1% higher than in 2015), in which many papers published in journals with high impact factors showing that research quality of VAST has been raised a step.

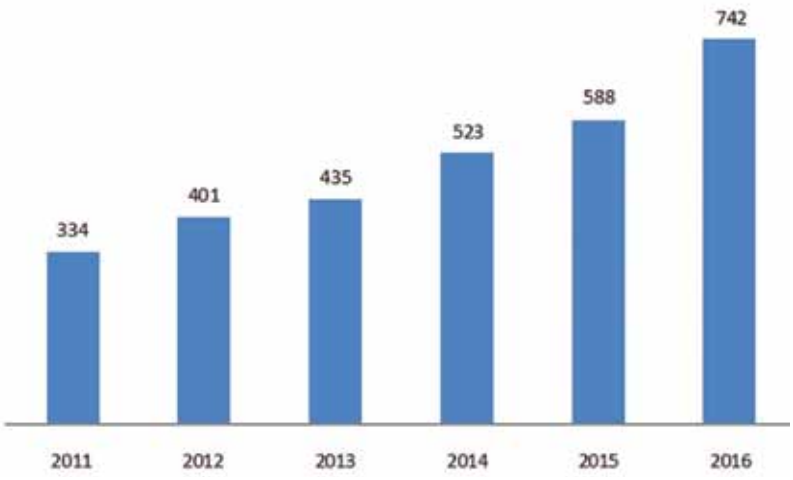
In 2016, VAST has funded 69 basic research projects covering 241 subjects. In total, during the period of 2010 - 2016, the VAST has received funding for 392 basic research projects from NAFOSTED, accounting for about 30% of the country's research projects. Total registration of intellectual property has been 28 certificates, including 11 patents, 17 utility solutions (an increase of 56% compared to 2016). In 2016, VAST has published 39 monographs, a significant increase compared to 2015.

In the field of materials science, journal "Advances in Natural Sciences: Nanoscience and Nanotechnology", jointly published by VAST and IOP Publishing (UK) has become Vietnam's first international standard journal. The journal of the Institute of Mathematics - Acta Mathematica Vietnamica (AMV) - is indexed by Scimago, and its ranking there has increased from Q4 in 2015 to

The total number of international articles in 2016: 996



Number of articles in the SCI, SCI-E journals in 2016: 742



Number of articles in the national journal in 2016: 1011

Research results published in the past 06 year of VAST

Q2 in 2016. Furthermore, two journals VJM and AMV are indexed for the first time in Emerging Sources Citation Index (ESCI) by ESCI - IP & Science - Thomson Reuters - Web Of Science. This is a clear indication of its ongoing improvement in quality over last three years.

This year, scientists of the VAST have received many awards:

- Associate Professor Dang Thi Cam Ha (Institute of Biotechnology) was a prizewinner for Vietnam women scientists in the field of natural sciences (Kovalevskaya Award).

- One of the major highlights of 2016 has been the granted Award of the Ta Quang Buu Prize to Dr. Phung Van Dong (Institute of Physics) for his publication *"3-3-1-1 model for dark matter"*, which was published in 2013 in the journal Physical Review D.

- Associate Professor Pham Hoang Hiep (Institute of Mathematics) was elected as a young fellow of the TWAS from November 2016 onwards. Thus, until now, the institute has 04 fellows and 01 young fellow of TWAS.

With the support and help of the Ministry of Science and Technology, Ministry of Foreign Affairs, 02 centers in mathematics and physics at VAST have been recognized and have been supported by UNESCO.

In the field of basic research in the natural sciences, 03 Advanced Centers were founded by VAST and have commenced implementing national tasks this year.

Determination of Basic research has been a very important task in 2016. VAST has continued to coordinate with the Ministry of Science and Technology to implement the Physics Development Program towards year 2020, network development planning of Biotechnology by year 2025 as approved by the Prime Minister. In the future, VAST continues to cooperate closely with the Ministry of Science and Technology to make a draft of four other programmes in chemistry, life science, earth science, marine science which will be submitted to the Vietnamese Government for improvement.

MSc. NGUYEN TUONG LAN
Institute for Scientific Information

Two journals of VAST are included in ESCI in 2016

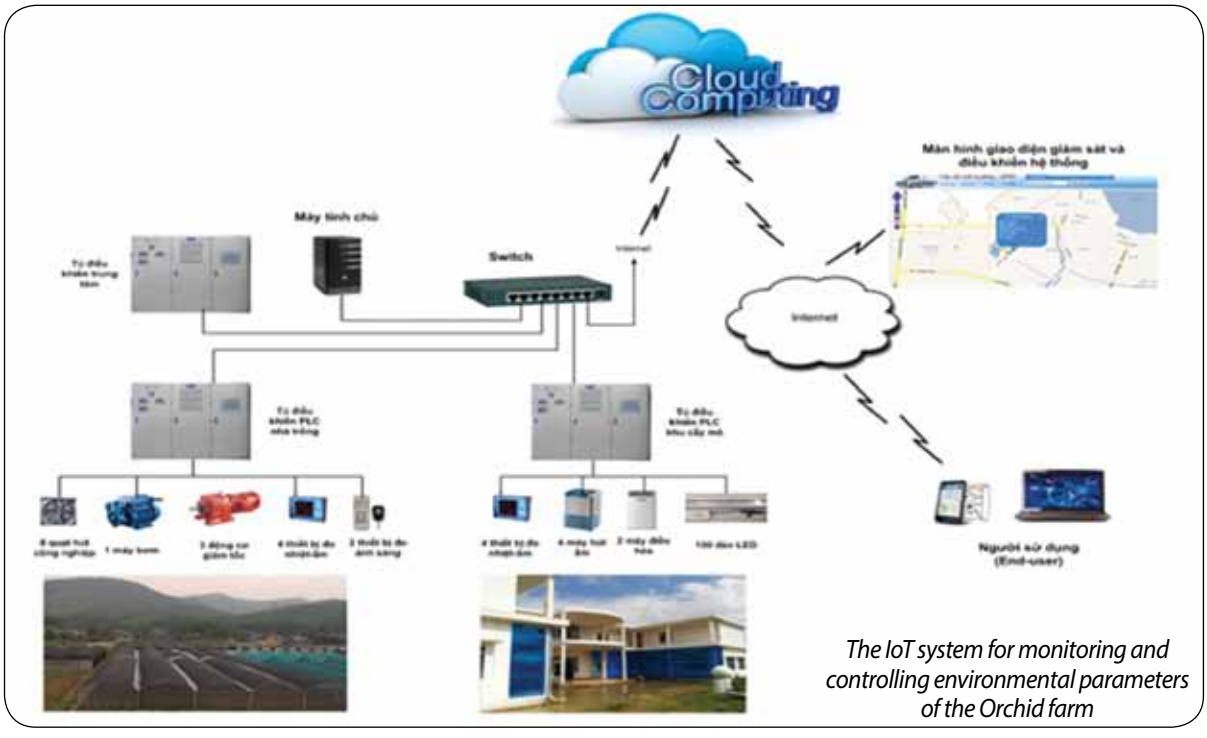
IT-ELECTRONICS-AUTOMATION AND SPACE TECHNOLOGY

Prof. Dr. Sc. DUONG NGOC HAI
Chairman of Scientific Council

In 2016, in the field of Information Technology, Electronics, Automation and Space Technology (VAST01), 30 projects have been carried out, from which 10 projects continue in next year. Among the 20 projects expected to be ended in 2016, 07 subjects were completed and evaluated. In addition, 10 new projects for the period 2017-2018 have been approved. The main implementing institutions in these areas are: the Institute of Information Technology, the Institute of Mechanics, Vietnam National Satellite Center and the Space Technology Institute. The projects are being implemented according to plan and in accordance with the approved schedule of annual funding of the state budget. Specific research within the field of Information Technology, Electronics, Automation and Space Technology within VAST includes:

INFORMATION TECHNOLOGY

In the field of information technology, within the project *"Data analysis methods for inspection of tax collection and payment assessments for businesses"*, the survey report on the current situation of analysis and assessment as well as reports on data collection and preprocessing methods were completed. Two research articles have been accepted for publication in the journal of ICT of the Ministry of Information and Communications, and one paper has been submitted to the journal CIT (Scopus). Within the project *"Research and development of AR-LBS software based on cloud technology for application in transport and tourism"*, the interactive virtual reality software AR-LBS was developed; 02 papers were published in VAST journals.



The IoT system for monitoring and controlling environmental parameters of the Orchid farm

The other main research results are listed below

- Applications in Nano-materials

• The use of theoretical and computational tools such as the tight-binding method, transfer matrix method, non-equilibrium green function method to study the electronic structures, electronic transport properties. As well as to study the effects of magnetic fields, grained boundaries and mechanical deformation on properties of graphene materials, graphene quantum dot systems and graphene nano ribbons. The objectives are geared towards the design of functional nano-electronic devices based on graphene.

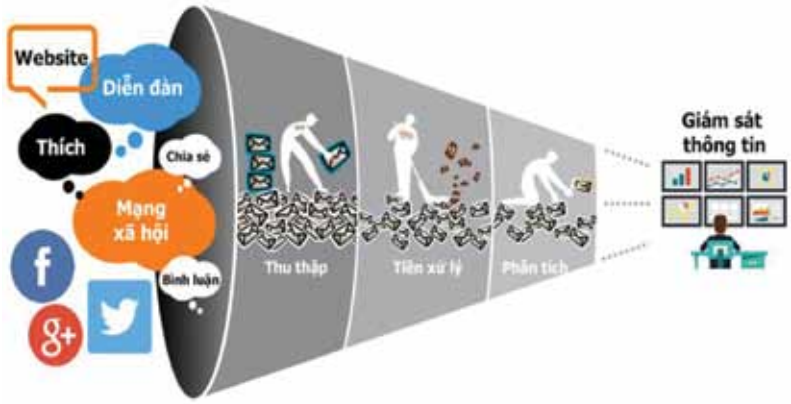
• The development of computational methods for materials research. In particular, the application of the density functional theory and ab-initio calculation methods to study structural properties of nano-crystals and polymer crystals.

• Research on the effects of surface plasmon in low-dimensional, nano and bio-nano systems.

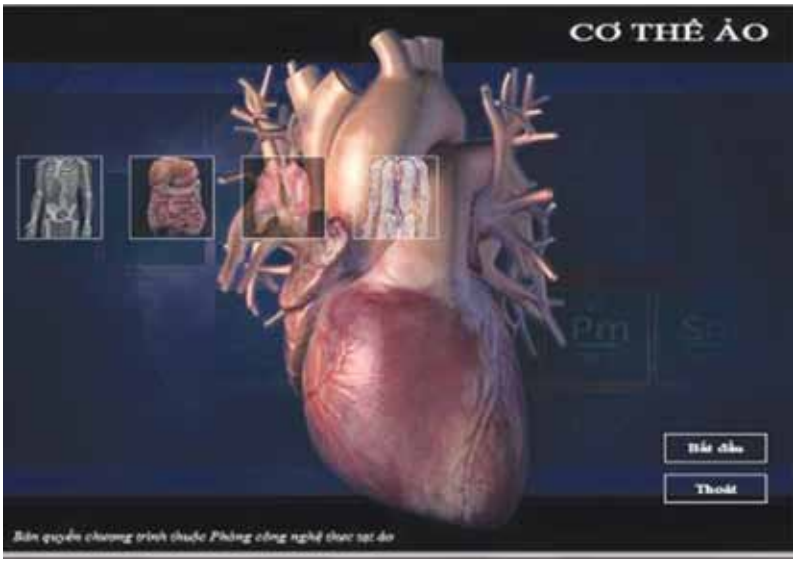
- Applications in Biology

•The use of computer simulations methods, theoretical modeling and calculation to study the protein folding problem, the effects of cellular environment on protein folding, protein aggregation and amyloid fibril formation, DNA condensation, phase behaviors of biopolymers, shapes of biological membranes and ribbons.

• The application of methods of data analysis and theoretical modeling to study the mechanisms of cardiac contraction control.



Building a system for prediction and management of information spreading in social networks in Vietnam



Virutal body 1.0

Display AR data in the user's smartphone camera

- Applications in Economics:

• The applicationsof methods of theoretical physics to study stock market behaviors.

In 2016, 11 papers on the above mentioned research topics were published in SCI journals and another 14 papers were published in other peer-reviewed international journals.

Electronics and automation

The field of electronics and automation is one of the priority areas of research and development. Relevant topics included are: the technical diagnosis of machinery and equipment; structural health monitoring; analysis of measurement, signal processing and calibration of vibration and noise control equipment; technologies to exploit clean energy (wind, solar, sea waves...); design and simulation of mechatronic systems, control systems, and automation.

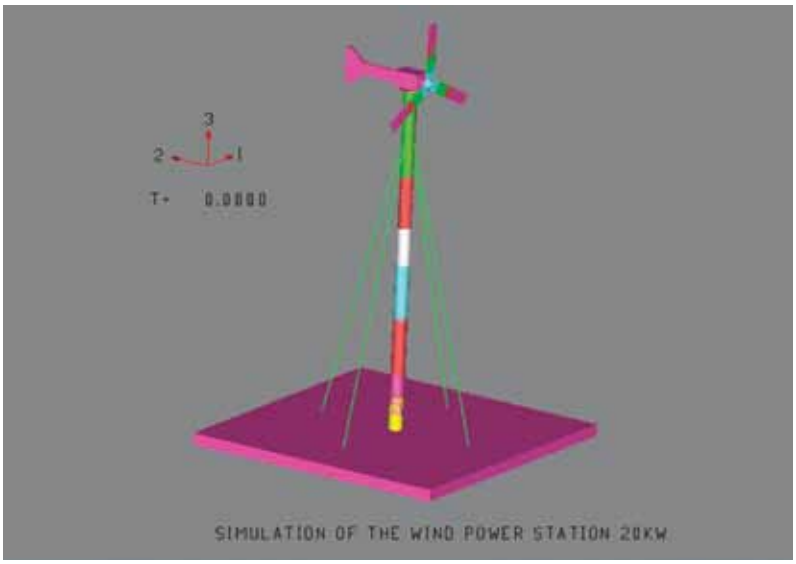
In the field of electronics and automation, within the project *"Investigation on the technological solutions of combined crane control and damping devices for the safe vertical transport of people and goods at ocean construction sites"*, 01 conference paper was published, and the experimental model was built. Within the project *"Design and manufacture of the instrumentation systems and structural monitoring on-line by means of vibrations"*, the on-line structural monitoring methods and the remote transceivers were studied; the circuit diagrams for instrumentation were designed and the equipment for remote reception is manufacturing.

The other main results are

- The development of the

Structural Monitoring Software

Hybrid Robot in Laboratory



Wind turbine

diagnostic software for pile-foundations connections of DKI was conducted.

- The development of the supported devices for an indirect balancing system of steam turbines and generators with nonlinear components was conducted.

- Research, design and manufacture a prototype hybrid structure robot 03 translational degrees of freedom for industrial applications have been concluded.

- Research and manufacturing of generators for sea wave energy extraction has been conducted

The intellectual property: Trademark Structural Monitoring Software

SPACE TECHNOLOGY

In the field of space technology, the majority of subjects revolves around remote sensing technology: Within the project *"Investigation of the relationship between urban heat islands of Hanoi city with land use changes by multi-time satellite data"*, the database of surface temperature and the PALSAR ALOS satellite imagery archive have been built, DEM and land use status maps were compiled. Within the project *"Research on and testing of established surface modeling and the plan of orthogonal images from unmanned aerial vehicle images"*, multi-analysis reports and the report on findings by UAV flights were completed.

Some other main topics

* Development of the small satellite technology for the earth observation, the earth station technology and other related technologies;

* Support of transferring the technology, the research results of the space science and technology into practical applications.

In this year, VAST has cooperated with the University of Science and Technology of Hanoi (USTH) and the University of Engineering and Technology, The Vietnam National University in Hanoi in education of the information technology, automation and space technology bachelor, master, and doctor students.

VNSC staff studied the MicroDragon satellite in Japan

BIOTECHNOLOGY

Prof. Dr. TRUONG NAM HAI
Chairman of the Scientific Council

In 2016, the Biotechnology field of VAST has 15 projects that have been implemented. Of these projects, 05 projects of the period 2014-2015 were extended to June 2016, 05 projects performed in the period 2015-2016 and 05 projects performed in the period 2016-2017. The biotechnology scientific council evaluated 05 projects finished in June 2016 and selected 05 new projects for the period 2017-2018.

THE NEW PROJECTS FOR 2017-2018

The VAST Scientific council in the field of Biotechnology has approved 05 new projects for 2017-2018.

- The project *"Screening research of marine bacteria associated with sponges and soft corals for antimicrobial producing strains by using of Polyketides synthases (PKSs) and peptide synthetases nonribosomal (NRPS)"*, code VAST02.01/17-18. Dr. Pham Thi Mien, Institute of Oceanography, is the project leader.

- The project *"Research of using several organic compounds to produce Ngoc Linh ginseng (Panax vietnamensis Ha et Grushv.) cell biomass"*, code VAST02.02/17-18. MSc. Do Dang Giap, Institute of Tropical Biology, is the project leader.

- The project *"Characterization of pluripotent gene expression of bovine granulosa cells and assessing the ability to differentiate into neural cells and cartilage cells"*, code VAST02.03/17-18. Dr. Le Long Thanh, Institute of Tropical Biology, is the project leader.

- The project *"Studies on single nucleotide polymorphisms of some genes related to Gout disease in Vietnam"*, code VAST02.04/17-18. Dr. Nguyen Thuy Duong, Institute of Genome research, is the project leader.

-The project *"Screening of potential plant-associated-microorganisms for inhibitory activities of enzymes involved in diabetes mellitus"*, code VAST02.05/17-18. Dr. Tran Thi Nhu Hang, Institute of Natural product chemistry, is the project leader.

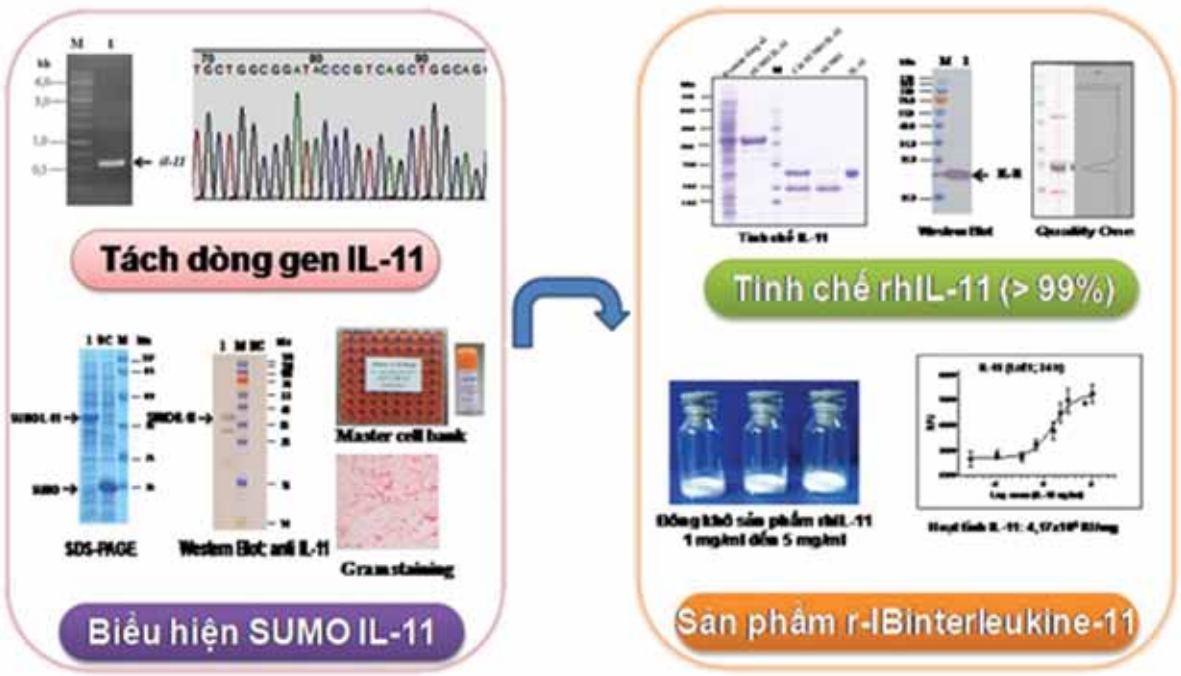
HIGHLIGHT RESULTS

Study on producing recombinant Interleukin-11 for medical use. Institute of Biotechnology,Hanoi.

