

# Innovations

Annual Report 2017



DEPARTMENT OF SCIENCE AND TECHNOLOGY  
PHILIPPINE COUNCIL  
FOR INDUSTRY, ENERGY,  
AND EMERGING TECHNOLOGY  
RESEARCH AND DEVELOPMENT  
(DOST-PCIEERD)



# Innovations

Annual Report 2017



# INNOVATION COUNCIL

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FOR INDUSTRY, ENERGY AND EMERGING TECHNOLOGIES (DOST-PCIEERD)



## ABOUT THE COVER

The cover is a “beehive” of activity, representing the scientific endeavors of the Innovation Council for the year 2017. A few photos, seen through a subtle filter, give a sneak peek of the contents of the report.

The lines form connections that make for a stronger network, as Science & Technology cannot work by itself, but needs a support structure to innovate and generate wealth. As a design element, the hexagon shape presents several interlocking sides— a metaphor for organic building, and reflective of the Council’s goal to make a collective effort from different sectors to promote science and innovation.

Finally, the interplay of colors represents a solid foundation (black) and the five values (various colors, most importantly PCIEERD’s cyan blue) of commitment, respect, excellence, sense of urgency, and teamwork.

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# Profile

The Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD) is one of the three sectoral planning councils of the Department of Science and Technology (DOST).

It is mandated to serve as the central agency in the formulation of policies, plans, and programs, as well as in the formulation of strategies in the industry, energy, and emerging technology sectors through the following science and technology (S&T) programs:

- Policy Development and Advocacy
- Support for Research and Development
- Human Resource and Institution Development
- S&T Information Dissemination and Promotion
- Support for Technology Transfer and Commercialization

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## Mission

To lead and partner with the public and private institutions in generating S&T policies, strategies, and technologies that will contribute significantly to national economic development.

## Vision

PCIEERD envisions to be recognized for the quality of its people, leadership, and performance, and contribute to the nation's productivity and competitiveness.

Towards this end, PCIEERD commits to pursue and make available S&T solutions and innovations to help create and sustain competitive industries, attain energy self-sufficiency, and ensure the efficient and effective use of emerging technologies for the inclusive growth and development of the country, through:

1. A well-defined Research and Development (R&D) thrust from innovative idea to technology development and knowledge generation, to technology transfer and utilization;
2. Active engagement of scientists, researchers, and engineers in R&D activities; and
3. Strengthened partnerships and significant collaborations with industry, academe, and government agencies to complement resources and expertise.

# Introduction

For several years now, PCIEERD has put itself at the forefront of local science and technology. PCIEERD's annual report, *Innovations*, showcases the most advanced, well-executed, and impactful science and research projects in its sectors. In 2017, PCIEERD brings the benefits of these advancements to Filipinos everywhere.

With projects aimed at engaging stakeholders, improving facilities, and giving opportunities to science practitioners and students, PCIEERD leverages on science and research to discover new technologies and techniques, support Filipino ideas and industries, and create solutions to pressing problems.

PCIEERD is not only committed in using science and technology to quickly respond to current conditions while anticipating future needs, but also in cultivating new areas and opportunities. This culture of forward-thinking is ingrained in its new moniker: The Innovation Council.

As the Innovation Council for industry, energy, and emerging technologies, PCIEERD contributes to nation building, whether in furthering research and development, or local businesses. This name not only represents a series of new projects aimed at improving the abilities of Filipinos to do science, or giving Filipino businesses the edge in keeping

up with today's rapidly changing digital world. It represents a change in mindset. Instead of pursuing innovation simply for the sake of being novel, PCIEERD always seeks to improve lives.

The Innovation Council holds a set of core values, which will guide its personnel to see this work through, and remain on track for years to come. PCIEERD's central values are:

- *Commitment.* Having faith in the system, we are passionate at what we do. We take the extra mile and make things happen.
- *Respect.* We demonstrate integrity and fairness in all we say and do. We treat everybody with respect.
- *Excellence.* Innovative and competitive change agents, that is who we are. We do our best where we are the best.
- *Sense of Urgency.* Time is of the essence. What we do today is always the priority.
- *Teamwork.* Our success is characterized by our collective energy and intelligence. We grow, prosper, and celebrate success together.

This is the Innovation Council.

# Impact Science through Effective R&D Management

It is now clear to us that research and development contributes to academic gains through the creation of new knowledge, manpower development and facilities. Its indicators are now used DOST-wide through PCIEERD's 6Ps metrics: Publications, Patents, Products, People services, Policies, and Partnerships. No doubt, the 6Ps metric alone has increased DOST's R&D output simply by putting in place tangible targets for each and every project. However, there's a bigger output to be achieved. We are also learning that R&D can be a viable tool to effect an even wider positive impact in society—through the provision of important public service, environmental protection, and economic gains. And while the 6Ps metric is now well-entrenched in the DOST system, we also need to start putting in place the planning and tracking of these wider impacts.

Positive gains to society beyond academic outputs are called outcomes (medium term and wholly attributable to a project) and impacts (long term and the project is a contributor). Example—a project on a novel chemical for treatment of industrial wastewater may have publications and a patent (output), later on licensed and used by an industry partner (outcome), and eventually contributes to the reduction of water pollution in the country (impact). Project proposals need to be written with the desired outcomes and impacts in mind. In other words, it is much easier to write a proposal with the end goal in mind—I want to reduce

traffic (impact) by reducing vehicles that are parked in public roads (outcome) which can be achieved by a software that the Metropolitan Manila Development Authority can use to map out illegally parked cars using satellite imagery (output).

There are standard tools on how to effectively write proposals with impacts in mind. However, I think what needs to be done first is to change the mindset of our researchers for them to start framing their R&D as an impact science—science and technology used for the betterment of society. And this fits well with DOST's overall program of Science for Change (S4C) and Science for the People (SFTP).

We, as a funding agency, play an important role in ensuring that our projects result in positive impacts. Three things can be done right away: including impact indicators in the periodic monitoring of projects, extending monitoring beyond project completion, and writing about R&D impacts. The shift towards impact science will not happen overnight as we are just a piece in the whole R&D ecosystem. But we can be the catalyst for such change and finally show to the whole country that S&T improves lives.



CARLOS PRIMO C. DAVID, Ph.D.

“We need to start framing R&D as an impact science—science and technology used for the betterment of society.”



## Message from the Executive Director

# Message from the DOST Secretary



The Philippine Council for Industry, Energy, and Emerging Technology Research and Development (PCIEERD) has always been an active contributor to nation building as it aids in the development of solutions to the country's problems through science and technology.

The DOST takes pride in the endeavors of PCIEERD as it continues to fulfill its mandate as our Innovation Council. This year, five new areas of research have been added under its coverage—Artificial Intelligence (AI) and Data Science, Human Security, Space Technology Applications, and Creative Industries.

With the aim to jumpstart AI development in the country, PCIEERD, in partnership with the academe, government, and industry sectors, has come up with a set of proposed projects for the AI program, including Data Analytics and Data Science.

Areas covered under Human Security are food security defense, biosecurity, cybersecurity, and resources protection. PCIEERD's collaboration with the Department of National Defense, National Security Council, Philippine Navy, and the Philippine National Police are geared towards creating various systems that support human security. On the other hand, the priority programs under space technology applications are the application of remote sensing data and location-based services using Global Navigation Satellite System (GNSS). The focus on creative industries are those sectors where science and technology application can create big positive impact.

Congratulations to PCIEERD for excellently navigating through 2017 with its various successful S&T undertakings. Let this annual report serve as a reminder of 2017 milestone achievements which will serve as inspiration to achieve more.

**PROF. FORTUNATO T. DE LA PEÑA**



## Message from the DOST Undersecretary for R&D

**G**uided by its objective to enable scientific solutions through strategic R&D, the Philippine Council for Industry, Energy, and Emerging Technology Research and Development (PCIEERD) continues to prove that it is an accelerator of progress through consistently rendering new innovations.

Covering the most diversified sectors out of the three sectoral planning councils in the DOST, PCIEERD has been a fundamental part of the department's striving to offer more solutions to the Filipino people. The development of an Integrated Food Safety program, the establishment of halal laboratories through OneLab, and the construction of gold-copper mineral processing pilot plants in various regions are some projects that PCIEERD has delivered for the industry. These create opportunities for business enterprises, ensuring improved industrial processes. The Council also supports R&D that enhances our transportation system. An example of this is the Contactless Apprehension of Traffic Violators on a 24-hour basis and all-vehicle Detection System, or CATCHALL, which uses a network of roadside cameras to identify law violators through vehicle detection, tracking, and license plate localization and recognition.

Moreover, prototype trainsets are being tested for enhancement until these are ready to be integrated to public transport. As for renewable energy, Project PhilSHORE has identified our country's potential sites for conversion of tidal current energy. I am sure that these will lay groundwork for the advancement of ocean renewable energy. PCIEERD is also known for the development of emerging technologies on disaster risk reduction. The Cartography of Old Can Inform the New (COIN) project is an example of this, which will provide vital clues on the cause of flooding and other hazards by digitally scanning historical maps and aligning them with modern maps of the same geographic location; noticeable changes in waterways will then be tagged as flood and liquefaction hazards.

These are but few of PCIEERD's accomplishments. This annual report details only 17 notable S&T projects from the council's roster of 256 approved projects this year. Congratulations, PCIEERD, for harmoniously working with state universities and colleges, and higher education institutions, government agencies, and the private sector. These successful projects manifest a culture of collaboration that is beneficial to the Filipino people.

A handwritten signature in black ink, appearing to read 'Rowena Guevara'.