In Vietnam, the recombinant protein products used as pharmaceuticals have not been thrived yet. Study on producing a recombinant IL-11 as a treatment of the hematopoietic system has been reported. Thus, we proposed the national project *"Study on producing high quality recombinant Interleukin-3 and Interleukin-11 used as medicine (treatment)"*. The results of the project are outstanding. For the first time in Vietnam, molecular biology techniques have been applied to create a recombinant *E. coli* strain expressing IL-11; the procedure for effective extraction and purification protein IL-11 with ≥ 99% purity, ~19 kDa molecular weight has been successfully established, with the product having 15 N-terminal amino acid sequence identical to currently available products of Neumega for treatment in humans. The IL-11 product has been fully evaluated for the safety criteria of a recombinant product by injection in animal models (general safety, acute toxicity, chronic toxicity, pyrogenic level). Besides, the biological activity of the IL-11 product has been evaluated on TF-1 cell line, which is 4.17 x 105 IU/mg, as well as on the haematopoietic stem cells model from bone marrow failure patients and normal people. Basic standards for the recombinant IL-11 product (r-IBinterleukin-11) have been developed and tested by the National Institute for Control of Vaccine and Biologicals (NICVB) as well as Biovision Company (USA). The project's achievement is the premise for a pilot production of commercialized IL-11 which is safe, effective and high-quality in line of wide application in cost-effective disease treatment as compared to overseas products. Thereby, it aims to contribute to the modernization of Vietnam's medicines and the improvement of people's health.

Whole-exome sequencing of patients with autism in Vietnam". Insitute of Genome Research, Hanoi.

Despite that the number of autistic patients in Vietnam is very high and increasing, no



Main results for producing human recombinant Interleukin-11

adequateand systematic statistical analysis about the disease has been conductedacross the country up to now. In particular, molecular biology technics (sequencing the entire exome) for patients diagnosed with autism have been highly understudied. These techniques are completely new to Vietnam. This is a new direction in medicine - the results of the research will be a prerequisite for further studies on early diagnosis and treatment for patients with autism spectrum disorders by sequencing the entire exome.

The aims of project were: Screening and selection of the typical patients with autism in Vietnam, whole exome sequencing of the patients with autism on Illumina next-generation sequencing system, analysis and evaluation of the achieved results to give genetic variations related to autism.

The results of project: The project has obtained scientific and applied results as shown below:

- 14 sets of records and samples of the patients with autism and their family members in Vietnam have been collected and screened. Whole-exome sequencing of seven patients with autism by Illumina next-generation sequencing.

- A process of exome sequencing and bioformatic analysis in patients with autism has been constructed.

- A dataset of gene mutations and genetic variants in coding regions related to autism have been identified in seven patients. The data of 285 genetic variants of 101 genes of seven patients related to autism have been collected after comparing with the data of genes sensitive to ASD by Gene Tests and ApolloGen.

- 16 genes sensitive to the ASD relating to ion channel in seven patients have been identified as: *CACNA1C*, *CACNA1D*, *CACNA1E*, *CACNA1F*, *CACNA1G*, *CACNA1H* and *CACNA1I*. Data of three pathways of genes (66 genes) related to the characteristic manifestations of the studied patients (repeated habit, flavor recognizability, and the brain development), of which 5 characteristic genes were shown to share interactions in three pathways: *AFF2*, *NTRK3*, *CAMK2B*, *ATP2B2* and *GNAO1*.

- Two novel missense mutations (p.L111P and p.R3048C) of RYR3 gene related to transportation of Ca^{2+} ions and the pedigree of genetic mutation have been given in the sixth patient and the sixth patient's family.

Construction of a medicinal plant biomass production process (Anoectochilus formosanus Hayata) which has biological activities by liquid medium culture techniques. Institute of Tropical Biology, HCM City.

The high medicinal value of Jewel orchid was proved and this plant was classified as a precious medicinal plant of the world. *Anoectochilus sp.* has several Vietnamese names, such as "kim cuong", "kim tuyen", "moc son thach tung", it belongs to family *Orchidaceae*, includes four genera *Ludisia*, *Anoectochilus*, *Goodyera*, *Macodes* with more than fifty species (Ormerod Paul, 2005). Among those genera, *Anoectochilus* has the most

abundant species (30 - 40 species). The species with the highest medical and economic value is *A. formosanus* Hayata. *A. formosanus* Hayata, termed as "ngoc van bac" in Vietnamese. The species is closely related to several other species such as *Anoectochilus setaceus* and *Anoectochilus yungianus* which has scattered distribution in Southeast Asia region. It has dark green, heart-shaped leaves with silver nerve and burgundy red underside. The fresh herb is used to treat snakebite by covering the external wound. *A. formosanus* Hayata has high value of use. Especially, in the USA, there is a patent US 7033617 B2 of "*Use of Anoectochilus formosanus plant extracts and their derived fractions as herbal medicines or nutraceutical supplements for chemoprevention or treatment of human malignancies*". The current market price of fresh herb collected from their natural habitat is about US $320 per kg, while dry herb sold for US $3,200 per kg.

Due to the inherent biological characteristics of this species, it grows very slow. Until now, yield of *Anoectochilussp.*has never fully meet consumer demand. The targets of this subject is toimplement the process of biomass production of *Anoectochilus formosanus* Hayata by plant tissue culture technique with the targets of biological activities, safety of chemical residues, fast and large-scale production.

Based on the results of the project of the National Key Laboratory of Plant cell technology in 2015, the process of biomass production of *A. formosanus* Hayata - which has biological activities by plant tissue culture technique in liquid medium - was implemented. The extract of *A. formosanus* was evaluated against Gram negative bacteria (*Salmonela typhimuricum* and *P. aeruginosa*) better than Gram positive (*B. subtilis* and *S. aureus*). The results above suggested that *A. formosanus* may contain antibacterial substances and could be used to control human bacteria pathogen which cause various diseases. Therefore, the potential results from this work may encourage furtherelaborate research on antimicrobial activities of *A. formosanus*.

Along with other units, the product from this subject contributes to create a research value chain of *Anoectochilus sp.* which leads to formation of the high commercial final products. The results of this project indicate that plant tissue culture methods can be used in producing *A. formosanus* biomass for application in functional foods or medicine.

A. formosanus shoots in 500ml bottle

A. formosanus shoots in sigma boxes

Ex vitro plantlets.

The process of A. formosanus culture for biomass in pilot scale.

MATERIALS SCIENCE

Acad. NGUYEN VAN HIEU
Chairman of the Scientific Council

FABRICATION OF PLASMONIC BIOSENSORS

Based on the East Asia Science and Innovation Area Joint Research Program (e-ASIA JRP) signed by Japan, Thailand and Vietnam in 2012 (website https://www.the-easia.org/jrp/), the Ministry of Science and Technology of Vietnam has funded an e-ASIA JRP project titled "Plasmonic Bio-Sensor for Detecting of Serious Diseases in Southeast Asia". This joint research project aims at high level fundamental research that is oriented to clearly possible applications, and to strengthen the international collaborations in the field of materials science, technology and life sciences as well.

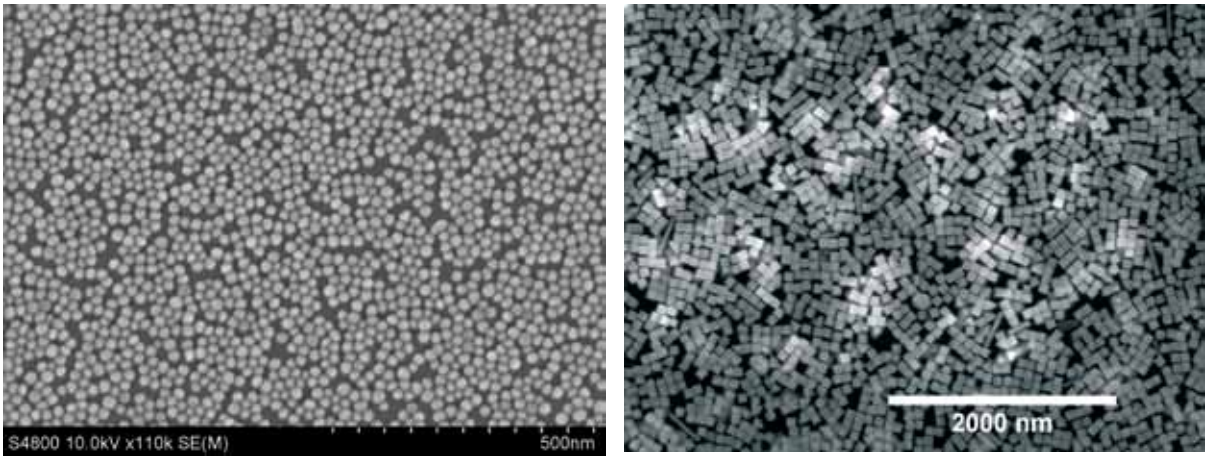
To realize this e-ASIA JRP project, three research groups at the Institute of Materials Science (IMS, Vietnam), the National Institute for Materials Science (NIMS, Japan), and the National Nanotechnology Centre (NANOTEC, Thailand) have discussed and assigned concrete tasks among the partners. The Institute of Materials Science has completed the research assignment to obtain the following results:

FABRICATION OF 02 DIMENSIONAL ARRAYS OF AU, AG NANOPARTICLES

Au, Ag nanoparticles (NPs) were synthesized by a chemical reduction method and then functionalized their surfaces with ligands suitable for making 02 dimensional arrays (2D-arrays). Functionalized Au, Ag and Au/Ag core/shell NPs of different core sizes of 20-50 nm were successfully arranged onto ITO substrates to fabricate the 2D-arrays with a high coverage (>80%) and with distances between the NPs that exceed 5 nm. Figure 1 represents the typical SEM images of 2D-arrays of Au NPs (20 nm) and Ag nanocubes (85 nm) respectively.

FABRICATION OF 02 DIMENSIONAL ARRAYS OF AU NANODISKS

The AAO templates were prepared by a two-step anodization process; then sputtering Au on the AAO templates, thermal annealing; and finally removal the AAO to obtain the 2D-arrays of Au nanodisks (NDs). The square-inch 2D-arrays of Au NDs were fabricated with the Au NDs having diameters of



SEM images of 2D-arrays of Au NPs (left) and Ag nanocubes (right).

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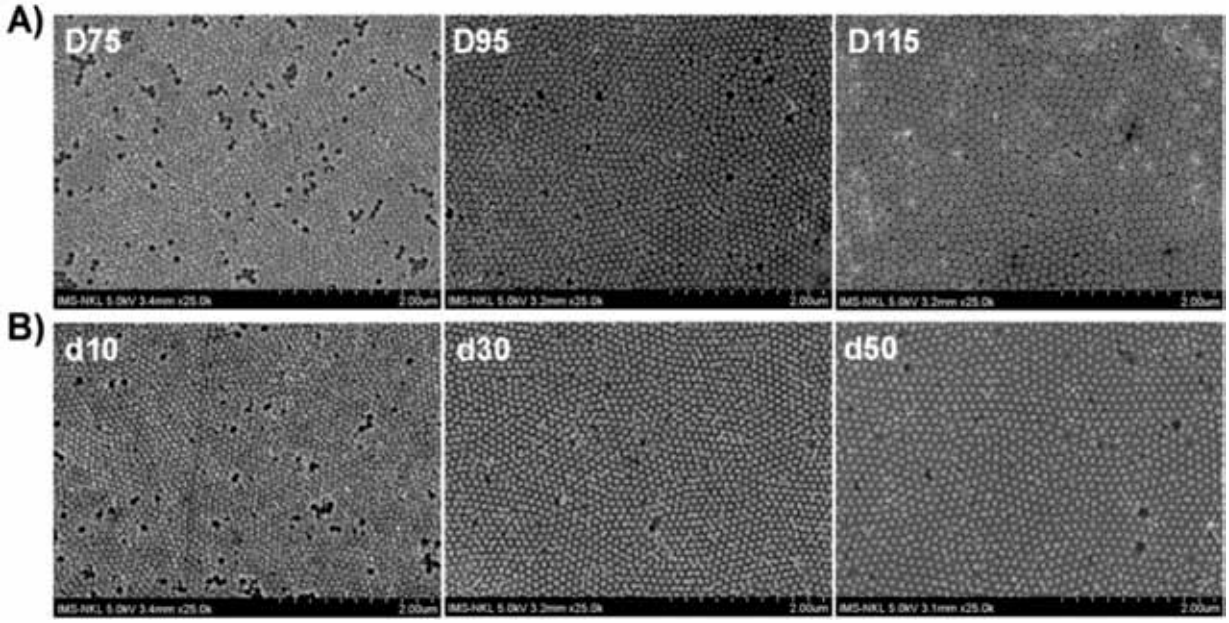


SEM images of 2D-arrays of Au NDs with different (A) disk diameters D and (B) separations d between the disks. These D and d values (in nm) are indicated in the figure.

75–115 nm, and the separations between NDs are ranging from 10 nm to 50 nm to have surface plasmon resonance (SPR) absorption in the spectral range of 600 nm-1600 nm, which covers the lasers being widely used as the excitation sources in the Raman scattering measurement, namely at 532 nm, 650 nm, 785 nm, 1060 nm, 1350 nm.

NANOTEC (the Thailand partner of the e-ASIA JRP) has tested an electrochemical immune biosensor using plasmon resonance effects of Au and Ag nanoparticles (NPs) showing high selectivity and sensitivity for detection of p16 protein, a biomarker for the cervical cancer. The detection limit is 1.3 ng/ml pure GST-p16 protein and 28 cervical cancer cells, much lower than the actual concentration in the samples taken from patients.

The results mentioned above have proven that it is possible to use p16 biomarkers on 2D arrays of metal (Au, Ag) NPs or Au NDs to continue developing another kind of biosensors that arebased on surface-enhanced Raman spectroscopy (SERS) to directly record the characteristic Raman signals from biomarkers. At the Institute of Materials Science, some preliminary SERS-based results of the H5N1 virus at very low concentration of 4ng/ul have been obtained. The results are promising as these show a high sensitivity and direct selectivity of SERS-based biosensors.

The results, contributed by the Institute of Materials Science into the aforementioned e-ASIA JRP project,have beenevaluated as "Excellent" by the National Council for Research Project Evaluation.

FABRICATION OF AN ALIGNED CARBON NANOTUBE AND GRAPHENE-BASED FIELD EFFECT TRANSISTOR AND THE APPLICATION FOR THE DETECTION OF HERBICIDE TRACES

This work was performed by the Institute of Materials Science and has achieved following results:

- Scientific results: Aligned SWCNTs and graphene film were successfully fabricated by a CVD method; Graphene films (2-6 layers) were successfully transferred from Cu substrates to electrode substrates; SWCNT-FETs and graphene-FETs were designed and fabricated by photolithography.

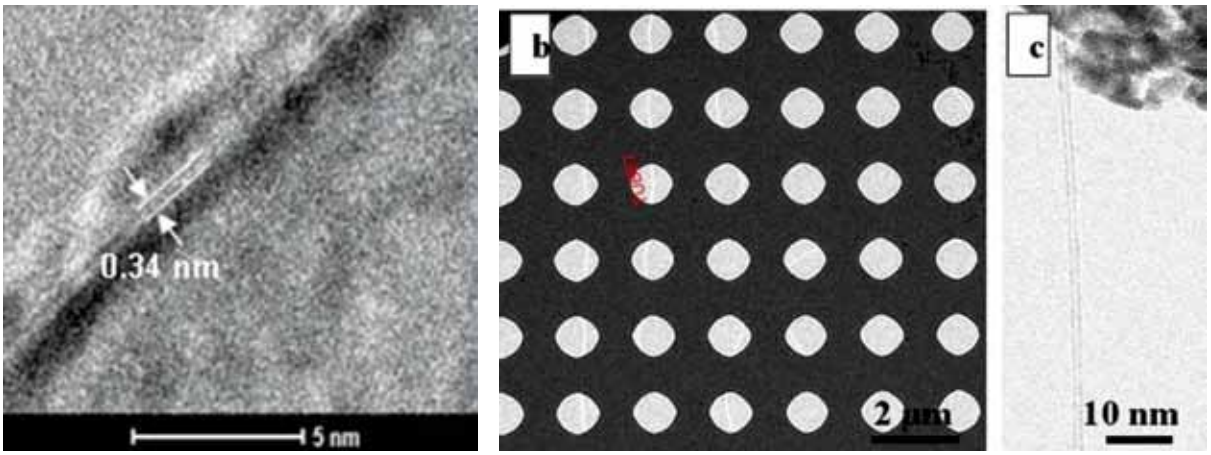
- Applied results: SWCNT-FETs and graphene-FETs were also piloted to detect atrazine and carbarylin low concentration (<ppb).

RESEARCH AND DEVELOPMENT OF A PROTON EXCHANGE MEMBRANE FUEL CELL (PEMFC) USING HYDROGENFUEL.

This work was performed in Institute of Materials Science and has achieved following results:

- Synthesized catalyst material Pt/C 20%wt. by a chemical deposition methodwith an average particle size of ~ 2.45 nm and an electrochemical surface area (ESA) of ~ 78.88 m^2/g.

- Conducted the optimum synthesis process of Pt/C



HRTEM images of: (a) graphene film and (b, c) SWCNT

20 %wt in laboratory scale > 200mg/batch.

- Researched and synthesized the catalyst material Pt3Ni/C, Pt3Co/C và Pt3Fe/C 20%wt. by a chemical deposition method. The catalyst activity of the oxygen reduction reaction of Pt3Ni/C 20%wt reached the maximum current density of -349.3 μA/cm2 at i@0,9V which is many times higher than the current density of the PT/C 20%wt. catalyst.

- Selected Pt3Ni/C as the cathode catalyst material in PEMFC.

- Researched and prepared membrane electrode assembly MEAs by a hot - pressing method. The influences of pressing parameters on MEA behaviors have been evaluated and the optimal hot - pressing condition have been established at; T= 1300C; pressing time 180s; pressure 19-21kg/cm^2

- Fabricated MEA with maximum power density ~640 mW/cm^2 by synthesized catalysts.