**ROWENA CRISTINA L. GUEVARA, Ph.D.**



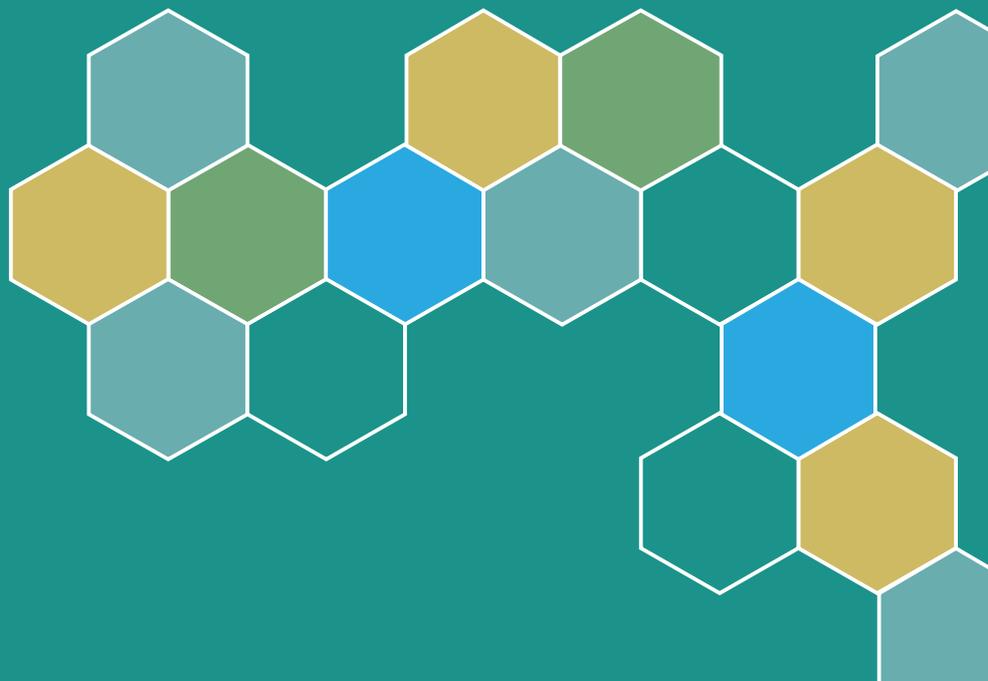
# Support to Primary Sectors

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## Industry

The Philippines is a rapidly developing nation, with hard-working Filipinos driving the growth of the economy. Technology plays an important role in ensuring that the Philippine industry, in general, stays competitive in the global arena.

PCIEERD seeks to do its part in strengthening the nation's economy by supporting research and development, and improving access to new technologies to benefit Filipino industries. The projects featured here focus on various industries, including mining, food processing, textiles, metals and engineering, and more.



# Preserving the Nutrients in Food

## *Design and Development of an Automated Multi-Commodity Heat Pump Dryer*

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**Dr. Lorcelie B. Taclan,**  
Project Leader,  
Adventist  
University of the  
Philippines

**F**ood drying is one of the oldest and most effective methods of food preservation. Dried food not only retains its quality longer, it is also easier to package and sell. Moreover, dried food is characterized with a unique texture, flavor, and nutritional benefits that appeal to consumers. For example, Cebu's mangoes are as popular when dried as they are unprocessed.

To the processor, drying of food provides a distinct advantage that can extend product shelf life, as well as diversify product line. To the consumer, it becomes a convenient way to consume food.

Micro, small, and medium-sized enterprises (MSMEs) that sell these dried products often face challenges in the drying process. Leaving products to dry in the sun is cheap, but it can be unreliable since the drying conditions cannot be controlled. Industrial dryers solve these issues, but they can be expensive to run.

A heat pump dryer is useful for MSMEs to save as much money as they can, without compromising the quality of their products. A heat pump dryer makes use of the exhaust from a condenser (a component of a refrigeration or air conditioning system) to dry products, minimizing the nutrient loss of food

products being dried. Dr. Lorcelie B. Taclan, from the Adventist University of the Philippines, has developed an automated version of this technology, suitable for MSMEs.

Dr. Taclan's automated multi-commodity heat pump dryer is equipped with sensors for temperature, relative humidity, and air flow rate, which are important conditions to control when drying products. These are regulated by a Raspberry Pi, where the established drying conditions for different kinds of fruits (e.g., mangoes, bananas, pineapple) and vegetables (e.g., *Moringa* leaves, and mulberry leaves) are programmed.

This automated dryer is able to effectively dry up to 100 kilograms of a product within 8 to 12 hours, depending on the commodity. The project team is looking at MSMEs in Ilocos as adopters of these equipment to help them become more competitive in their businesses. Possible beneficiaries also include other MSMEs around the country, and other Asian countries such as Thailand.

# Safe Food for Everyone

## Integrated Food Safety Program

**Dr. Mario V. Capanzana,**  
Project Leader,  
Department of  
Science and  
Technology – Food  
and Nutrition  
Research Institute

In 2017, over 40,000 cases of foodborne and waterborne diseases, such as diarrhea, cholera, hepatitis A, and typhoid were reported in the Philippines, according to the Public Health Surveillance Division of the Epidemiology Bureau of the Department of Health. There have also been several cases of rejected and recalled Philippine food exports due to detected health risks. These are only a few examples of food safety issues that the Philippines is constantly dealing with.

To help combat these issues, PCIEERD led the development of an Integrated Food Safety Program, which combines the work and research of several government agencies and stakeholders. This program envisions “Safe food for everyone, by everyone, through science, technology, and innovation by 2022.”

The Integrated Food Safety Program has four main components that are meant to address problems and gaps in food

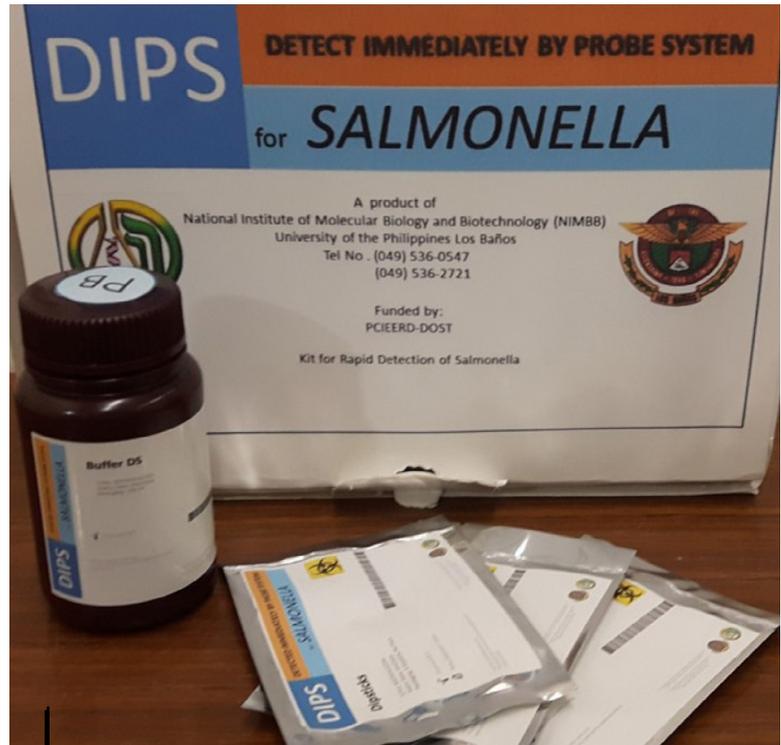


Unified Food Safety Training Modules for MSMEs

safety. These components are: 1) research and development; 2) enhancement of testing capabilities; 3) development of human resources; and 4) knowledge/technology transfer and policy advocacy.

This five-year program aims to help assure the safety and quality of food products and to help reduce the costs for small businesses to implement effective food safety and quality control systems. This will help ensure the safety of the nation's food supply by preventing contamination, and establish the country's market reputation as a producer of safe and high-quality food products.

Overall, new food safety innovations and policies, better-educated food handlers and customers, and well-designed systems will ensure safety and quality at every step of the food production process, from farm to fork. In general, efforts of PCIEERD and DOST with the support of the food safety regulatory agencies will create a united front against preventable foodborne diseases, for a safer, healthier Philippines.



● Dipstick kit developed by UPLB-BIOTECH which can detect Salmonellae in food samples within one (1) day.

# Accessible Laboratory Testing Services

## Enhancing OneLab for Global Competitiveness

**Ms. Rosemarie G. Salazar,**  
Project Leader and Assistant Regional Director,  
DOST Regional Office No. 9

OneLab is a referral system that tracks the services that each DOST laboratory provides, as well as the demand for testing within the laboratory network. Anyone wishing to avail of the testing services may approach any testing center. That testing center will then be able to use OneLab to determine the best place for the testing to be done, and will take care of facilitating the request.

The OneLab system was successfully launched in 2015. Since then, it has been opened for integration with non-DOST laboratories, such as private and other government laboratories in the Philippines and selected laboratories in Asia. Constant improvements have been made to the platform to make it easier to use and to have it provide more services. One major development is the inclusion of halal testing in 2017.

There are many requirements for a food to be certified as halal. For example, a halal product cannot contain pork (or any components derived from pig) and alcohol. To test these, two DOST OneLab member laboratories were equipped with Halal verification capabilities such as porcine alcohol testing. This will help restaurants and food manufacturers serve the Muslim population of the country, giving Muslims more and better food options.

Specifically, halal testing capabilities were established at DOST Region 4A and DOST Region 11. This is part of DOST's support for Republic Act 10187, the Philippine Halal Export Development and Promotion Act. This law seeks to increase the global demand for halal products, increase the quality of local halal products, and boost the confidence of consumers in these products.



Launching of Halal Verification Laboratory in DOST Region XI on November 24, 2017 attended by (from left) DOST-TAPI Director Engr. Edgar I. Garcia, NCMF XI Regional Director Dr. Norhaida M. Lumaan, CESO III-DOST XI Regional Director Dr. Anthony C. Sales, DFA Davao OIC Mr. Ebrahim T. Zailon, and Alem Mohammed Pasigan from DAMUHCAMA

# A Better Option for Small-Scale Miners

## *Field Testing of the Integrated Gold-Copper Mineral Processing Pilot Plant in the Regions*

**Dr. Herman D. Mendoza,**  
Project Leader,  
University of the Philippines -  
Department of Mining,  
Metallurgical,  
and Materials  
Engineering

**S**mall-scale mining operations can be challenging to set up and run. For example, traditional processing techniques require expensive equipment, which smaller operations might not be able to afford. Also, these traditional techniques can be difficult to use, and pose threats to the environment and the health of workers if not properly managed.