- Researched, designed and fabricated components of PEMFC (MEAs, bipolar, collectors) and assembled a PEMFC stack ~ 16W.

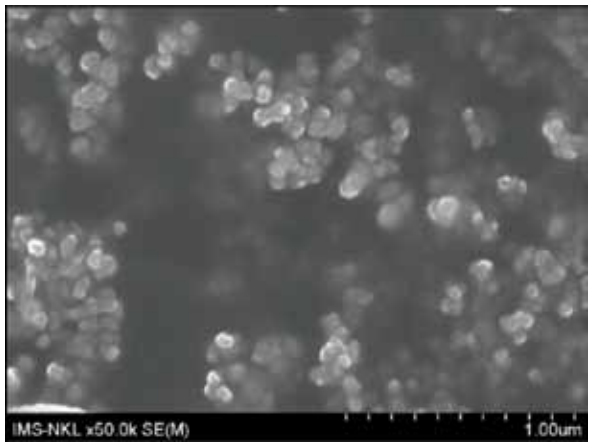
RESEARCH ON THE FUCOIDAN-SAPONIN GINSENG-CURCUMIN NANOSYSTEM FOR THE PREVENTION, SUPPORT AND TREATMENT OF CANCER

In this research of the Institute of Materials Science, natural materials including saponin ginseng extracted from Panax noto-ginseng and fucoidan extracted from brown algae were chosen to fabricate curcumin nanoparticles. Furthermore, both saponin ginseng and fucoidan exhibit anticancer activities. The combination of three components was expected to create synergistic effects against cancer.

The nano particles (Fucoidan - Saponin ginseng - Curcumin) were well soluble in water and had small, homogenous size of 50 -70 nm, which is potential for passive targeting effect, and high zeta potential of -32.3 mV. Curcumin and saponin ginseng content were 22.16% and 20.76%, respectively. Solubility of curcumin increased by more than 1000 times compared to pure curcumin (1.119% compared to 0,001%). The nanoparticles

PEMFC stack ~ 16W

Operation of PEMFC stack ~ 16W



FeSEM image, size distribution and zeta potential of nano system (Fucoidan - Saponin ginseng - Curcumin)

(Fucoidan - Saponin ginseng - Curcumin) were not toxic for testing animal and had anti-cancer effects in human cancer cell lines (Lung cancer cell line A549, liver cancer cell line Hep 3B, HTB 43). Providing the nanoparticles (Fucoidan - Saponin ginseng - Curcumin) alone and in combination with chemotherapeutic drug inhibited tumor development in nude mice, improved immune system: increased ratio of macrophages, natural kill, dendritic cell, limited loss of weight, and raised survival ratio compared to control group. These results demonstrated that nanoparticles (Fucoidan - Saponin ginseng - Curcumin) can be applied in prevention and support the treatment of cancer.

On 11/10/2016, the Institute of Materials Science transferred the nano particle complex (Fucoidan - Saponin ginseng - Curcumin) to the CVI pharma company for production of functional food, later named CumargoldKare, which is used in the prevention and support of the treatment of cancer in combination with chemotherapy.

FABRICATION OF THE ECO-FRIENDLY PAINTS BASED ON NANO-TIO_2 AND HOLLOW MICROSPHERE CERAMIC PARTICLES

Currently, common solar heat reflective coatings consist two layers: (1) primer coating and (2) solar heat reflective topcoat, which can reflect about 60-80% ofnear-IR radiation. Their life-time and solar heat reflectance can be strongly negatively affected by weathering conditions. In the period of 2014-2016, a group of researchers at the Institute for Tropical Technology, have conducted research using rutile titanium dioxide nanoparticles, hollow ceramic microspheres and acrylic emulsion. The research successfully led to asound environmentally friendly coating system with a high effective heat reflection and strong weathering durability. The obtained paint system consists of three layers: (1) alkali resistant primer coating, (2) the solar heat reflective basecoat and (3) a UV-shielding nanocomposite topcoat. The designed paints possess a high solar heat reflectance and stability under a wide range of weathering impacts. As shown in the research results, the coating systems can reflect more than 90% of IR radiation and also reduced the temperature of the concrete surface upto 09°C below that of the uncoated concrete surface for ambient air temperatures (> 35°C). For their weathering durability, the accelerated test indicated the lifetime of over 10 years. The on-site roof coatings have been applied in Ha Long city.

From the research findings, these coating systems are very effective in solar heat reflective applications, as they can significantly reduce the energy consumption and improve the living environment.

Photo of the application of solar heat reflective coating on the roof of houses at a new urban area -The Little Vietnam, Ha Long City, Quang Ninh;

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BIODIVERSITY AND BIOLOGICAL ACTIVE SUBSTANCES

Prof. Dr. Sc. TRAN VAN SUNG
Vice-Chaiman of the Scientific Council

Some optical - active bengamide derivatives have been synthetized and their cytotoxicities were evaluated on the KB, MCF 7, Lu - 1, Hep G2, HL60 and Hela cancer cell lines. Compound 3'R - 13 showed very strong activities on all 6 tested cell lines, while the enantiomere 3'S -13 indicated much lower activities.

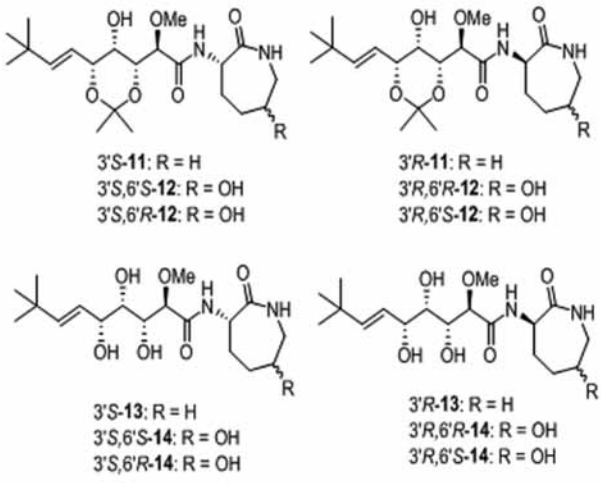


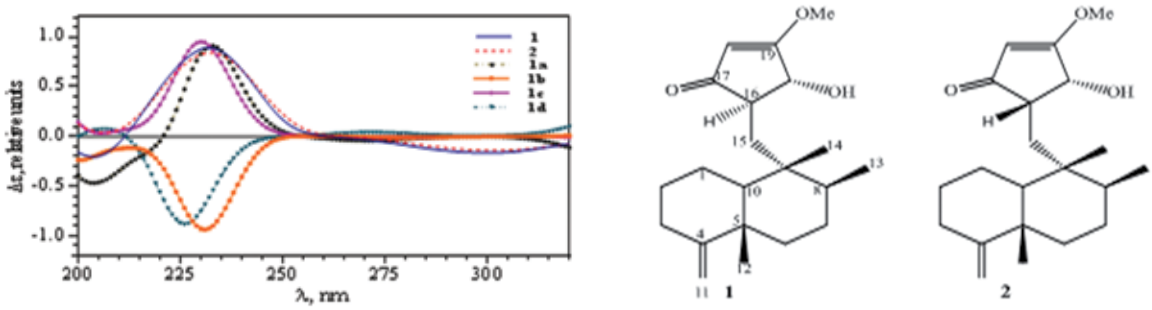
Table of Cytotoxicity (IC_{50}, µM)

Substance	KB	LU1	HepG2	MCF7	HL60	Hela
3'*S*-**13**	21.0	4.3	21.1	1.3	83.3	60.7
3'*R*-**13**	1.1	0.5	1.1	0.2	5.3	2.1
3'*S*,6'*S*-**14**	19.8	10.0	103.1	144.5	>150.0	>150.0
3'*R*,6'*R*-**14**	5.1	17.2	21.3	164.9	12.1	15.4
3'*S*,6'*R*-**14**	62.6	23.4	>150.0	23.4	>150.0	>150.0
3'*R*,6'*S*-**14**	23.7	36.3	137.6	80.4	>150.0	>150.0
3'*S*-**11**	>150.0	>150.0	>150.0	>150.0	>150.0	>150.0
3'*R*-**11**	>150.0	>150.0	>150.0	>150.0	>150.0	>150.0
Ellipticine	1.2	1.6	1.2	2.4	2.0	1.6

The first circular dichroism (CD) equipment in Vietnam (Chirascan) has been installed and used in the institute of marine biochemistry. This equipment has helped in the determination of the absolute stereos - tructures of compounds **1** and **2**, isolated from the sponge Smenospongia cerebriformis as well as the calculated ECD spectra of the optical isomers **1a** (16R, 20R), **1b** (16R, 20S), **1c** (16S, 20R), **1d** (16S, 20S).

(Institute of Marine Bio - Chemistry)

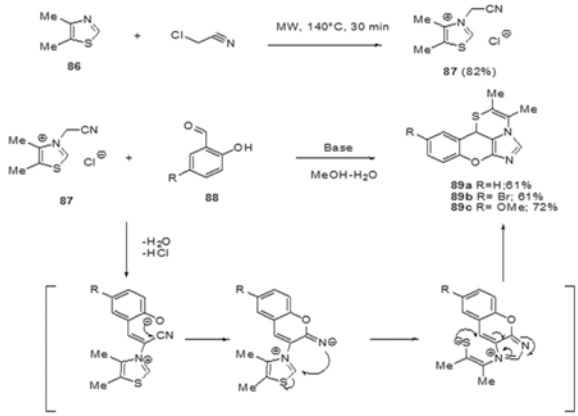
CD- equipment installed in IMBC on 12/2015



*CD spectra of 1,2 and ECD of **1a – 1d***

The use of the domino – reaction in transformation of natural products as a new approach to the bioactive molecules: For example: Synthesis of chromene derivatives 89a-c in Scheme 1

(Instifute of chemistry)



*Synthesis of chromenoimidazothiazine **89a-c***

Institute of natural product chemistry has improved the technology and equipment system for the extraction of 2nd generation curcumin .

- Origine: This is a technology developed by a pilot project of VAST "Development of technology for production of curcumin from Curcuma longa cultured in Thach Quang - plantage, Thanh Hoa province".

- Technology highlights:

+ Used ethanol and high - pressure water vapour.

+ The yield on curcumin is 20% higher than that of the 1st generation .

+ Curcumin meets the BP standard

+ Functional use of production by-products: The residue can be used as animal feed; essential oil and oleoresin as spices.

+ Equipment system: all are made in Vietnam, easy to use and semi – automatic

Curcumin extract line

Some new species have been discovred in Vietnam in 2016

Thelodermaannae,.

Photo: Nguyen Quang Truong

Odorrana mutschmanni

Photo: Nguyen Quang Truong

Dixoniusminhleii.

Photo: Nguyen Quang Truong

Tylototriton anguliceps

Photo: Nguyen Quang Truong

Cyrtodactylus otai

Photo: Nguyen Quang Truong

Cyrtodactylus bobrovi

Photo: Pham The Cuong

LasianthushonbaensisV.S.Dang, Tagane&H.Toyama

Aspidistra parviflora N.S. Lý& Tillich)

Cleisostomayersinii J. Ponert&Vuong

Liparishonbaensis Aver. &Vuong

Peliosanthesaperta Aver., N. Tanaka &Vuong

Peliosantheselegans Aver., N. Tanaka &Vuong

EARTH SCIENCES

Assoc. Prof. Dr. Sc. TRAN TRONG HOA
Chairman of the Scientific Council

SCIENCE AND TECHNOLOGY ACTIVITIES

Science and Technology projects

In 2016, the Earth Science Institutes, including the Institute of Geological Sciences (IGS), the Institute of Geography (IG), the Institute of Geophysics, the Ho Chi Minh City Institute of Resources Geography completed 09 National Science and Technology projects (including 02 of fundamental research projects funded by National Foundation of Science and Technology Development NAFOSTED); 12 projects/tasks funded by Vietnam Academy of Science and Technology (VAST); 02 Central and Provincial administration collaborative projects.

The Earth Science Institutes have completed 52 institutional research projects, 26 young researchers awarded projects and more than 30 science and technology contracts.

By mid-2016 the science and technology projects in earth sciences within the Tay Nguyen 3 Program were completed and the achievements were submitted fully to the Program Directorate, VAST, and Ministry of Science and Technology to transfer to the Board of Tay Nguyen Program and Tay Nguyen provincial administrations.

Earthquake and tsunami monitoring and warning

The earthquake and tsunami monitoring activity has been operated by the Institute of Geophysics throughout the 2016 year. In total, 21 earthquakes with magnitudes ranging from 2.5 to 4.7 of moment scale were recorded on land and the East Vietnam sea, including 6 with magnitudes stronger than 3.5. All were instantly informed to the public.

Publications

In 2016, the four Institutes had 103 research articles published. These include 17 in international SCI and SCI-E journals, 09 in international ISSN journals and 77 in VAST-based journals and in other national scientific journals. Eight monographs were published including one printed by Springer Publishing, and numerous reports have been published in national and international scientific proceedings.

International collaboration and training

The activities are as follows: continued to implement the agreement on Science and Technology collaboration between IGS and (1) the Institute of Geology and Mineralogy, the Siberian Branch of the Russian Academy of Science, (2) the Institute of Earth Sciences, Academia Sinica of Taiwan, (3) signing cooperation agreement with the Western Kentucky University (WKU CHNGES), Bowling Green, Kentucky, USA, (4) joint-organized an international symposium on *"Geodynamics & Geohazards in Vietnam and Neighboring regions"* 23-25 October, in Hanoi. The Institute of Geography implemented the collaboration agreement with the Pacific Oceanological Institute, the Far Eastern Branch of Russian Academy of Sciences (POI-FEB, RAS) and joined with the Earth Monitoring Institute of Taiwan to organize an international seminar on *"Monitoring Meteorological hazards using Earth monitoring technologies"*. The four Earth Science Institutes have also sent a number of young researchers for master and doctor studies at the international collaborative establishments, meanwhile educational courses have also been opened for domestic and international students at various VAST-based facilities.

NEW RESEARCH ACHIEVEMENTS

Application of remote sensing and GIS in investigating landslides, flashflood, soil erosion and land surface deformation

The application of (1) combining high-resolution remote sensing VNREDat-1, SPOT-5 and Landsat-8 images and GIS technologies in establishing

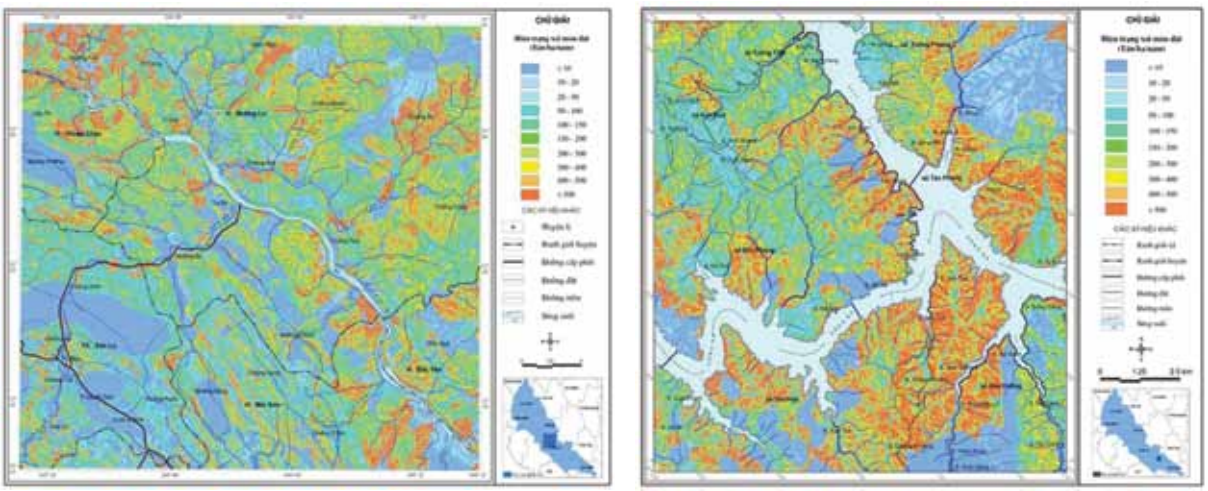
status and prediction maps of geological hazard (landslide, flashflood at 1/50,000 scale for Hoa Binh - Son La hydroelectric region, National Route 6, 12, 4D and Viet Tri - Lao Cai Railroad), and potential land erosion for Muong La and Ban Van areas at 1/25,000 scale; (2) detailed evaluation of factors igniting geological hazards such as geological and lithologic, weathering crust, forest cover, land use status, and their areal contours were precisely defined; (3) using space models in prediction of geological disasters showing high accuracy and actuality. Combination of morphological monitoring data of lake bottoms for sedimentation rate calculation and application of hydrodynamic models in constructing risk maps of lake bed accretion in the key area of Ban Van at 1/25,000 scale (Space Science and Technology's Project).

Map of soil erosion status of Muong La and Ban Van areas. The national project "Study on application of VNREDSat-1 satellite imagery and equivalents to investigate, forecast and evaluate geohazards of hydroelectric reservoir works and traffic in northwestern provinces" (Institute of Geological Sciences).

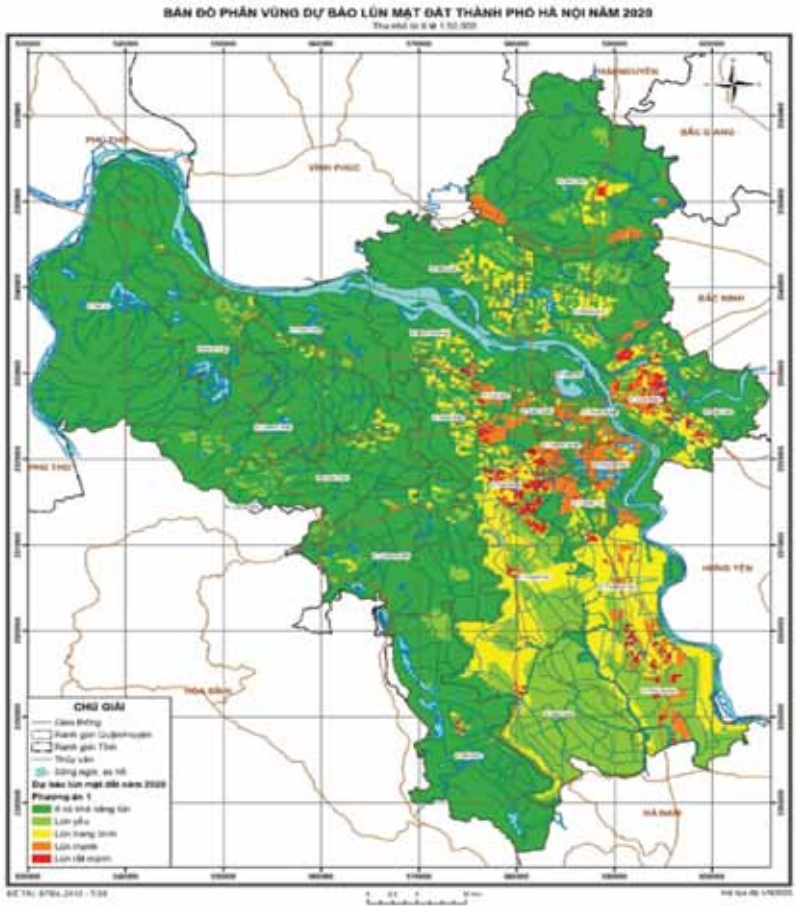
For the first time for the greater Hanoi area, various SAR X-band data have been applied in studying surface deformation. The combined application of various remote sensing information (TerraSAR-X, Cosmo-SkyMED, EnviSAT, Alos-Palsar) and GPS, levelling data, DTM and field survey data have lead to the comprehensive study of subsidence in the Hanoi area. This has allowed an objective evaluation of the input data (SAR, DTM...) and Interferometric synthetic aperture radar (InSAR) techniques. It also allowed an evaluation of its predictive ability for deformation results by InSAR for land subsidence of the Hanoi area. The main achievements of the project include: a map of surface deformation relative to vertical axis for the entire Hanoi area in the periods of 2000-2005, 2006-2010 at 1/50,000 scale, and for the Hanoi inner and neighboring areas in the period of 2011-2014 at 1/25,000; a map of classification of estimated surface subsidence across Hanoi in 2020 and 2030 at 1/50,000 scale following the planned scenario by Degree 499/QD-TTg and a scenario proposed by the project; a proposal on integrated monitoring system, space-time monitoring and surface subsidence warning systems for the greater Hanoi area.