In response to these challenges, Dr. Herman D. Mendoza, a metallurgical engineering expert, developed a new type of processing that is optimized for smaller-scale operations. The equipment in this new type of process is more affordable and safer to use, and the techniques are more environment-friendly.

Dr. Mendoza's process makes use of gravity concentration, a technique that separates gold and copper from other minerals based on how they float in water. Moreover, the new process minimizes the use of chemicals such as mercury and cyanide, thus ensuring that effluents from the plant are non-pollutant. This is a win for small-scale miners, as it is a much cheaper and cleaner option for processing that still yields desirable results.

One pilot plant was established using the new process and is currently being tested in Benguet, with three more to be built in Agusan del Norte, Camarines Sur, and Compostela Valley by June 2018.



● Gold-Copper Mineral Processing Plant in Benguet

# Going Natural

## Natural Dyes and Colorants R&D Program

**Ms. Evangeline P. Manalang,**  
Project Leader,  
Philippine Textile  
Research Institute  
– Project 1.  
Commercial Scale  
Verification of Natural  
Dyes for Textiles

**Dr. Rosalinda C. Torres,**  
Project Leader,  
Industrial Technology  
Development Institute  
– Project 2.  
Development of  
Natural Colorants for  
Cosmetics

**Ms. Trinidad T. Arcangel II,**  
Project Leader,  
Food and Nutrition  
Research Institute  
– Project 3.  
Extraction,  
Characterization  
and Application of  
Natural Colorants  
in Nutritional Food  
Products

**Ms. Ma. Dolor L. Villaseñor,**  
Project Leader,  
Industrial Technology  
Development Institute  
– Project 4.  
Natural Food Colors  
from Local Source as  
Food Additive

Today's consumers are not only concerned with the quality or price of products. There is now a growing concern about how products are made, and where products come from. More than ever, there is a preference for natural and organic products that are less harmful to the environment.

This trend includes the components that make up a consumer product, such as dyes. Statistics show that the global demand for natural dyes will increase 6% annually until 2019. To capitalize on this growing market, Filipino scientists have started developing natural dyes from Philippine flora.

PCIEERD supports this effort through the Natural Dyes and Colorants Research and Development Program. In cooperation with the Philippine Textile Research Institute, Food and Nutrition Research Institute, and Industrial Technology Development Institute, this program seeks to develop dyes for use in textiles, cosmetics, and food.

To keep the research up-to-date, the project teams sent representatives to Ohio State University in the United States for a benchmarking activity in August 2017.

It is expected that the researchers, using their newly acquired knowledge, will be able to increase the number of research projects on natural dyes and colorants, as well as improve their quality. This will ensure that the dyes and colorants that they develop will be technologically ready and environment-friendly. Once research on product development is done, efforts will be focused on refining the process of extracting these dyes and producing them on a larger scale. This will help Filipino scientists and industries take charge of every step of utilizing these natural, local products. This will also lead to developing the expertise of Filipino scientists on using natural local materials.

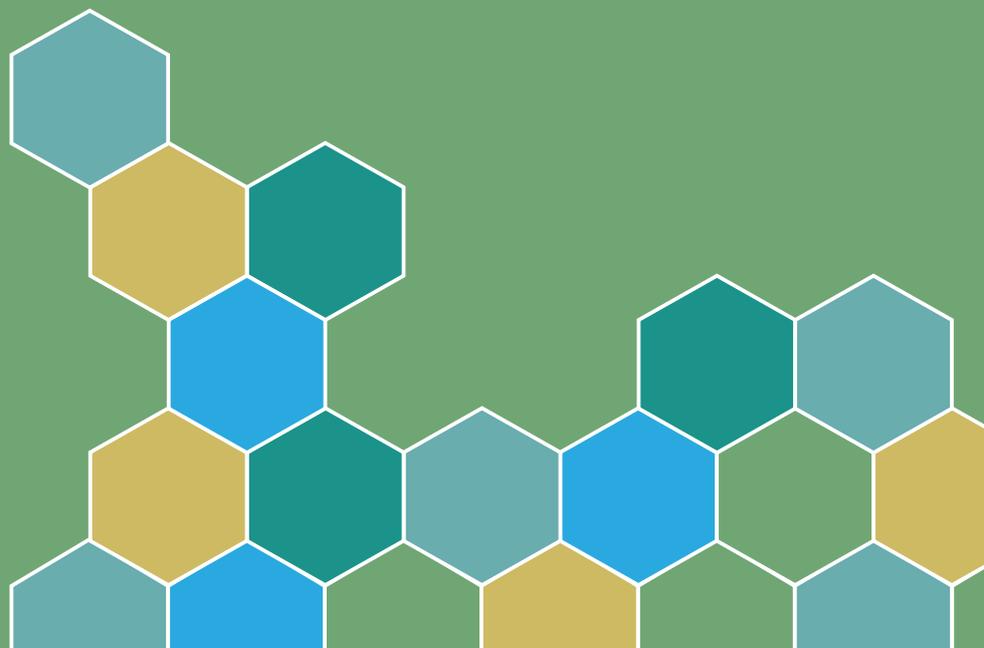


Colors of the rainbow using natural dyes (left-side bottle) versus synthetic ingredients (right-side bottle)



# Energy & Utilities Systems

Developments in science and technology can open up a wide variety of possibilities when it comes to energy and utilities systems. This year, PCIEERD showcases the best of these developments, from finding new ways to harness renewable energy and managing energy usage, to helping ease transport solutions, and mitigating and preparing for disaster situations.