Study of paleoclimate conditions and historic flooding events from lake and swamp sediments

This is a new direction of research implemented within the collaborative framework between Vietnam Academy of Science and Technology (VAST) and JSPS (Japan). Based on In-situ sedimentary samples from a maar in Pleiku (Gia Lai province), in-depth analysis using an attenuated total reflection Fourier transform infrared (ATR-FTIR) spectroscopy and ^{14}C isotopes have determined two periods of significant bio-geochemical changes at about 6,500 and 10,600 years ago which mark the transitionfrom a dry to humid climate. The change from dry to humid between the Pleistocen and the Holocene was about 10,600 years ago, much later as compared to conventional timing at 11,700 years ago, the reason may be caused by the change in intensity of the East Asia mon soon and/or Atmospheric circulation over the Pacific. Based on these results,



Map of landslides and flash floods of rocks in Hoa Binh-Son La lake



Subsidence prediction map for Hanoi City in the year of 2030
(National Funded Independent Project coded 2012.T/28)

it is expected to detect periods of extreme climate changes such as flooding, drought events in the past while providing a new perception on current climate change based on studying the climatic changes in the past. Thereby, opening interesting future research directions on the paleoclimate and past environmental change in Vietnam.

Study on the use of microbiological technologies in gold-sulfide ore processing

The national project on *"Study of gold-sulfide ore type (invisible gold) in Northern Vietnam"* (KC08.14/11-15), a collaboration between the Institute of Geological Sciences and Institute of Biological Technology (VAST), is aimed to evaluate the industrial potential of the ore and to present appropriate Au-sulfide ore refinery and recovery technologies. Among the experiments using various ore processing and extraction techniques, a microbiological (oxidization) method appeared to be the most successful. Two species of aerobic bacteria, namely *Th. Thiooxidans* and *Th. Ferrooxidans,* were chosen based on the capability of oxidizing reduced Fe-sulfides, their fitness to an environment of Fe contents in terms of reproduction and functional productivity of the bacteria. Using these bacteria in gold extraction from Au-bearing sulfide ore appears to be efficient (>85%) while reducing risk of environment pollution. This application shows realistic prospect in Au-sulfide ore processing in Vietnam.

Geochemical application in study of mining environment and pollution mitigation technologies

Using geo-environmental modeling approach to mineral deposits reveals the relationship between the geological, geochemical, mineralogical, deposit-type characteristics and the risk of heavy metal pollution in each model. The geo-environmental modeling approach shows that mining and mineral processing technologies, especially the method of waste dump and tailing creation has an important role in the metal release into the environment. These results have important significance for mining environmental protection as well as proposing tecnological measures for pollution mitigation (Project VAST05.05/15-16).

An test model using natural, environmental friendly materials had been created for acid mine drainage treatment in Minh Quang Pyrite Mine (Ba Vi, Hanoi). The model uses limestone to neutralize acid in combination with laterite for metal adsorption. Acid mine drainage after treatment has pH increased from average 3 - 3.5 to 6 - 6.5. The contents of some metals such as Fe from an average of 150 - 250mg/L to <3 mg/L; Zn from an average of 10 - 15 mg/L to 1-3mg/L, Cd from ~ 0.2 mg/L to <0.1 mg /L. After treatment the acid mine drainage with low pH and high metal concentrations became to be well satisfied the National Techinical Regulation on Industrial Waste water (QCVN40:2011/BTNMT). This model can be applied to treat acid mine drainage at industrial scale.

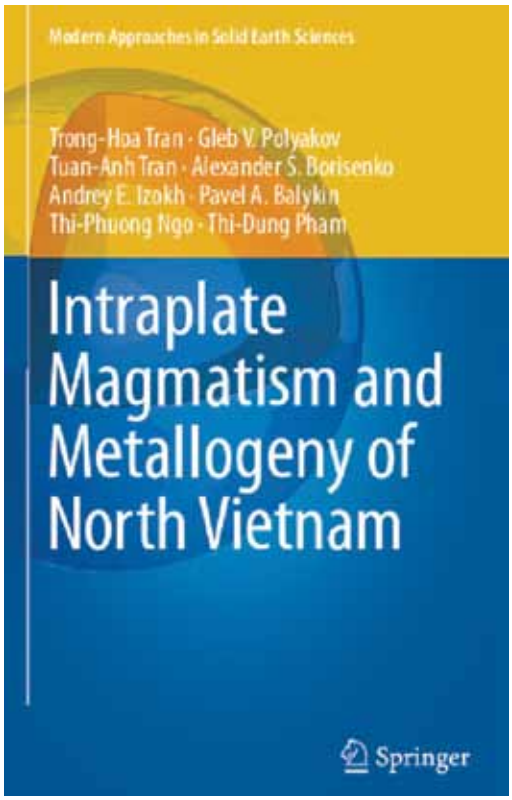
NEW SCIENCE & TECHNOLOGY PRODUCTS

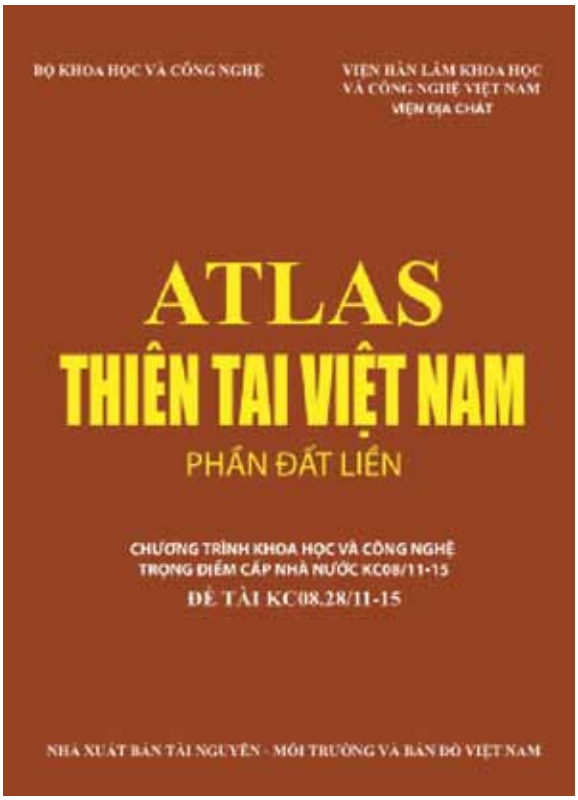
Monograph "Intraplate Magmatism and Metallogeny of North Vietnam"

The monograph was published by Springer in January 2016. Most essential achievements of the study are defining the Permian - Triassic intraplate magmatism in the Song Da - Tu Le and Song Hien - An Chau rift zone, and the Phan Si Pan uplift. The contributions elucidate the development history of the geology in Northern Vietnam in the Permian - Triassic period, and clarify the Cenozoic magmatism in Northwestern Vietnam, allowing for validating the scale of magmatism in relation to the formation and evolution history of Red River Shear zone. The determination of mantle plume-related Permian - Triassic intraplate magmatism in the Song Da - Tu Le, Song Hien - An Chau Rift zone and the Phan Si Pan uplift offers essential criteria in the potential assessment and endogenic mineral exploration such as mantle plume-related Cu-Ni-PGE, Fe-Ti-V and Au-sulfide believed to developed in geological structures in Northern Vietnam.

Maps of Natural hazards of Vietnam (continent) and Atlas (electronic and printed) of Natural hazards of Vietnam

Maps of natural hazards (typhoon, drought, flood, landslide, flashflood, land fracture, coastal erosion, earthquake) that have frequently occurred in Vietnam (continental part); a set of combined maps of hazard risks and regional hazards of Vietnam was issued in the form of both printed and electronic atlas (online) at 1/1,000,000 and 1/3,000,000 scale. The maps are accompanied by open access databases, easy to access and regularly updated with newer maps, instantly serving natural risk management, rational land use management for local to central levels.





MARINE SCIENCE AND TECHNOLOGY

Assoc. Prof. Dr. Sc. NGUYEN VAN CU
Chairman of the Scientific Council

In 2016, the Council has selected 24 state-level proposals, submitted by the Department of Finance and Planning to the Ministry of Science and Technology. The proposals are in consideration for the inclusion on the list of projects implemented in 2017. These include 04 proposals in the direction of marine geology and geophysical, 05 proposals in Oceanography, 12 proposals in marine environment and natural resources and 03 proposals in marine biology.

Currently 01 project belonging to the KC.09 /16-20 program, in the research direction on maritime security and sovereignty, has been signed by the Ministry of Science and Technology and the Vietnam Academy of Science and Technology for implementation in 2016 and onwards.

The Council also undertook to recruit and propose 6 VAST-level proposals, in which there are two proposals in the direction of the marine environment, two proposals in marine biology, one proposal on marine geology direction and one proposal on marine civil engineering.

The Council has selected two independent proposals by young researchers of the Vietnam Academy of Science and Technology to deploy in 2017 in the field of marine biology.

Talks between the delegation of the Council of Marine Science and Technology and the leaders of Geological Sciences, Chiang Mai University (8/12/2016).

The Council has selected 03 best works published on the marine science by the scientists of the Vietnam Academy of Science and Technology, at the request of the President of VAST.

Among 03 state-level protocol projects between Vietnam and the United State of America, one project was completed and accepted at the state level, 02 other projects were completed and accepted at VAST level and has been filed by MOST to wait for state level assessment and acceptance.

In 2016 the scientists of the Institute of Marine Geology and Geophysics and the Institute of Natural Resources and Marine Environment actively deployed a state-level protocol project between Vietnam and China within the framework of Vietnam-China Cooperation Forum on the East Vietnam Sea in less sensitive areas. The scientists at the two sides have held 03 exchange visits, in which each exchange visit includes field surveys, academic exchanges and training and scientific conferences. Also in 2016, the Vietnam site also sent two trainee groups, each group sent 02 persons to Qingdao Institute of Marine Geology,

Shandong, China to practice.

According to the 2016 work plan, the Council has implemented a working tour to Thailand with 3 members. The delegation visited and worked with Chiang Mai University, Thailand, opening up new possibilities for cooperation with the University, particularly in the field of analyses and interpretation of marine geophysical data at the center of scientific research of the Geology Department.

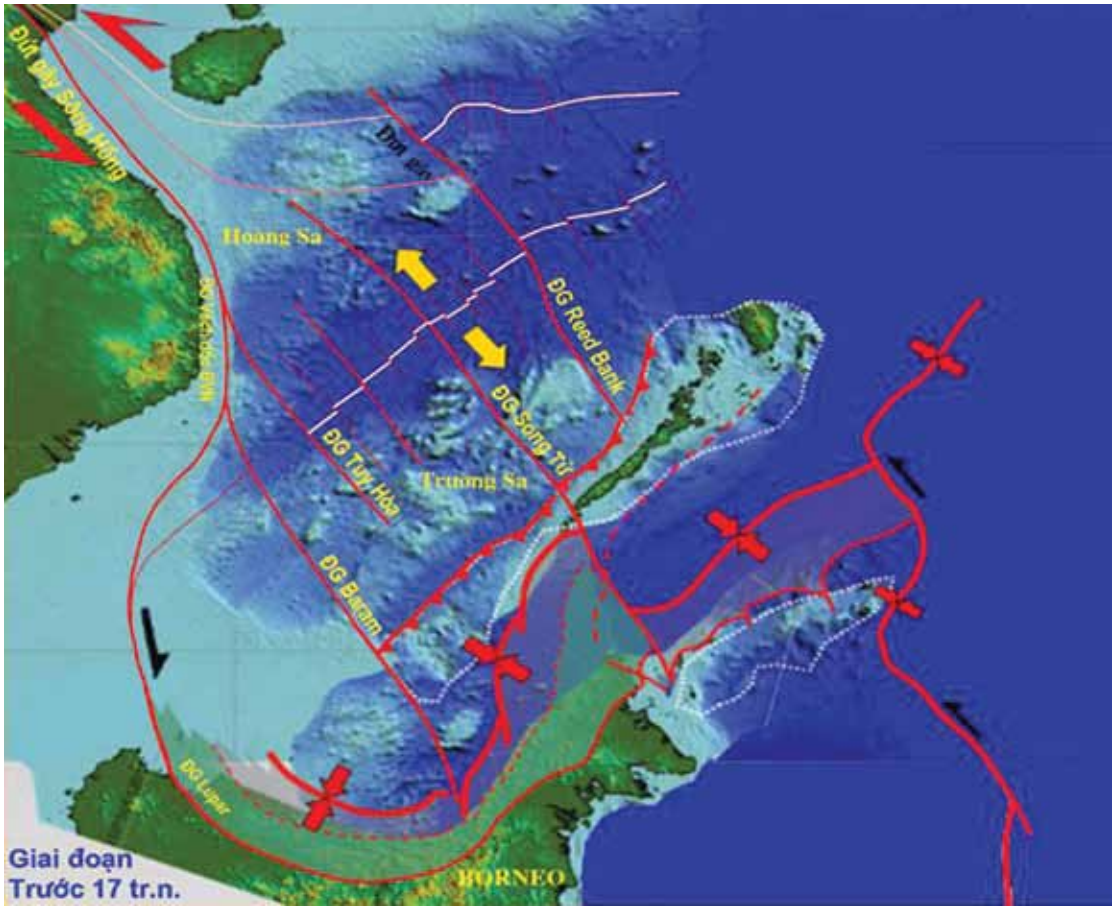
In 2017 the direction on marine science and technology is going to continue to carry out 6 projects from 2016 and 6 projects are planned to be performed from 2017 to 2018.

Some of the major results

- Results of the research project: *"Research structural features - geodynamic of Thuan Hai - Minh Hai fault according to geological and geophysical data"* has provided a database of geological hazards (earthquake, volcanoes, coastal erosion...) and their hazard assessment for serving socio-economic development planning, prevention and mitigation of natural disasters for coastal areas and Southeast continental shelf of Vietnam.

- Researched the tectonic environment and the establishing conditions of the geological structure in the South Central (from Binh Dinh to Khanh Hoa) and corrected the major tectonic phases in Middle Cretaceous (K2) by the geological structure-tectonophysics data, seismicity; Defined the tectonic structural features - geodynamics of fault systems in South Central. The study results have an important contribution in orienting mineral exploration and investigation in the East Vietnam Sea.

- The research project: *"Investigate the muddy process and the bottom sedimentary in Halong Bay aiming at contributing the protection and promotion of the values of the World Natural Heritage"* assessed the material source, the actual situation and forecast of the muddy process; calculated the rate of sedimentation in Halong Bay during 150 years



Simulating the East Vietnam Sea evolution and geodynamic conditions related to the time before stopping sea floor spreading (before 17 Ma). (by Phung Van Phach, 2016, using the 3D background and Southeast part of Manuel Pubellier 2013)

Delegates from the VAST participating the scientific conference in Yunnan University, Kunming, China, in the framework of the Cooperation Forum Vietnam-China on the East Vietnam Sea in less sensitive areas.

ago is from 0.02 to 1.56cm/year. Suggested solutions to prevent and restrict the muddy and the bottom sedimentary aiming at contributing to the protection and promotion of the values of the World Heritage Site.

- The research project: *"Research on geotechnical conditions for the construction of underground works in the coastal areas of Phu Yen - Khanh Hoa"* clarified geotechnical conditions of coastal areas of Phu Yen - Khanh Hoa as a basis for the selection of construction design of civil and defense underground works in the study area.

- The project: *"Research the modulation of polyguluronat sulfate chemical derivatives of low molecular weight of alginate from Vietnamese algae aiming at applications in pharmaceuticals"* have built a technology process of manufacturing polyguluronat sulfate chemical derivatives of low molecular weight of alginate from Vietnam algae. Products of the project contributed rational and effective use from algae, paving the way for the production technology of functional food from Vietnamese seaweed.

ENVIRONMENT AND ENERGY

Assoc.Prof.Dr.VU DUC LOI
Secretary of the Scientific Council

Vietnam Academy of Science and Technology scientists were collecting samples at sea bottom after the environmental disaster occuring in four central provinces

2016 PROJECT EXECUTION AND ACHIEVEMENT REPORT

In 2016, the environment and energy division has carried out 13 projects in which nine are transitional and the other four are new openings. The total budget is 3600 million VND, 2400 million VND for transitional projects and 1200 million VND for new ones. In 2016, all projects were chaired and operated properly according to the plan. This year, the environment and energy division has accepted 02 projects, which ended in June 2016, and both were classified as good. The projects in the environment and energy division focus on the following research areas: waste treatment technologies; wastewater treatment by membrane – biotechnology; waste gas treatment, research on waste leachate treatment by the combination of electrochemical flocculation and biofiltration; research and treatment of herbicides and disinfection in drinking water in rural and mountainous areas by TiO_2 photocatalyst; research treatment of heavy metal pollution in agriculture soils by plant in lead recycling villages; research to synthesize nanocomposite material containing nano silver to eliminate the harmful

effects of some fungi that persist in soil and cause disease in plants to replace pesticides that cause environmental pollution…thus propose environmental protection methods; research the catalytic cracking process on new FCC catalyst systems for the production of bio gasoline (Bio-20) from biodiesel (agro-forestry waste) and oil residues of equivalent quality to commercial gasoline; develop method and program for the assessment of reliability of electricity supply considering the roles of renewable energy sources and fuel sources for power plants in Vietnam.

Notably in 2016, many institutions in VAST that are working in the field of the environment and energy field have been assigned by the Government to determine the cause of the abnormal massive seafood death in coastal central provinces. The National Science and Technology Council which was led and chaired by the President of VAST had determined that the main cause of the environmental disaster of the abnormal massive seafood death in coastal central provinces was due to the waste discharge of Hung Nghiep Formosa Ha Tinh Steel (FHS).

2017 PROJECT DEVELOPMENT OUTLOOK:

In 2017, the environment and energy division will open 05 new projects, the new opening projects include:

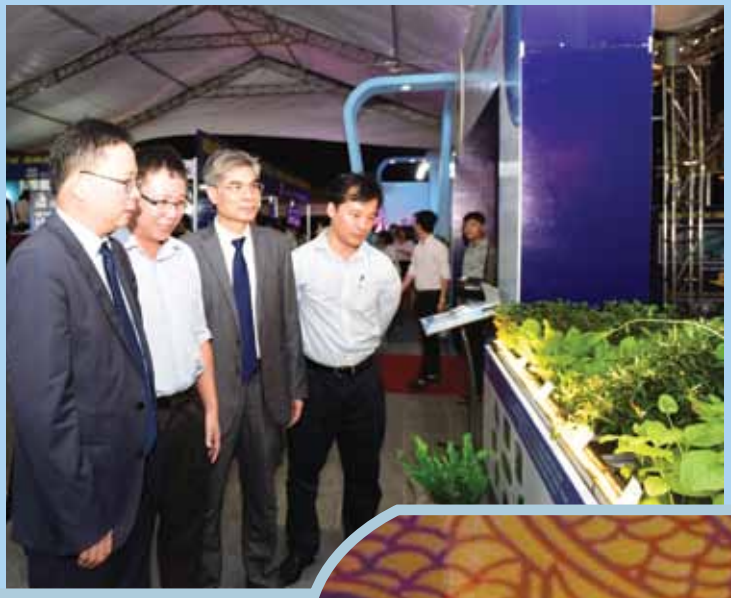
1. VAST07.01/17-18. Research the treatment of hazardous solid waste in the furnace without using column fuel NFIC.

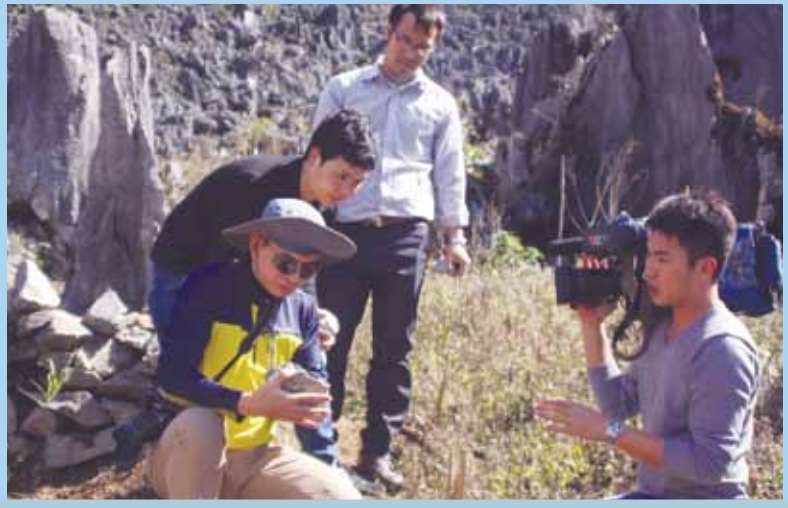
2. VAST07.02/17-18. Treatment of arsenic in well water by electrochemical flocculation technology at residential scale.

3. VAST07.03/17-18. Research the method and develop program for optimizing power flow in microgrid considering the dependence on frequency and voltage of source and load.

4. VAST07.04/17-18. Recovery of iron from rust removing solution to make magnetic nanocomposite having disinfection for hospital waste water treatment.

5. VAST07.05/17-18. Transformation of greenhouse gases on plasma-catalyst systems.





TECHNOLOGY APPLICATION AND DEPLOYMENT

TECHNOLOGY APPLICATION AND DEPLOYMENT

Dr. HA QUY QUYNH
Director, Department of Application and Development of technology

In 2016, VAST has developed, completed, transferred numerous technological processes, and technology products to the market and companies. This includes also marketing strategies and intellectual properties to the potential customers.

In the year 2016, the institutions under VAST have signed 1076 contracts with a total budget is 300 billion VND. This includes 834 economic contracts with companies with a total budget of more than approximately 200 billion VND. The remaining other type of contracts include 242 agreements, worth about 200 billion VND. The Institute of Environmental Technology has signed 467 contracts with a total revenue from economic contracts of approximately 90 billion VND in 2016.

In 2016, the Vietnam Academy of Science and Technology has presented 16 technologies that are ready for transfer. Of these, ultimately nine technologies have been transferred already in 2016. These include 07 technologies originating from national projects and 02 technologies were formed from technology contracts.

THE MANAGEMENT OF COOPERATION PROJECTS AND PILOT PROJECT

VAST has 28 cooperation projects with provinces and ministries, including 13 continuous projects (in 2015-2016 period), 10 newly started projects (in 2016-2017 period) and 05 projects planned for 2017-2018 years.

Pilot projects include 06 continuous projects (in 2015-2016 period), 05 newly-opened projects (in 2016-2017 period) and 04 projects planned for 2017-2018 years.

Evaluation of the projects which finish in 2015: 8/11 cooperation projects have been evaluated; 03 projects are prepared for evaluation; 3/3 pilot projects have been evaluated.

The local provinces and ministries in cooperation with VAST are: Bac Giang, Đien Bien, Lao Cai, Thai Binh, Hai Phong, Da Nang, Tra Vinh, Ben Tre, Đong Nai, Lam Dong, Tuyen Quang, Ha Giang, Quang Ninh, and the Ministry of Defense, Ministry of Public Security, and some companies.

DEVELOPMENT THE COOPERATION WITH MINISTRIES, LOCAL PROVINCIAL

Meeting with people committee of Ninh Thuan province, Dak Nong, Thua Thien Hue, Da Nang, Ha Nam province, Ministry of Agriculture and Rural Development on scientific and technological cooperation between the two agencies.

Organization of the meeting of the leaders of the VAST with the local provincial include: Da Nang City, Binh Phuoc, Thua Thien Hue. The subject of discussion is the application, technology transfer for socio-economic development of the provinces and cities.

Based on a sustainable relationship between the VAST and the provinces. Overall, the cooperation project and the pilot project are the urgent task, starting from the actual needs of the industry companies, of business and of demand from reality. The cooperation project, pilot project approach are shortcut to apply scientific and research results to the production and life. Through this approach, the VAST has played importance role and position towards the local.

THE NATIONAL TECHMART (28/09 - 01/10/2016)

VAST EXHIBITION AREA IN TECHMART DEMO IN THAI NGUYEN (11/ 2016)

THE STRENGTHENING AND PROMOTION OF TECHNOLOGY TRANSFER, AND THE COMMERCIALIZATION OF INTELLECTUAL PROPERTY

In 2016, Department of application and development of technology has organized many activities to promote and introduce important research results and technological achievements of the VAST, including:

- The completion of the project *"Improving the intellectual property system of the VAST"*. The project has brought forward a draft intellectual property management regulation of the VAST. In addition, 07 workshops, seminars for 300 participants (05 workshops, 200 participants compared to 2015) have been organized to raise awareness and to transfer skills and knowledge regarding how to develop descriptions of industrial property for its registration and further commercialization of technology. The workshops have been funded by a World Bank project and the Ministry of Planning and Investment. The workshops were appreciated with good feedback from participants.

- Collaboration with the National office of Intellectual Property to organize a training workshop on registration of projects under the intellectual property development assistance program. Through this training workshop, the institutes of VAST have registered 09 proposals to the program. Through training workshops the scientists of VAST have increased their awareness, contributing to the development of IP activities, increasing the number of approved IP application applications forms.

In 2016, within VAST, 29 intellectual property certificates were published, including 11 patents. The number of patents in 2016 increased by 06 compared to 2015. In addition, utility solutions have increased by 05 compared to 2015.

In 2016, VAST has participated in many National and regional Techmart programs to promote the introduction of technology, including:

In the National Techmart in October 2016 at the Hanoi Museum, 17 VAST's institutes has participated with 20 kiosks and more than 200 technologies introduced. At the Techmart, the Institute of Materials Science and the High Technology Development Center have signed a cooperation agreement on technology transfer and development with enterprises.

At the regional level and at the BioTechmart, VAST participated full time with many activities.

The Department of Application and Development technology collaborated with the Department of Science and Technology of Haiphong city to hold a mini techmart in Haiphong City, named *"Introduction of some achievements and results of VAST"*. At the Technology exchange conference in Hai Phong, there were 11 units with many technologies being demonstrated.

In 2016, Department of Application and Development technology has published the book *"Technology Introduction of the VAST"*. This book introduces technologies available for transfer and application.

The VAST organized many seminars and workshops to promote and commercialization the technology of VAST, including; "*Workshop on the application of science and technology in medicine"* in Da Nang City and the *"Workshop on the application of high technology in agriculture"*. The workshops were well-attended by the business community, the press and media.

The VAST authorized the organization of the Tran Dai Nghia Prize for the first time in 2016. The success of award and celebration left many echoes in society.

To assess the application and development of technology in 2016, the Industry and Trade Newspaper has published an article titled *"The VAST - Promoting the application of scientific research"* in a special issue of New Year newspaper.

The Vietnam National Television, VTV1 also produced a report on the New Year's theme, *"The new scientific values of the global geological plateau - Dong Van Plateau"*.

HIGHLIGHTS IN APPLIED TECHNOLOGIES IN 2016

Three institutes of VAST have transferred three high-tech technologies in the fields of material science, nanosciences, biomedical sciences, chemistry, and biotechnology for CVI Cosmetics Pharmaceutical Company, Goldhealth and Hau Giang Pharmaceutical Company. More details regarding the technology transfer are described below:

The Nha Trang Institute of Technology Research and Application organized a Technology transfer workshop on the *"Technology of producing sulphated Fuicoidan"* between the Nha Trang Institute of Technology Research and Application and the GoldHealth Company;

The Institute of Materials Science in corporation with the CVI Cosmetics Pharmaceutical Company organized a technology transfer workshop on *"Manufacturing Nano FGC Complex in Cancer Treatment Support"*;

The Institute of Biology Technology organized the transfer of *"Naturenz Products"* to the Hau Giang Pharmaceutical Company.

The Institute of Geology handed over the results of studying the new values of the Global Geopark - Dong Van Plateau to Ha Giang Province to exploit for tourism.

Technology transfer workshop on "Technology of producing sulphated Fuicoidan" between Nha Trang Institute of Technology Research and Application and GoldHealth Company

The Institute of Biology Technology organized the transfer of "Naturenz Products" to Hau Giang Pharmaceutical Company

Transfer workshop "Manufacturing Nano FGC Complex in Cancer Treatment Support" by the Institute of Materials Science to CVI Cosmetics Pharmaceutical Company

TRAINING ACTIVITIES

The Vietnam Academy of Science and Technology (VAST), as the leading scientific research institute in the country, has tied scientific research with the training of human resources, and for many years has become a cradle of quality human resource training. It is particularly well-known nationally in the field of natural sciences.

GRADUATE UNIVERSITY OF SCIENCE AND TECHNOLOGY

Dr. NGUYEN TIEN DAT
Vice Director, Graduate University of Science and Technology

GUST is a state-owned academic institution, an Organization under the VAST. The founding of GUST is the inheritance of the existing graduate level academic training of the Research Institute System of VAST, bringing it to new heights.

Currently, GUST is holding 50 Ph.D. programs and 14 MSc. programs in the fields of natural sciences and technology, belonging to 11 academic faculties. In 2016, the total number of Ph.D. students in training at the GUST is 798.

Based on the resources of equipment, laboratories, experienced scientific staff, the strong and long-standing tradition of international cooperation of VAST with over 50 scientific and technology organizations from all over the world, GUST aims to become a postgraduate academic university accredited in Vietnam and recognized internationally with the goal to raise high quality talents and human resources for the scientific and technological advancement of the country. GUST focuses on building a strong international cooperation program to raise the quality of academic training on par with international standards, associating training with scientific research activities of VAST.

Academic Staff

FACILITIES

MSc. TRAINING

On November 7th 2016, according to decision number 5238/QĐ-BGDĐT of the Minister of Education and Training, the GUST was licensed to hold academic training activities for M.Sc. programs for the school year 2016-2017 with 14 courses in 4 faculties: Mathematics, Physics, Ecology of Resources and the environment, and Chemistry. GUST continues to expand its M.Sc. programs to other faculties in its 2017 plan.

PHD. TRAINING

On July 7th 2015, according to decision 2348/QĐ-BGDĐT of the Minster of Education and Training, the GUST was licensed to hold academic training activities for Ph.D. level for the school year 2015-2016 with 50 courses from the research institutes of VAST.

In 2016, GUST awarded 41 Ph.D. diplomas. By November 2016, GUST has 798 Ph.D. students, distributed as shown below:

POSTDOC PROGRAM

GUST has been briefed by the VAST to develop and implement the Post-doctoral (Postdoc) program from 2017 to promote high standard human resources for science and technology at post-doctoral level for the VAST. These objectives aim to meet the growth requirements stipulated in the Master plan of 2020 and towards 2030 of VAST, which has been approved by the Prime Minister of the Socialist Republic of Vietnam (Decision 2133/QĐ-TTg, December 1st, 2011).

The Postdoc program builds on international standards, combining the post-doctoral human resource training with scientific research activities to encourage and motivate passion in scientific research for young scientists. Through this program, these post-docs are expected to gain knowledge and experience to become research staff of the VAST.

INTERNATIONAL COOPERATION

Inheriting the strength and tradition in international cooperation of the VAST with over 50 science and technology organizations worldwide, GUST continues expanding its international cooperation in academic training and research with many international partners such as: Kazan National Research Technological University (Russia), University of Technology, Sydney (Australia), Austria Institute of Technology (Austria), King Mongkut's University of Technology North Bangkok (Thailand), University of Science and Technology (Korea). In the near future, GUST plans to sign cooperation agreements with Pusan National University (Korea), University of Chinese Academy of Sciences, Chinese Academy of Sciences (China), Japan Advance Institute of Science and Technology (Japan).

In 2016, GUST officially became a partner in the European ERASMUS project for MSc. and Ph.D. training in Earth sciences. This project will promote the modernization and internationalization of the Vietnamese education system through creating an international education program, fostering regional integration and intercontinental cooperation, to provide better opportunities for exchange programs in the future.

Ph.D. diploma award ceremony of May 2016

UNIVERSITY OF SCIENCE AND TECHNOLOGY OF HANOI (USTH)

Prof. PATRICK BOIRON
Rector, University of Science and Technology of Hanoi

- A new model public university developed by Vietnam and France
- USTH is a teaching and research-oriented Higher Education Institution, enhanced by a strong connection with leading companies in Vietnam.
- A multi-lingual, multi-cultural environment: English, French, Vietnamese. Teaching methods are based on student self-sufficiency, initiative, team work and practical experiments.
- Access to leading laboratories of Vietnam at VAST and international joint laboratories.
- Various scholarships and internships for overseas programs as well as student exchange programs.

Transfer Ceremony of USTH from Ministry of Education and Training to VAST

On March 18th 2016, the University of Science and Technology of Hanoi (also called Vietnam France University), a public university modeled according to international standards, was transferred to the VAST, following the decision made by the Prime Minister. This decision was taken to help scientists and other institutes of VAST to actively contribute to the training of USTH students and the development of research.

USTH offers training courses at three levels: Bachelor, Master and PhD, the total number is about 600 students (408 Undergraduate students, 162 Master students, 11 Doctoral students in Vietnam and 65 Doctoral students in France).

USTH has eight training programs, including two new undergraduate training programs in the academic year 2016-2017, such as Food Science and Technology and Medical Science and Technology. All Bachelor and Master training programs have been accredited by the HCERES (The High Council for Evaluation of Research and Higher Education in France). All Master programs are prepared under the supervision of the French Ministry of Higher Education and Research. The Master students when they graduate wil receive 2 diplomas, one from France and one from Vietnam

USTH always focuses on

promoting research activities in parallel with training. Hence, in 2016, USTH implemented 01 topic granted by NAFOSTED with a total funding of 991 million Vietnam Dong. During the period 2015 - 2016, 07 topics about Science and Technology had been approved with a budget of VND 210 million /year/ topic. Additionally, in 2016 only, USTH published 31 international articles, including 21 articles in ISI journal and 10 articles in other international journals. The program "Objective Labos", a project that invests in research equipments by the French Embassy with a total grant of Euro165,000 is still ongoing. The LMI Rice Laboratory, the International Joint Laboratory on Functional Genomics & Biotechnology for Plants and Associated Microorganisms was internationally accredited recently.

For international cooperation in the year 2016, the University of Science and Technology of Hanoi welcomed 211 lecturers/ researchers and 14 foreign delegations to work at USTH and get to know it. Furthermore, 11 cooperation agreements and Memorandums of Understanding have been signed between USTH and universities, research organizations, the Embassy of France, Vietnam Airlines and Airbus to develop training, research and strengthen business partnerships. USTH has also received funding, research equipment and teaching facilities worth VND 5 billion.

Master degree graduation ceremony 2013-2015 (27/01/2016)

Main international partners of VAST

INTERNATIONAL COOPERATION ACTIVITIES

In 2016, VAST continued to enhance the traditional relationship with 19 internationally well-known academies. VAST strives to increasingly promote the cooperation with 5 National Centers and Institutes, 11 National Foundations and Research Councils, more than 30 Universities and Research Institutes, 12 Scientific Associations and International Organizations around the world. Especially in the field of space technology, the VAST developed the cooperation projects with 4 important Space Agencies, namely, the National Aeronautics and Spatial Agency, USA (NASA), the Centre National d'Etudes Spatiales, France (CNES), the Roscosmos State Corporation, Russia (ROSCOSMOS), and the Japan Aerospace Exploration Agency, Japan (JAXA). Through international integration and scientific programs with foreign partners, great opportunities for VAST have emerged to promote its potentiality, power, and to exploit the strong points as well as the achievements of advanced science and technology all over the world for its staff qualifications and capacity building and to create high value scientific and technological products.

INTERNATIONAL COOPERATION ACTIVITIES

Assoc Prof.Dr. NINH KHAC BAN
Director, Department of International Cooperation

In collaboration with French partners, Project VNREDSat-1 has been developed and exploited cautiously, which provided satellite images serving national defense and security activities contributing to the socio-economic development as well as research and training in Vietnam. In 2016, 14,010 photos have been taken by the VNREDSat-1 satellite, of which 10,644 were of Vietnam and 3,366 of the other areas.

In cooperation with Japanese partners, the VAST continued to carry out the project "Building the Vietnam Space Center" (ODA from Japan Government), which contributed to training of 36 Masters of Science students in the field of space technology, developing the Micro Dragon Satellite (50kg) in Japan, and building the Observatory in Nha Trang, Khanh Hoa province. The VAST also collaborated with the National Academy of Sciences of Lao PDR to implement the project "Enhancing capacity on scientific research and technology for scientists of the National Academy of Sciences of Lao PDR."

In the past year, the VAST sustained the financial support for VAST's scientists to carry out interdisciplinary research projects on new technology with high scientific values. The VAST also cooperated with the Czech Academy of Sciences, Academy of Sciences of Hungary, National Academy of Sciences of Belarus, Far Eastern Branch – Russian Academy of Sciences, Foundation for Basic Research of Russia, Foundation for Basic Research of Belarus, Korea National Foundation for Research, Japan Society for the Promotion of Science... to fund 31 joint research projects implemented during period 2016-2017 and launched 22 new projects in 2017-2018.