# An Eye on the Road

## Contactless Apprehension of Traffic Violators on 24-Hour Basis and All-Vehicle Detection System (CATCH-ALL)

**Dr. Elmer P. Dadios,**  
Project Leader,  
De La Salle University

The sheer volume of cars is a major cause of traffic in Metro Manila, but there are other contributing factors like irresponsible and reckless drivers whose violations can stop the flow of traffic. Moreover, it is also difficult to apprehend these drivers due to the number of cars on the daily commute.

A system that automatically detects traffic violations and tickets the drivers would be a fair, consistent way to reprimand those who break the rules. It will also reduce the traffic that these drivers cause. A team from De La Salle University, headed by Dr. Elmer P. Dadios, developed the Contactless Apprehension of Traffic Violators on 24-Hour Basis and All-Vehicle Detection System (CATCH-ALL) to do just that.

CATCH-ALL makes use of cameras installed at intersections to observe the flow of traffic. It also utilizes artificial intelligence to recognize drivers who break traffic rules, capture images as proof of their violations, and notify those violators in real-time.

The CATCH-ALL software can already recognize number coding violations, instances of swerving or reckless driving, and cars that drive through red lights. In lieu of issuing tickets, the system is connected to an electronic billboard, which automatically shows the plate number of a car when its driver committed a violation, as well as a photograph of the violation.

Automation means that more violators are ticketed, and fewer officers are needed on the streets. This would also eliminate the need to pull drivers over, which could itself result in more traffic.

As CATCH-ALL is developed further and deployed throughout Metro Manila, it will help reduce traffic. It will also instill a considerate and disciplined mindset for drivers, which, in turn, make for safer roads overall.



CCTV cameras located along Taft Avenue cor Estrada Street, Malate, Manila for the test run of CATCH-ALL.



Inauguration of CATCH-ALL Project at the De La Salle University on May 15, 2017 led by PCIEERD Executive Director Dr. Carlos Primo David and Project Leader Dr. Elmer Dadios (fifth and sixth from left, respectively).

# Energy from the Tides

## *Tidal Current Energy Integrated Resource Assessment and Marine Spatial Planning Tool (PhilSHORE)*

**Engr. Ma. Rosario Concepcion O. Ang,**  
Project Leader,  
University of the Philippines Diliman,  
Department of Geodetic Engineering

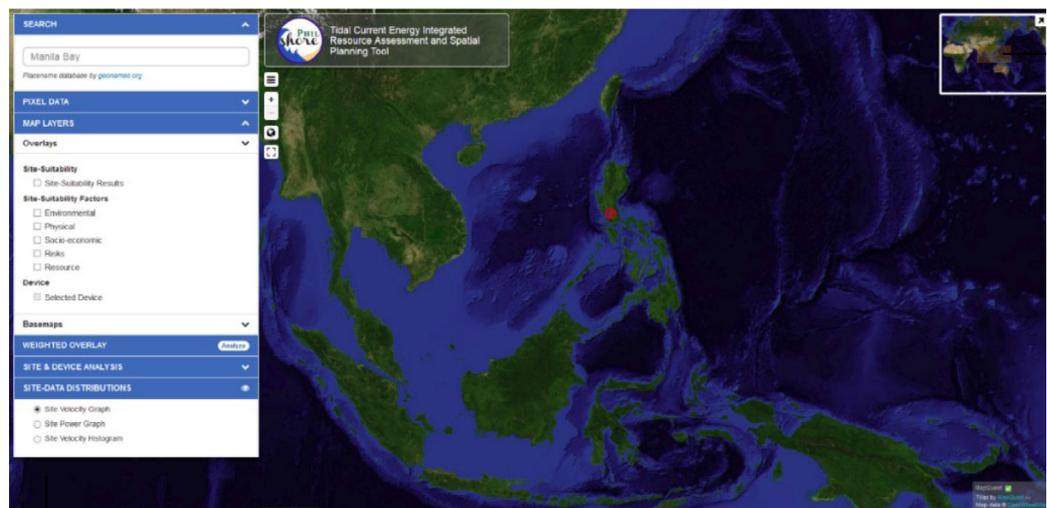
The Philippines already makes use of several kinds of renewable energy, such as solar and wind energy, but there is still a need to find new clean and cost-effective ways to produce power. One possibility is ocean energy, which harnesses the power of the ocean to generate electricity, whether through the movement of its waves or the movement of the tides.

Engr. Ma. Rosario Concepcion O. Ang, from the University of the Philippines, is heading the development of the Tidal Current Energy Integrated Resource Assessment and Marine Spatial Planning Tool (PhilSHORE). This makes use of Geographic Information Systems (GIS) to analyze sites around the Philippines to

see if they are suitable for the generation of tidal energy.