Many results of these scientific projects have been applied in real world situations, such as: Satellite imagery from VNREDSat-1 were used to assess the sea water environment in central Vietnam, which contributed to finding solutions to the environmental disaster caused by FOMOSA; Project "Unmanned Aerial Vehicle" was well introduced for scientific research activities; Project "Study and Technology Transfers using polyguanidine for treatment of flood water", etc. In particular, the research results on ecological and marine-biological resources and joint expeditions in the economic water zone of Vietnam aboard R/V "Academic Oparin" carried out by the VAST and the Russian Academy of Sciences contributed actively not only to the socio-economic development, but also to the marine sovereignty, defense and security of Vietnam.

In 2016, there were 11 new Memoranda of Understandings/ Agreements bilaterally signed by the VAST and important partners in the world and 43 Cooperation Agreements signed at the VAST's Research Institutes level. These cooperation MOUs/ Agreements are focused on research and training in the field of space technology, and the establishment of joint laboratories and centers for technology transfers. The VAST also successfully organized the scientific workshop on "Progress and trends in science and technology" in coordination with the Russian Foundation for Basic Research.

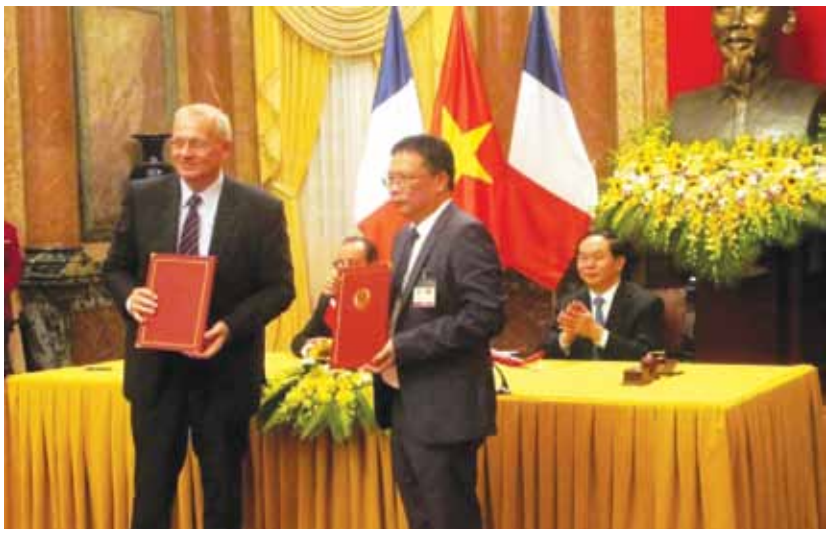
In 2016, the transfer procedure of the Hanoi University of Science and Technology (USTH) took place.

- The establishment and handing over of a university according to high international standards and following a new model from the Ministry of Education and Training to VAST has been completed. USTH is also known as the French - Vietnamese University. It is ranked in the list of 200 well-known universities in the world with 03 levels of training: Bachelors, Master of Science, and Doctorate, in 8 sectors of science and technology and a system of laboratories with international standards.

VAST President Prof. Chau Van Minh and IIASA Director Prof. Kabat signed an agreement of cooperation between Vietnam and IIASA (November 23, 2016).

VAST Vice-President Prof. Nguyen Dinh Cong and ROSCOSMOS Deputy General Director Mr. Sergey Saveliev signed a memorandum of understanding on space technology (June 27, 2016)

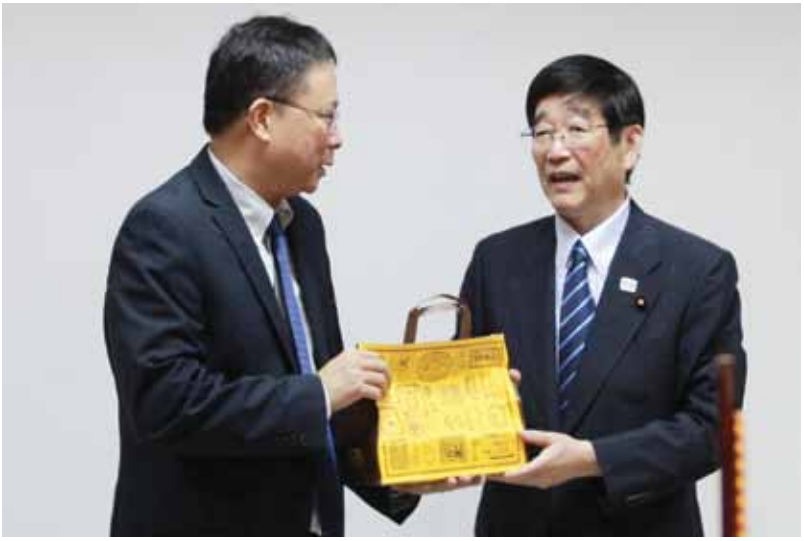
VAST President Prof. Chau Van Minh and other VAST members working with the Russian Academy of Sciences (September 15, 2016).



Prof. Chau Van Minh and CNES Chairman signed the cooperation agreement on aerospace in the presence of the President of the Socialist Republic of Vietnam and the President of France

The signing ceremony of a cooperation agreement between VAST and the National Academy of Sciences of Belarus (NASB) (November 01, 2016)

VAST President Chau Van Minh presents a souvenir to the French ambassador during his working visit to Vietnam (December 06, 2016).



VAST president Chau Van Minh welcomes Mr. Tsutomu Tomioka, Deputy Minister of Education, Culture, Sports, Science and Technology of Japan (July 18, 2016).

Scientific Conference on "Science and Technology Development and Direction" on the occasion of the 10th anniversary of cooperation between VAST and the Fund for Basic Research in Russia (February 29, 2016).

- INVESTMENT TO STRENGTHEN RESEARCH CAPABILITIES AND TECHNOLOGY DEPLOYMENT
- ACTIVITIES OF KEY LABORATORIES

INVESTMENT TO STRENGTHEN RESEARCH CAPABILITIES AND TECHNOLOGY DEPLOYMENT

MSc. TRAN VAN NGOC
Vice Director of Department of Planning and Finance

PLANNED CAPITAL: capital from the state budget in 2016 for the development investment is 386 billion VND of domestic capital and 125 billion VND of foreign capital (ODA). In addition, transmitted capital from 2015 to 2016 includes another 469.152 billion VND and more than 20 billion of investment non-business capital for the repair, renovation and upgrading activities. Totally, there are 25 projects of capital construction, 01 ODA project and 14 projects to repair and renovate research facilities of the subordinate units.

SOME RESULTS

Renovation of DNA assessment center for ill-informed martyrs in the Institute of Biotechnology: Place of construction: Research and development of Technology Zone in Co Nhue, Co Nhue II ward, Bac Tu Liem district, Ha Noi; Total investment: 229 billion VND; Implementation period: 2015 - 2016; extended to 2018 (due to budget unallocated). Results:

+ Construction: completed (2-storey building, floor area of 1472 m^2).

+ Equipment: on delivery, the installation and transfer of professional equipment worth more 60 billion VND has been performed. The remaining equipment will be delivered in line with the budget allocation.

Building of the Center for DNA assessment

Technology Incubation Center of VAST

- Total investment: 179,866 billion VND;
- Implementation period: 2014 - 2017;
- 17-storey building, total floor area of 13.880 m^2.
- Started in 8/2014, almost completed so far, to be delivered early 2017 (ahead of schedule).

Pilot investment for development and modernization of the Institute of Geology

- Total investment: 119,952 billion VND

- Implementation period: 2013 - 2017;

- Scale: renovation of the existing 05-storey and 2-storey buildings with total floor area of 4.800 m^2, construction of multifunctional 7-storey building (completed, delivered) and prepared to start laboratory 5-storey building with total floor area of 7.300 m^2

Research premises of Space Technology Institute and Institute of Marine Biochemistry

- Total investment: 93,864 billion VND;

- Implementation period: 2013 - 2017;

- 09-storey building, total floor area of 8.500 m^2

Expected to be delivered in 1st quarter of 2017.

Research premises for the Institute of applied material sciences

- Total investment: 114,690 billon VND

- Implementation period: 2013 - 2017

- 06 floors for research and administrative units, total floor area: 4.320m^2; delivered and in use.

- 03 floors for pilot workshop, total floor area: 1.500m^2 under construction

VIETNAM SPACE CENTER PROJECT

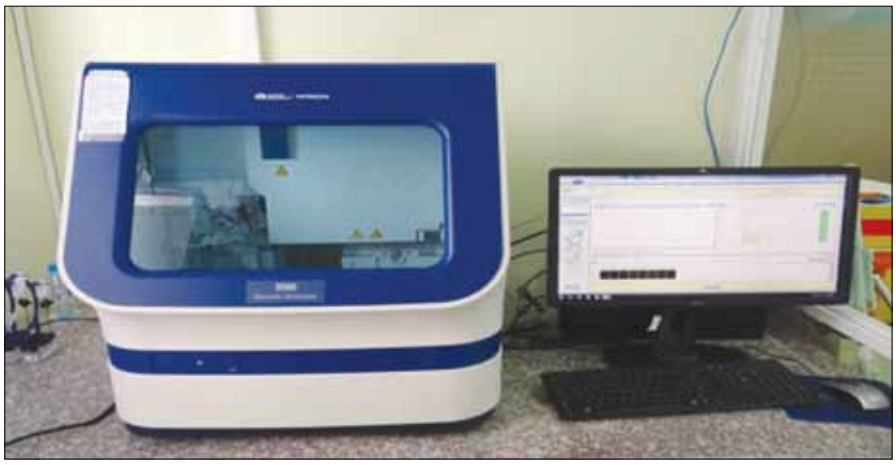
- Vietnam Space Center Project: Central building for human resource development support and technology transfer has been completed, the building is located at 18 Hoang Quoc Viet; Constructions in the Northern zone in Hoa Lac Hi-tech Park are in progress (counter-capital, package price of ~125 billion VND); Bidding is in progress for the package of design, manufacture, launch of the 1st satellite and constructing of the Southern zone in the Hoa-Lac Hi-Tech Park (ODA capital).

Observatory No. 2 in Hon Chong, Nha Trang City, Khanh Hoa Province

The construction of the Center for Space technology human resource development and technology transfer support, No. 18 Hoang Quoc Viet Scale:10 floors, total floor area 6.450 m^2 Completed, delivered and in use in 01/2017..

Observatory and museum on Space Science in Hoa Lac Hi-tech Park; Construction area: 3.632m^2, Number of floors: 02

System for genetic analysis of human and the endemic fauna of Vietnam for Genome Institute
Total investment: 75 billion VND; expected to be delivered in 2017



Automated sequencing genetic analyzer
Model: ABI 3500

Genome sequencing system
Model: Nextseq500

Some photos of Dioxin laboratory Total investment
148,644 billion VND; Time of delivery: Early 2018

Some photos of Key laboratory on food safety and environmental research

The project for the construction of the University of Science and Technology of Hanoi (preferential loans from the Asian Development Bank-ADB, with the total investment of 210 million USD, including 20 million USD from counterpart funds. The project was transferred from the Ministry of Education and Training to VAST under Decision No. 430 / QD-TTg of the Prime Minister dated 18/03/2016. On 20/04/2016 VAST and MOET completed the handover. During the transfer, there were still some issues that needed to be solved, including emerging urgent issues relevant to legal procedures: for instance, the ADB has not yet recognized VAST as the new managing organization of the USTH project

ACTIVITIES OF KEY LABORATORIES

Dr. NGUYEN THI TRUNG
Department of planning and finance

VAST is assigned to manage, operate and harness the equipment of four national key laboratories. It includes: The key laboratory of gene technology; The key laboratory of materials and electronic components; The key laboratory of network technology and multimedia and The key laboratory of plant cell technology located in Southern Vietnam. In 2016, four key laboratories were allocated 6,237 million VND by the state budget for regular activities. The key laboratories have carried out 16 regular missions under the function of four key laboratories, including both transition and new tasks. The remaining funds will be used to spend on general activities of the four key laboratories, mainly used to repair damaged machinery and equipment and for the maintenance equipment.

In addition to regular assignments, the four key laboratories are the place to carry out hundreds of major State-level projects and projects of units belonging to the VAST and its affiliates. In addition, the four key laboratories are a common place for internships of university students, particularly for MSc and PhD students from many universities in the North. In particular because these large laboratories appoint many students from the Hanoi University of Science and Technology and the Graduate Academy of Science and Technology. The key laboratory of gene technology by itself had 42 PhD students, 21 graduate students and 70 graduate students in 2016. In general, the four key laboratories have made every effort to effectively exploit existing equipment to serve projects.

However, many equipment currently in use is old and outdated. The equipment has been intensively used since its early days until now. Some of the older generation equipment currently is no longer supported for maintenance since spare parts

and/or supplies are no longer available which gives problems for its sustained operation and use. On top of that, a part of the equipment is regularly broken such as centrifuges, amplifiers of genes, which interrupts the experiments. Furthermore, in the current situation in which the laboratory is downsizing its staff, it is difficult to arrange staff to be in charge of the key laboratory.

SOME RESULTS

Copdyceps is a product of the project "Study on fermentation of biomass of insecticides of Vietnamese insect pests to recover medicinal substances for their functional properties" done at the key laboratory of gene technology, Institute of Biotechnology.

Ingredients: contains 17 different amino acids; important trace elements such as D-mannitol, Al, Si, K, Na ... have the effect of protecting the immune system and increasing the resistance; it also contains vitamin B12, vitamin A, vitamin C, in addition to vitamin B2; cordycepin component inhibits the fission of cancer cells; the polysaccharides component promotes the metabolism of lymph nodes, enhancing the body's ability to fight cancer. Hematopoietic stem cells are therefore often used as food supplements to prevent cancer and adjuvant therapy, rather than using medicine that often has side effects.

Copdyceps (dried biomass is packed)

Copdyceps (freshed biomass)

Copdyceps (in Vietnam traditional wine)

INFORMATION, PUBLISHING AND MUSEUM ACTIVITIES THE SCIENTIFIC INFORMATION

SCIENTIFIC INFORMATION

Assoc. Prof. Dr. NGUYEN HONG QUANG
Director, Institute for Scientific Information

ACTIVITIES IN SCIENTIFIC INFOMATION

In order to raise societal awareness about the role of science and technology, to shed light on scientific and technological achievements and to popularize the results of applied research, the VAST actively implemented scientific and technological information activities through many different channels.

The electronic website (http://www.vast.ac.vn), updated regularly for comprehensive activities, is the main information channel of VAST. By the end of 2016, the number of unique visits to the website reached 27.6 million for its Vietnamese version and nearly 2.8 million for its English version.

In addition, a monthly Science and Technology E-Newsletter is maintained to provide VAST's outstanding science and technology activities as well as to update multifaceted information

Home page of the electronic website of VAST

The online-Scientific and technological Newsletter

on science and technology in the country and around the world.

In June of 2016, the annual workshop on "Science and Technology Information Activities" was organized with the participation of VAST's subordinate institutions, Ministry of Science and Technology and various universities.

VAST also enhanced its support in providing information for radio and television broadcasting to propagandize and disseminate the results of activities of VAST via public media.

ELECTRONIC LIBRARY ACTIVITIES

Maintaining a continuous operation of the e-library, in 2016 VAST has continued to purchase foreign science and technology journals for the 2014-2016 period, thereby supplementing a large number of foreign e-journals in 2016 such as the ScienceDirect Database with 2,396 journals, Springerlink databases, 38 ACS journals, 11 AIP journals, 08 APS journals, 66 IOP journals and the ProquestCentral database. Up to November of 2016, already 88,491 full-text articles were downloaded from the e-library. In particular, the most-downloaded databases are ScienceDirect (77,100 items), SpringerLink (6,106 items), ACS (2,560 items), APS (1,427 items), ...

INTELLECTUAL PROPERTY ACTIVITIES

In 2016, VAST has made a strong push to promote and disseminate information on procedures for intellectual property registration. In 2016, within VAST, 29 intellectual property certificates were published, including 11 patents. The number of patents in 2016 increased by 6 compared to 2015. In addition, utility solutions have increased by 05 compared to 2015. The Office of Intellectual Property in the Institute for Scientific Information (ISI.VAST) has begun working and successfully supported 2 applications which were accepted within a short period of time.

CALENDAR RESEARCH ACTIVITIES

The Institute for Scientific information is responsible to provide annually data on Vietnamese lunar calendar to Publication, Printing and Publishing Department - Ministry of Information and Communications and other publishing houses throughtout Vietnam. The Institute also carried out research on various astronomical phenomena, such as lunar and solar eclipses, calculated sunrise and sunset times.

The 4th Korea-Vietnam International workshop on Science and Technology Information (March 15, 2016)

SCIENTIFIC PUBLISHING ACTIVITIES OF VAST

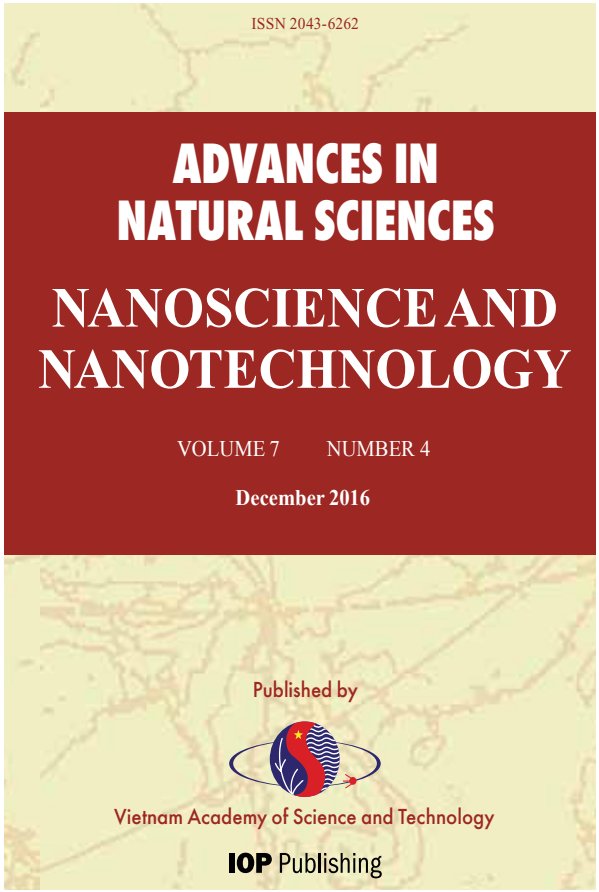
MSc. TRAN VAN SAC
Director, Publishing House for Science and Technology

The Publishing House for Science and Technology (PST) is the State administrative unit under the VAST. Its assignment is to produce publications such as: scientific and technological journals, monographic books, reference books, postgraduate and higher education textbooks et cetera. The annual science and technology activities of VAST, with its large team of scientists, have been chaired at many important national projects. Annually, thousands of high level science articles are published in national journals of science and technology and international prestige journals, as well as hundreds of monographic books, reference books, postgraduate and higher textbooks are published. This underlines that the importance of publishing in scientific journals is increasingly acknowledged and successfully pursued by the VAST.

PUBLISHING SCIENTIFIC AND TECHNOLOGICAL JOURNALS

Currently, VAST is publishing 12 journals dedicated to science and technology. These are national widely-read journals recognized and licensed by the government. Several journals have been upgraded from being published in Vietnamese into English such as Vietnam Journal of Mathematics, Vietnam Journal of Mechanics, Communications in Physics and Journal of Advances in Natural Sciences: NanoSciences and Nanotechnology (ANSN), Journal of Acta Mathematica Vietnamica, Journal of Computer Science and Cybernetics. Particularly noteworthy, the Vietnam Journals of Mathematics and Acta Mathematica Vietnamica are published by Springer, hence internationally issued, and have both met the regional standards and SCOPUS standard in 2013. The Journal of ANSN is being published by IOP Publisher and has met the SCOPUS standard in 2013. Other journals are also upgraded in quality, both in terms of content and form as well as quantity and frequency of publication to meet the regional and international standards. In particular, the journals are being prepared to increasingly publish in English. Thereby, the journals meet the demand of publishing relevant works and sharing scientific study results of national and international scientists.

Alongside the efforts of Editorial boards of the journals, VAST's investments and engagement in the coordination between PST and the Editorial boards has helped to strengthen the editorial boards, improve high quality printing, popularize their journals to readers in national and international conferences and seminars. Especially, on December 29th 2015, the Journal of ANSN was officially recognized by Institute for Scientific Information (ISI). Thereupon, on the January 7th 2016, the journal was published on the website of SCIE. Thereby, the Journal of ANSN was the first journal of Vietnam to be officially recognized with the impact factor (IF) of 1.581 in 2015 by Thomson Reuters. The above achievements of Journal of ASSN is an important mark of its great progress and other journals are able to achieve success if they have reasonable financial investment, resourceful management, and progressive policies from the Government as well as of course the wide support from scientists



and the contribution of their Editorial Boards.

Three journals have met the international standards (Journal of ANSN, Vietnam Journal of Mathematics, and Journal of Acta Mathematica Vietnamica (this Acta is under the Institute of Mathematics). They always receive hundreds of articles from international scientists. The number of articles accessed and download by readers globally is also steadily increasing.

The editorial boards of journals are well organized with the contribution from many national and international leading scientists. In 2016, all journals have strengthened their editorial boards. Currently, more than 300 national scientists and over 100 foreign scientists take part in Editorial boards of the journals. These developments show great potential for the journals to gradually develop into renowned international journals.

Articles published in the journals have to meet the requirements of scientific integrity, accuracy and the imposed copyrights following the current regulations of the State, and the regulations of the editorial boards. Normally, an article must undergo strict assessment, evaluation, editing and review to ensure its scientific quality and other requirements of the editorial boards before it is published.

PUBLISHING SCIENTIFIC BOOKS

In addition to publishing periodical scientific journals, every year VAST reserves a special fund for publishing scientific works in the form of books.

A Monographic Book Volume has been continued to publish, it is divided into 4 fields:

- *Monographs within the field of technology and technological development*

- *Monographs within the field of natural resources and environment of Vietnam*

- *Monographs within the field of sea and marine technology*

- *Textbooks for training graduate and postgraduate education.*

The editorial boards were set up follows their fields.

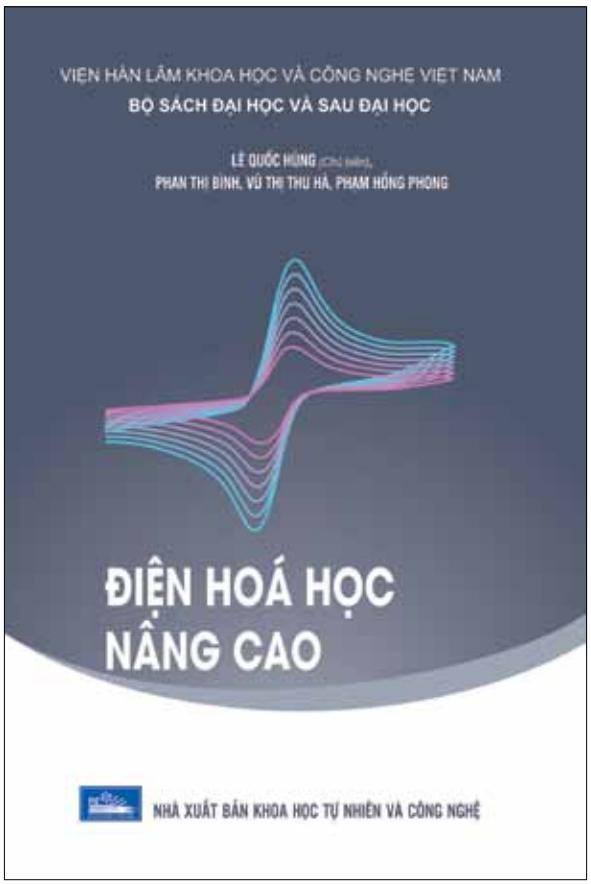
The monographs are selected and published to contain relevant results of one field of science and technology by the author or the co-authors after many years of research. In general, the

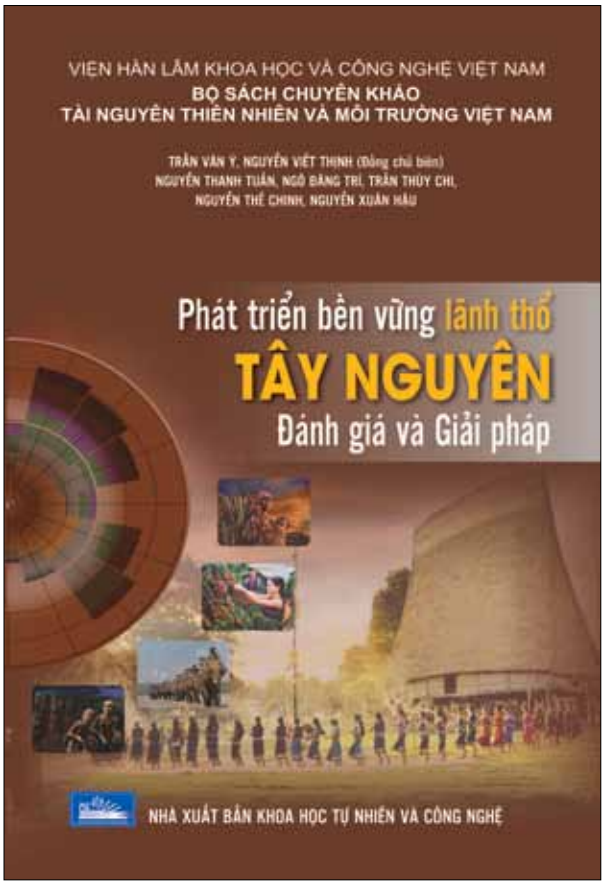
monographs aim to provide an elaborate overview and a contribution to scientific theory. The form of the monographs is presented consistently, printed with high quality and solemnity. After publication, the PST has released to the required addresses, according to the plan a set of book will be published about 7-10 books per year, and respectively published 08 monograph books, the total of monographic books were published in 2016 is 88 books.

PST continued to publish books about the Vietnamese Sea - Islands which are a predominant field of VAST. These books were ordered by the State. By the end of 2016, it published 45 books in the fields related to the sea and islands. Through the assessments of scientists and other readers, it has high scientific value and is very useful in popularizing and improving people's knowledge about the marine sector, contributing to National Sea Strategies up to 2020.

In 2016, PST registered the publishing plans for 90 books, issued the publishing decisions for publications in accordance with its principles and objectives that are permitted by State agencies. There were no mistakes in publishing publications in 2016.

With the high science quality content, and good form, many books were nominated in the Vietnam Book Awards and won the interesting book prizes and beautiful book prizes: Respectively in 2010: 01 gold prize (interesting book) is "Vietnam geology and resources"; in 2011: 02 Silver Prizes (interesting book) are "Atlas of Vietnam insects" and "Earthquake and tsunami hazard at coastal areas of Vietnam"; in 2013: 01 Bronze Prize (interesting book) is "Vietnam Geomorphology: structure - resources and environment" and 01 Consolation Prize (interesting book) is "Vietnam Birds Identification"; in 2014: 01 Consolation Prize (interesting book) "Humid tropical weathering in Vietnam"; in 2015: 01 Bronze Prize (interesting book) is "Carbon nanomaterial and its potential applications" and 01 Consolation Prize (beautiful book) is "Vietnam with overview of VNRED Sat 1".





MUSEUM ACTIVITIES

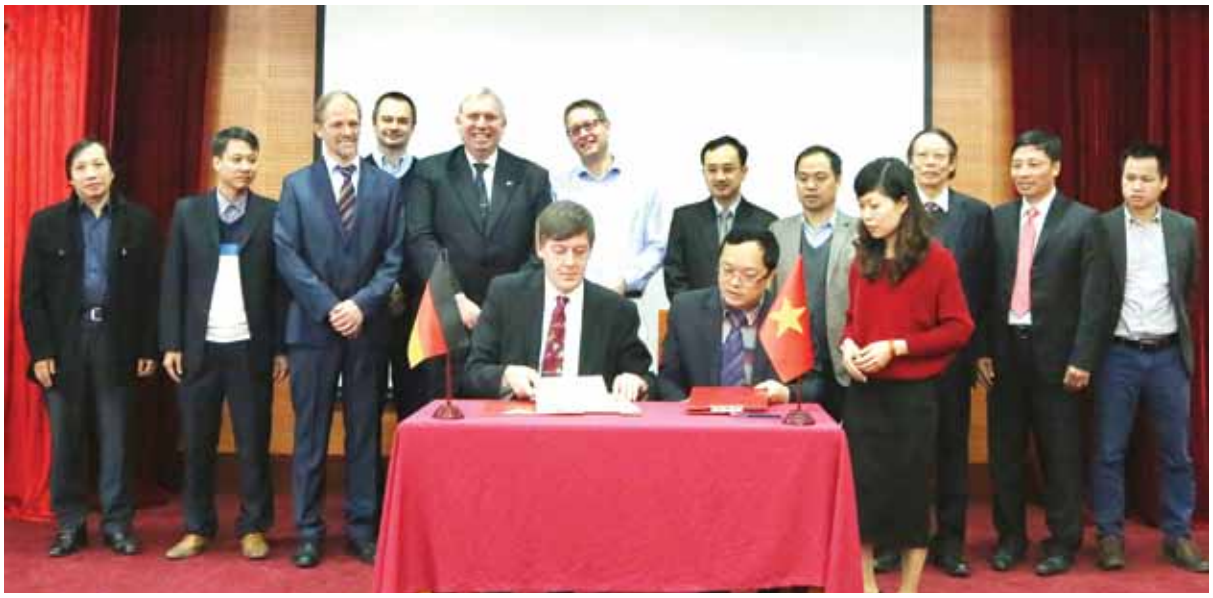
Vietnam National Museum of Nature

Assoc. Prof. Dr. NGUYEN TRUNG MINH
Director, Vietnam National Museum of Nature

Vietnam National Museum of Nature (VNMN), a national museum, head of the Vietnam natural museum system, was established under Decree No. 27/ND-CP, dated 16/01/2004 (presently, the Decree 108/ND-CP dated 25/12/2012) of the Government. The functions, duties, powers and organizational structure of the museum were stipulated in Decision No.305/QD-VAST, dated 10/03/2006 (presently, the Decision No. 261/QD-VHL dated 26/02/2013) of the President of VAST. In 2016, Vietnam National Museum of Nature has had the honor to celebrate its 10th anniversary and received the 3rd Labor Medal awarded by the President of the Socialist Republic of Vietnam. The name of Vietnam National Museum of Nature is becoming increasingly a household name within the scientific community as well as receiving growing recognition from domestic and overseas visitors. Although VNMN is a young unit, the notable results achieved in the last 10 years in general, and in 2016 in particular are achievements to be proud of.

RESEARCH ACTIVITIES

In 2016, VNMN performed 30 project tasks. These include projects at all levels including 13 Institutional projects, 03 projects of NAFOSTED funding, 05 projects of the VAST, 01 state-level project, 06 components projects under the project



International cooperation activities

"Building National Specimen Collection" and 02 tasks given by the Government. As the results, VNMN had 94 articles published in prestigious scientific journals including 51 international articles namely: 13 articles of the SCI list, 22 articles of the SCI-Expanded list, 01 articles in the Journal of the VAST of Scopus list and 15 articles in other journal lists with ISSN/ISBN index; 14 articles in national journals published by VAST, 29 articles in other journals, 02 monographs and 01 copyright registration certificate on land evaluation software. Published 01 distribution genus and 20 new species, added 04 species.

INTERNATIONAL COOPERATION AND TRAINING

The directorate of the Vietnam National Museum of Nature have made strategic plans in terms of international cooperation, understanding the important role of international cooperation in the museum development course. Vietnam remains under the ongoing process of deeper integration with the international community, VNMN usually benefits much from international cooperation activities, these performed activities are regulated by laws of State and regulations of VAST under the VNMN functions and tasks through activities such as: specialists exchange, international conferences, seminars, international workshop, international training program, update information on the Museum's Website in both Vietnamese and English; introducing the museum's activities on the mass media to foreigners and overseas Vietnamese to reach a wider public (as VTV4 channel, Vietnam news, many newspapers and Websites in Vietnam, etc. in English).

To date (12/2016), VNMN has signed a total of 50 Memorandum of Understanding and Cooperation Agreement (in effect) with Museums of Natural History, famous research institutes, universities and international organizations belonging to 20 different countries around the world. Through international cooperation activities, the Museum accumulated more experience and collected a wide range of samples. The young scientific staff has acquired specialized knowledge, their foreign language skills are improved remarkably and many scientific articles were published in the prestigious international journals. In 2016, the Museum received and worked with 21 groups of researchers from abroad, including 90 specialists, completed procedures for the 28 delegations to go abroad for scientific exchange and training, including 24 officials visiting and exchanging experiences at the Museums of Natural History, research institutes and universities and 04 staffs studying in PhD programmes. In 2016, one employee successfully obtained a PhD title in Japan, presently; there are 03 undergraduate doctoral students in training abroad.

VNMN is a member of Vietnam ICOM and international ICOM (International Council of Museums) since 2014. In 2016, Assoc. Prof. Dr. Nguyen Trung Minh, Director General of VNMN, has been honored to be elected as Vice President of ICOM Vietnam. In July 2016, Museum Director

THE ORGANISM EVOLUTION EXHIBITION ROOM

and 04 staffs attended the 24th Conference of the International Council of museums - ICOM in Milan, Italy, the theme of the conference is "Museums and cultural landscape - a challenge for the museums at 21st century. This topic guided the discussion to enhance the role of museums in the protection and promotion of cultural heritage and the space-related heritage, promoting new opportunities for cooperation between experts in and outside the cultural heritage sectors. The main objectives of the session were the approval of a declaration on the museum and cultural landscape, thus forming a new strategic objectives and activities for the museum in the future.

In December 2016, the VNMN became the 54th full member of the Global Genomic Biology Network, which comprises a collection that includes 5,000 DNA samples and 300 samples of tissue covering more than 50 species.

ORGANISM EVOLUTION EXHIBITION ROOM'S ACTIVITIES

The first Organism Evolution Exhibition Room of Vietnam with the areas of ~300m^2, opened to the public from mid-May 2014, in 2016 (from 01/12/2015 to 30/11/2016) the Room has received more than 76,000 visitors, up 86% compared to 2015. This figure includes primary, secondary and high school students which accounted for 40%, preschool age accounted for 35%, and other groups accounting for 25%. Considering the small area of the room, this is a very impressive figure.

The museum organizes and

Activities of specimens processing and collection

guides students to visit and study in the Exhibition Room in conjunction with the participation of Museum experts and research staff: 41 schools from Primary to University have participated including the following 16 schools: Doan Thi Diem Hanoi, Doan Thi Diem Ecopark, Singapore international primary school, Dich Vong A primary school in Cau Giay, et cetera. In addition, 09 Secondary Schools participated; Secondary Minh Chau Ba Vi, Olympia, Lomonoxop, Pascal School in Dong Anh, high school deaf students; As well as 10 High Schools: Hanoi-Amsterdam High School, Nguyen Hue High School in Ha Dong, Nguyen Tat Thanh High School, Olympia High School, Phan Huy Chu High School in Yen Hoa; And 13 Universities, Colleges: University of Natural Resources and Environment in Hanoi, Hanoi Normal University, the University of Natural Sciences (VNU), University of Hoa Lu, Ninh Binh, Foreign Language Center: 06 Units: Edumax English Center, Ehapu, EDUCAP International English Center, ...

According to the visitors' comments at home and abroad, although the exhibition space is narrow, the contents and layout of the scientific exhibit is logical and attractive. Overall the exhibition is considered very suitable for visitors, students, pupils and teachers. The overall opinion is that the exhibition room is truly a reliable and useful place to visit. The visitors view the content presented on Phylogenetic Tree of Life on animals, plants... and the models of human evolution, the 3D movies system on dinosaurs, universes..., even access to the specimens as interesting and practical compared with theory learning by books.

This year, VNMN participated in the Techmart 2016 exhibition at the Museum of Hanoi, and has been involved in organizing the 27th International Biology Olympia contest in Vietnam with good results. The Vietnam National Nature Museum of Nature and participating candidates received the Merit of the Ministry of Education and Training.

The general planning of the Vietnam natural museum system according to Decision No. 86/2006/QD-TTg

Monitoring the implementation progress and consulting, supporting on technical topics for project members. VNMN has successfully organized the Second Vietnam National Museum of Nature System Conference.

PERFORM THE TASKS OF COLLECTING SPECIMENS FOR THE VNMN GIVEN BY PRIME MINISTER

The Museum's Leaders regard the specimens as the soul of the museum. In 2016, the Museum has organized 47 admissions of biological specimens from 15 authorities and local people, including 109 dead animals cadavers, including; a tiger, otters, a loris, a ratel, moon fish, a Leopard, a monkey, a langur... 01 pairs and 02 pieces of ivory. The Museum manipulated the otter samples, wild red ears chickens, birds, red face chickens and South American Parrots. Pretreatment and storage included 20 set of skins and 17 sets of skeletons. Identification of the scientific name with DNA analysis methods has been conducted for 4 samples. 01 coal sample was collected under the cooperation and exchange Program between the VNNM and Quang Ninh Provincial Museum. 18 geological samples were collected from Bac Giang, Khanh Hoa, Yen Bai and Gia Lai. Especially, VNMN is processing the Ho Guom turtle specimen by the most modern method, the asphalt method, which is a very important specimen in the spiritual life of Hanoians and all the people in the country.

PROJECTS

Project: "Building Vietnam National Museum of Nature"

The project is ongoing and currently in the investment decision period. The construction location has been planned in an area of 32.8 hectares. The project investment policy has also been adopted in the Official Letter No. 86/TTg-KGVX dated 01/19/2015 of the Prime Minister. The project has been granted by the planning permission No.1637/GPQH used to frame the construction investment project plan dated 04/27/2015 by the Hanoi Department of Planning and Architecture. Currently, the project is being outlined in a detailed plan with ratios 1/500 and for submission to approval as a No.1 component project: Preparing the construction ground "Phase I (2016-2020).

The project "The Centre for conservation of Vietnam natural resources and rescue of animals and plants of VNMN" and the project "Infrastructure transport connecting Center for Conservation of Vietnam natural resources and rescue animals and plants of VNMN" was started on 16/10/2016, the package of consultancy is being implemented, completing project evaluation procedures and

initiated packages of construction and road making.