This research leverages on the topography of the Philippine archipelago, with its many channels and straits, which are ideal for tidal energy. Project PhilSHORE will help assess how well-suited these sites are to the development of tidal energy projects, and will map out these results, allowing others to make use of this information.

With 10 sites surveyed and many more planned, this effort will help support future research on tidal energy. It will also help determine the best locations for tidal energy development, in line with the Department of Energy's (DOE) goal to have the first tidal power project by 2018.



● Marine Spatial Planning Tool WebGIS platform for tidal in-stream current energy development

# Powering the Economy

## *Disaggregated Electricity Consumption Baseline Measurement of Micro, Small, and Medium Enterprises in the Philippines, and Behavioral Response Analysis to an Intelligent Energy Management Platform using Real-Time Electricity Monitoring with Integrated Analytics and Recommendations Engine*

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**Mr. Jan Aaron Augustus Garcia,**  
Project Leader,  
WattSmart  
Philippine Corp.

**M**icro, small, and medium-sized enterprises (MSMEs) make up over 90% of all businesses in the country. Ranging from eateries and restaurants to innovative start-ups and small businesses, MSMEs are an essential driving force of the national economy.

Electricity use is a major factor that these smaller businesses must consider, as electricity bills can take a huge chunk out of their limited resources. A business that mismanages its power consumption could face financial trouble.

WattSmart is an intelligent energy management platform. It is designed to help MSMEs track their electricity usage, and plan out the best ways to use their electricity efficiently, helping to reduce power costs. WattSmart is connected to a business' electrical system, which determines the energy usage in kilowatt hours, peak times of electricity usage, and energy usage of

individual appliances. Data collected will be analyzed by the Wattsmart team then turned over to the business, along with recommendations on how they can improve their energy efficiency.

Under the WattSmart program, data is collected from a wide range of businesses. Aside from making recommendations to the businesses, the data are also collated and analyzed to allow researchers to gain insights to accurately forecast energy demand, implement demand side management programs, and improve efficiency of typical appliances that the MSMEs use.

When the project was implemented in 2016, only a few dozen businesses installed WattSmart. By the end of 2017, 122 MSMEs had installed the system. Also in 2017, the DOE began plans to adopt the WattSmart technology, and apply it on a wider scale.



Installed WattSmart Energy Management System

# Making Bridges Unshakeable

## *Wireless Sensory Network System for Structural Integrity Monitoring of Bridges (Smart Bridge)*

**Dr. Francis Aldrine A. Uy,** Project Leader, School of Civil, Environmental, and Geological Engineering, Mapúa University

Many of Manila's most important commuting routes make use of bridges and flyovers. Even EDSA, the main highway of the capital city, passes over the Pasig River. Damage to these bridges, whether due to natural disasters or wear and tear from lack of maintenance, could be disastrous. Unaddressed structural damage could result in bridge failures leading to property damages and serious injuries or deaths.

To veer away from the conventional method of visual physical inspection, Dr. Francis Uy from the School of Civil, Environmental, and Geological Engineering at Mapúa University developed Smart Bridge, a weather- and theft-proof system that remotely monitors the stability of bridges in real time. This means that the structural integrity of bridges equipped with this system can be monitored closely, allowing maintenance teams to see early signs of structural instability, and respond accordingly. Considering the frequency of storms and earthquakes in Metro Manila, this invention will be very useful in scheduling infrastructure upgrades, as part of disaster prevention and risk mitigation.

The Smart Bridge System is made up of a series of accelerometers—sensors that measure acceleration—which are placed at key spots on a bridge, where the most stress is applied to the structure. The accelerometers will be able to sense vibrations moving through the structure, and record the patterns of these vibrations. These patterns will show whether the bridge is functioning as it should, or if certain points are under more stress than usual and might be prone to failure. The system is also equipped to transmit this data, which can be accessed over the internet.

Pilot testing of the Smart Bridge system is ongoing. It was fitted to the Padre Jacinto Zamora Bridge, which connects Pandacan, Manila with Paco, Manila.



Smart Bridge wireless sensor node installed at a column mid-height of Padre Jacinto Zamora bridge in Pandacan, Manila

# A New Way to Commute

## Performance Testing and Evaluation of Prototype Train Set

**Engr. Pablo Q. Acuin,**  
Project Leader,  
Metals Industry  
Research and  
Development Center

Transportation has long been a concern for Filipinos, especially in Metro Manila, where crowded trains and roads are a common source of frustration for commuters. DOST, through the Metals Industry Research and Development Center (MIRDC), is aiming to alleviate this concern with a new and improved train.

Designed and built locally by Filipino engineers, this train has better access to replacement parts and components, compared to the current trains whose components need to be sourced from abroad.

It is also a hybrid train, meaning it can run on fuel or battery—which makes it a more environment-friendly alternative to the current Philippine National Railways (PNR) trains that run purely on diesel fuel.

The train set can be used by the PNR, which operates a commuter rail service within Metro Manila. Throughout 2017, the prototype train set was tested for speed, acceleration, and braking distance, among other factors. Apart from these tests, Systra Philippines Inc., a transportation consulting and design firm that worked on the MRT 3 and LRT 1 lines, was contracted to perform an analysis of the train.