In 2016, VNMN has completed the assigned plan. The projects completed on time, 94 articles published in prestigious scientific journals at home and abroad and monographs including 48 international articles (13 articles of the SCI list, 19 articles of the SCI-Expanded list (rate 1.05 articles of SCI, SCI-E per person, ranking the second in the VAST), 16 articles with ISSN/ISBN index), 15 articles in national journals published by VAST, 29 articles in other journals, 02 monographs and 01 copyright registration certificate.

The Organism Evolution Exhibition Room received impressive amount of visitors, almost double compared to 2015. VNMN successfully organized the Second Vietnam National Museum of Nature System Conference.

The Project "Centre for conservation of Vietnam natural resources and rescue of animals and plants of VNMN" and project "Infrastructure transport connecting Center for Conservation of Vietnam natural resources and rescue animals and plants of VNMN" in Phong My village, Phong Dien, Thua Thien-Hue is being implemented in terms 2016-2020 as plan.

The project "Building Vietnam National Museum of Nature" is being carried out the procedures to implement.

Master plan: "Building Vietnam National Museum of Nature

Ground breaking ceremony "Centre for conservation of Vietnam natural resources and rescue of animals and plants of VNMN "

The Museum of Oceanography

Accos. Prof. Dr. VO SI TUAN
Director, Institute of Oceanography

The Museum of Oceanography is a prestigious address for visitors who want to explore the marine world. In 2016, the Museum received 390,770 arrivals, among them are more than 54,000 international visitors, thousands of students and school children from universities, schools and pre-schools. The thematic exhibition of "Scientific investigation in Hoang Sa - Truong Sa archipelagos" was organized this year in the museum, showing publications, information and photos of the Institute of Oceanography's scientific investigations in the Paracels and Spratly since the early years of the 20th century, contributing to the affirmation of Vietnam's sovereignty over these archipelagos.

As a member of the Organizing Committee of the 6th National Children's Festival - one of the major events of national children - held in Khanh Hoa this year, the Museum has welcomed more than 1,100 festival visitors, contributed significantly to the success of the festival.

Also in this year, the Museum collected about 100

marine specimens for its collection, especially a big guitarfish (2.9 m- 180 kg). The specimens of whale shark (5.5 m – 1 ton) and ocean sunfish (2.3 m) were handled and ready to display. 12,500 specimens of molluscs and crustaceans were also digitalized.

Foreign students visit and study at the Museum

The "Academician Oparin" ship is doing well in surveying marine resources in the territorial waters and special economic zones of Vietnam in the sea

Samples analysis on the "Academician Oparin" ship

Samples collection in Con Co during the surveying trip by "Academician Oparin"

ORIENTATIONS AND PLANS FOR THE YEAR 2017

2017 is the second year of the Governmental five-year plan (2016 - 2020). Based on the actual situation and the resources, some major directions of the 2017 plans of VAST are as follows;

- Continue to keep on track with the development planning of VAST up to 2020 with the vision until 2030, which has been approved by Prime Minister. The objectives in effective implementation of the research and development agendas for Science and Technology should be met with optimal use of the currently available manpower and assigned budgets, which have been granted by the government for 2017.

- Strive to successfully implement the 2017 plan, paving the firm foundation for excellently completing the plans stipulated for the 2016 - 2020 period, to meet the country's requirements for the development stages and facilitate exchanges and deeper integration in all fields.

- Increase the number of scientific publications with international standards; Improve the quality of products in different science and technology missions; Strengthen technology incubators, the application of science and technology to production and practice, and gain intellectual property; Strengthen activities in information services and publication of scientific results to enhance the quality of VAST journals; Promote activities of 02 International Centers of Type 2 for Mathematics and Physics, under the auspices of UNESCO and 03 Advanced Centers; Promote training and put the Graduate University of Science and Technology and University of Science and Technology of Hanoi into effective operation.

- Continue implementing big projects such as the satellite and space projects, projects for earthquake observation network, project tsunami warning in Vietnam; project "Collection of national specimens and planning museum systems", Tay-Nguyen 3 project, project Building High-technology Zone of VAST in Hoa Lac. Improving the effectiveness for 04 national key laboratories; And the implementation of the "National Physics Program 2020" project.

- Concentrate on steering the key tasks at VAST level, especially those on strengthening research facilities, which have been supported and financed by different ministries, and set up key tasks; Put the projects into highly effective operation.

- Focused on Governmental construction of a number of major projects: The Project regarding the Advanced Center Vietnam - Japan in Hoa Lac; the Ocean Research Ship project; the projects on the Planning in biotechnology development for 2020; the projects on the basic research in chemistry, life science, earth science and marine science and technology; project VNREDSat-2 and 2B.

- Implementation of the projects of investment in basic construction which were carried out from 2016 and the projects that are newly commenced in 2017; Continue the establishment of material facilities in order to create a new face suitable to the position of a leading national scientific authority; Focus on building and gradually implementing the medium-term investment plan for the period 2017-2020.

- Continue the young scientists program, deploying the project for construction of a technology incubator of VAST based on the stipulated time schedule in order to provide accommodation for young scientists in next few years.

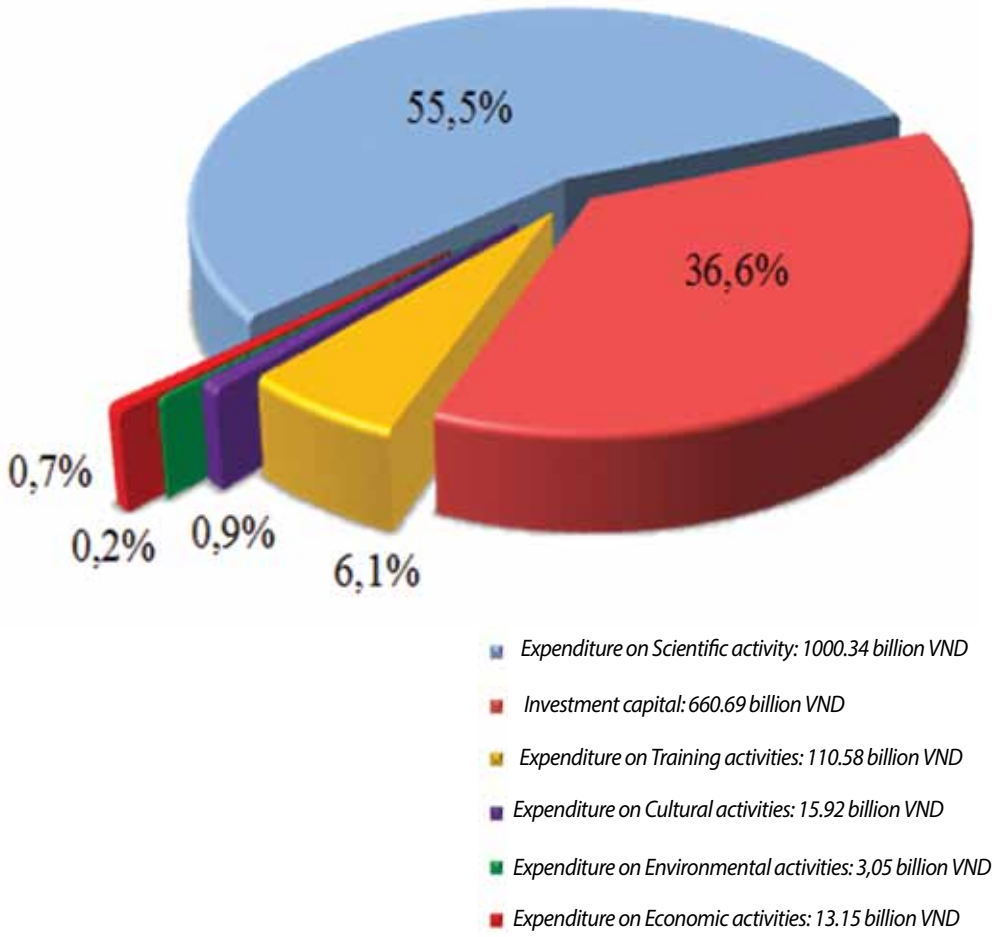
- Continue the management of innovation,

enhance checking and monitoring the budget implementation, the deployment of science and technology projects at all levels, the projects of basic construction investment: economically and efficiently use equipment and work area for each unit in VAST; accelerate completion of settlement report in the unit.

The Prime Minister and the Ministry of Finance have decided to allocate an amount of 1,661.1 billion VND as the 2017 governmental budget of VAST, among which 660.7 billion VND is for development investment, 419.1 billion for recurrent expenditure.

VAST has worked with all its units on the 2017 plan, has prepared a scheme to distribute the 2017 budget and is ready to present the budget distribution scheme to the ministries before 31/12/2016, in accordance with regulations.

Expenditure estimates for 2017 VAST's budget



SOME IMPORTANT STATISTICS

NUMBER OF BASIC RESEARCH PROJECTS OF THE VAST IN THE 2010-2016 PERIOD (*)

No	Sponsored field	The total number of newly opened projects							Total
		2010	2011	2012	2013	2014	2015	2016	
1	Mathematics	1	24	1	2	17	1	5	**51**
2	Information and Computer science	0	3	2	2	2	0	0	**9**
3	Physics	12	23	12	15	16	1	16	**95**
4	Chemistry	19	10	17	15	11	3	14	**89**
5	Earth sciences	8	5	2	3	5	1	2	**26**
6	Life sciences (**)	17	16						**33**
	- Bio-agriculture			11	12	10	1	23	**57**
	- Biomedical			3	5	2	1	2	**13**
7	Mechanics	2	4	1	3	2	0	7	**19**
Total		**59**	**85**	**49**	**57**	**65**	**8**	**69**	**392**

**Source: NAFOSTED. Number of projects approved by year.*

*** Since 2012, Life sciences splitted into 2 fields: Bio-agriculture and Biomedical.*

TABLE OF STATISTICS FOR SCIENTIFIC PUBLICATIONS, PATENTS, UTILITY SOLUTIONS FOR 2011-2016 PERIOD (*)

No	Statistics Category	2011	2012	2013	2014	2015	2016
A	Total number of scientific publications (1+2+3+4+5)	1.612	1.698	2.298	2.074	2.197	2.007
B	Number of publications in international journals (1+2+3+4)	550	601	660	803	802	996
C	Number of publications in SCI, SCI-E journals (1+2)	334	401	435	523	588	742
1	Number of publications in SCI journals	209	258	282	298	317	387
2	Number of publications in SCI-E journals	125	143	153	225	271	355
3	Number of publications in international journals with ISSN/ ISBN codes (2016 only count the number of articles for journals ISSN)	216	200	225	246	176	248
4	Number of publications in VAST1 journals (**)				34	38	6
5	Number of publications in national journals	1.062	1.097	1.638	1.271	1.395	1.011
6	Number of patents	7	7	7	3	11	11
7	Number of utility solutions	4	5	6	10	7	17

(*) Statistics taken for the period: 01/12/previous year - 30/11/following year

(**) In 2014-2015: 03 journals (Advances in Natural Sciences: Nanoscience and Nanotechnology, Vietnam Journal of Mathematics, Acta Mathematica Vietnamica); In 2016: 02 journals (Vietnam Journal of Mathematics, Acta Mathematica Vietnamica).

STATISTICS OF SCIENTIFIC PUBLICATIONS, INTELLECTUAL PROPERTIES OF VAST IN 2016 (*)

(Sort by total number of publications in SCI and SCI-E journals)

No	Name	Number of articles in International journals						Number of articles in local journals			IP		Book
		ISI			VAST 1(***)	ISSN/ISBN	Total	VAST2(***)	Other	Total	Patents	Utility Models	
		Total	SCI	SCI-E									
1	Institute of Materials Science	119	83	36		6	125	32	14	46	1	1	
2	Institute of Ecology & Biological Resources	100	36	64		50	150	37	39	76			7
3	Institute of Mathematics	59	25	34	6	10	75	1	4	5			2
4	Institute of Physics	56	50	6		25	81	10	17	27	1		
5	Institute of Biotechnology	48	19	29		14	62	45	22	67		4	1
6	Institute of Marine Biochemistry	43	19	24		8	51	48	12	60	3	1	
7	Institute of Chemistry	35	20	15		7	42	62	18	80		3	
8	Vietnam National Museum of Nature	32	13	19		16	48	15	29	44			2
9	Institute for Tropical Technology	27	14	13		6	33	39	7	46	1	2	2
10	Institute of Tropical Biology	21	7	14		22	43	10	23	33			2
11	Institute of Mechanics	17	7	10		3	20	8	26	34			
12	Institute of Applied Materials Science	17	6	11		4	21	22	10	32			
13	Institute of Environmental Technology	17	8	9		15	32	15	33	48	1	2	1
14	Institute of Natural Products Chemistry	13	4	9		8	21	25	17	42	3	2	
15	Institute of Information Technology	11	6	5		3	14	23	3	26		1	

No	Name	Number of articles in International journals						Number of articles in local journals			IP		Book
		ISI			VAST 1(***)	ISSN/ISBN	Total	VAST2(****)	Other	Total	Patents	Utility Models	
		Total	SCI	SCI-E									
16	Institute of Oceanography	11	7	4		3	14	18	40	58			1
17	Ho Chi Minh City Institute of Physics	9	9			2	11	1	1	2			
18	Institute of Marine Environment & Resources	9	4	5		5	14	21	14	35			5
19	Institute of Genome Research	9	7	2		1	10	11	3	14			
20	Tay Nguyen Institute of Scientific Research	8		8			8	18	4	22			
21	Vietnam National Satellite Center	7	6	1		4	11		7	7			
22	Southern Institute of Ecology	7	4	3			7	2	3	5			
23	Institute of Information Technology	6		6		15	21	4	14	18			2
24	Institute of Geophysics	6		6		3	9	9	3	12			2
25	Institute of Geography	5	3	2		3	8	4	22	26			1
26	Nha Trang Institute of Technology Research & Application	5	4	1		2	7	13	12	25			
27	Institute for Marine Geology & Geophysics	5		5		3	8	7	16	23			3
28	Center for Training, Consultancy and Technology Transfer	5	3	2			5						
29	Institute of Geological Sciences	4	2	2		1	5	21	7	28			5
30	Institute of Applied Physics & Sci. Instruments	4	4			2	6		2	2			
31	Centre for High Technology Development	4	2	2		1	5	7	17	24	1		1

No	Name	Number of articles in International journals						Number of articles in local journals			IP		Book
		ISI			VAST 1 (***)	ISSN/ISBN	Total	VAST2 (****)	Other	Total	Patents	Utility Models	
		Total	SCI	SCI-E									
32	Center for Informatics and Computing	4	3	1			4						
33	Space Technology Institute	2		2		3	5	1	6	7			
34	Mien Trung Institute of Scientific Research	2	1	1		1	3	1	5	6			2
35	Institute of Applied Informatics & Mechanics	1		1			1		7	7			
36	Hochiminh city Institute of Resources Geography					2	2	1	10	11			
37	Institute of Energy Science					2	2	7	1	8			
38	Publishing House for Natural Science and Technology							7		7			
Training units													
39	Graduate University of Science and Technology	37	22	15		1	38	8	4	12		1	
40	University of Science and Technology of Hanoi	22	15	7		3	25		2	2			
Total (**)		**742**	**387**	**355**	**6**	**248**	**996**	**537**	**474**	**1.011**	**11**	**17**	**39**

(*)Statistics taken for the period 01/12/2015 - 30/11/2016

(**) The publications with coauthors belonging to different institutes are counted only once

(***) VAST1: 02 VAST journals: Vietnam Journal of Mathematics, Acta Mathematica Vietnamica

(****) VAST2: 09 remaining VAST journals: Communications in Physics; Vietnam Journal of Mechanics; Journal of Computer Science and Cybernetics; Journal of Science and Technology; Journal of Chemistry; Journal of Marine Science and Technology; Journal of Biotechnology; Vietnam Journal of Earth Sciences; Journal of Biology

STATISTICS OF SCIENCE AND TECHNOLOGY CONTRACTS IMPLEMENTED IN 2016 (*)

Unit: million VND

No	Name	Contract with usage of state budget			Contract without usage of state budget			Total		
		Number of contracts	Total value	Value in 2016	Number of contracts	Total value	Value in 2016	Number of contracts	Total value	Value in 2016
1	Institute of Environmental Technology	16	12.807	2.311	451	100.289	83.957	467	113.096	86.268
2	Institute of Energy Science	13	8.377	2.875	52	77.187	24.627	65	85.564	27.502
3	Institute of Materials Science	7	8.181	4.674	15	7.313	7.313	22	15.494	11.987
4	Institute of Natural Products Chemistry	9	13.199	5.953	18	4.681	4.681	27	17.880	10.634
5	Institute of Applied Physics & Sci. Instruments				3	8.675	8.675	3	8.675	8.675
6	Institute of Mechanics	21	12.047	4.290	14	9.023	4.312	35	21.070	8.602
7	Institute of Physics	34	29.813	6.843	17	1.443	1.443	51	31.256	8.286
8	Institute of Geological Sciences	25	17.004	6.507	6	564	564	31	17.568	7.071
9	Institute of Oceanography	5	6.412	2.572	10	15.998	4.342	15	22.410	6.914
10	Institute of Chemistry	7	3.874	1.556	9	7.823	5.053	16	11.697	6.609
11	Institute of Chemical Technology				26	5.971	5.971	26	5.971	5.971
12	Southern Institute of Ecology				13	14.954	5.154	13	14.954	5.154
13	Institute of Tropical Biology	13	9.035	3.468	51	1.491	1.491	64	10.526	4.959
14	Hochiminh city Institute of Resources Geography	4	8.973	3.324	6	2.240	909	10	11.213	4.233
15	Institute of Marine Biochemistry	22	19.710	4.045				22	19.710	4.045

No	Name	Contract with usage of state budget			Contract without usage of state budget			Total		
		Number of contracts	Total value	Value in 2016	Number of contracts	Total value	Value in 2016	Number of contracts	Total value	Value in 2016
16	Institute of Genome Research	6	8.528	3.798				6	8.528	3.798
17	Institute of Applied Informatics & Mechanics				82	3.558	3.558	82	3.558	3.558
18	Institute of Information Technology	4	3.360	400	28	6.790	2.827	32	10.150	3.227
19	Nha Trang Institute of Technology Research & Application	5	1.174	95	13	3.270	2.949	18	4.444	3.044
20	Vietnam National Museum of Nature	3	14.813	2.691	2	240	143	5	15.053	2.834
21	Institute of Geography				8	7.847	2.789	8	7.847	2.789
22	Institute of Biotechnology	6	1.947	1.001	5	727	723	11	2.674	1.724
23	Institute of Geophysics	6	8.626	1.472				6	8.626	1.472
24	Space Technology Institute				2	3.280	1.441	2	3.280	1.441
25	Institute of Applied Materials Science				8	2.673	1.336	8	2.673	1.336
26	Centre for High Technology Development	3	1.653	715	1	156	156	4	1.809	871
27	Tay Nguyen Institute of Scientific Research	3	3.752	416	3	147	147	6	3.899	563
28	Institute of Marine Environment & Resources	11	1.034	242				11	1.034	242
29	Mien Trung Institute of Scientific Research				3	90	90	3	90	90
30	Institute for Scientific Information				1	46	46	1	46	46
31	Ho Chi Minh City Institute of Physics	1			0			1		
	Total	**224**	**194.319**	**59.248**	**847**	**286.476**	**174.697**	**1.071**	**480.795**	**233.945**

(*) Statistic data for the period 30/11/2015-30/11/2016

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