The results of these tests were positive, showing that only a few adjustments had to be made before the train is ready for deployment. Systra's tests were also able to uncover areas that still need to be addressed.



Testing of the trainset prototype from Sta. Rosa to Calamba, Laguna in the presence of DOST Undersecretary for R&D Dr. Rowena Guevara (third from right) and Project Leader Engr. Pablo Acuin (leftmost).



● Test run of the hybrid train from Sta. Rosa to Calamba, Laguna

The initial evaluations have shown that the train set is comparable to commercially available trains. Instead of importing trains, it will allow the country to support and embrace Filipino science and engineering, while making life better for commuters.



*The train set is a more environment-friendly alternative to the current PNR trains.*

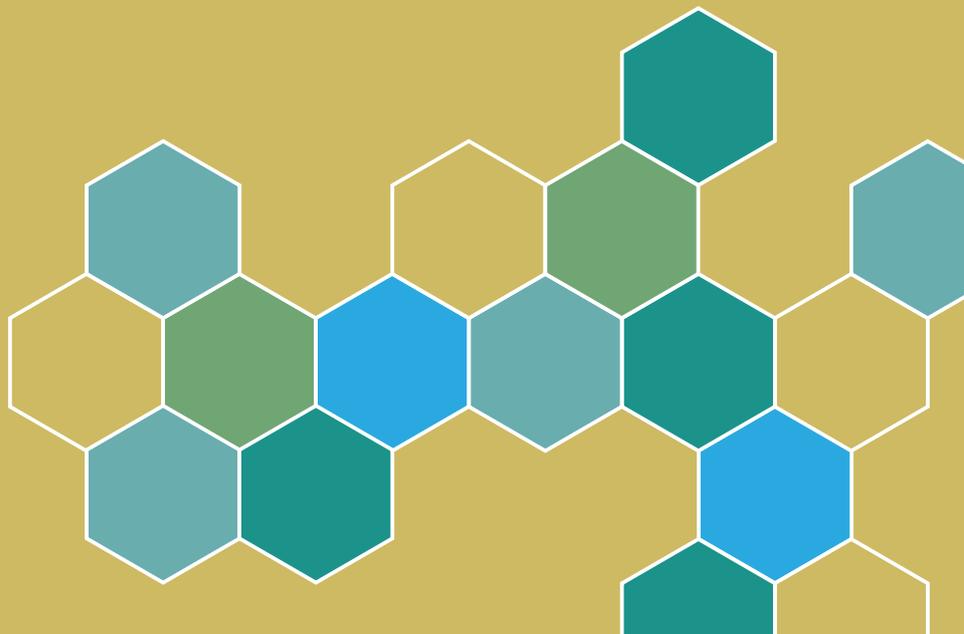


● The sacks represent the weight of passengers for the test run; each of the five coaches can load up to 220 passengers.



# Emerging Technology

The Innovation Council prides itself on constantly being on the cutting edge of science. Among the notable projects this year would be a supercapacitor made partly from piña fiber and a slime mold serving as a “biological robot” in the laboratory. PCIEERD-funded and monitored projects make use of indigenous materials in uncommon ways, and technologies that are uniquely Filipino, inspired by Filipino values, and developed by Filipino talents. Behind every project and problem-solving endeavor is the potential to change the status quo and make a difference in people’s lives.



# Learning from the Past

## *Cartography of the Old Informs the New (COIN)*

**Dr. Maricor N. Soriano,**  
Project Leader,  
National Institute of  
Physics, University  
of the Philippines  
Diliman

**H**istory always has lessons to teach us; sometimes in ways that we do not expect. There is a wide variety of historical sources that we can draw from and apply to our lives in the present day.

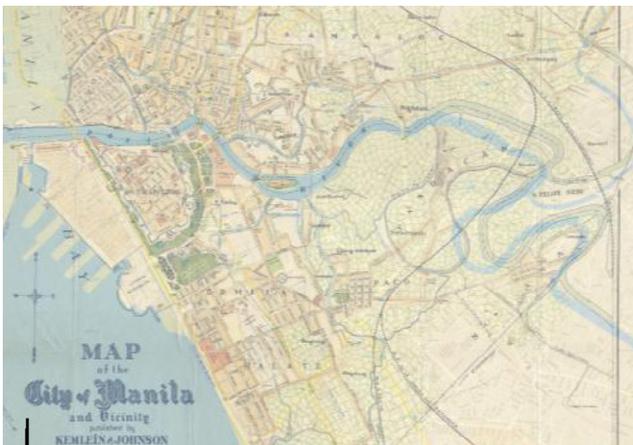
Philippine historical maps offer a rich source of invaluable information. As the cities in Metro Manila rapidly change over the years, archived historical maps endure to provide better insights on how to select the best places to put up new buildings. The research team from the National Institute of Physics, led by Dr. Maricor Soriano, is using these maps to determine areas of cities vulnerable to water hazards.

Using the NIJI-S Scanner, obtained through a collaboration with Kyoto University, the team digitally scanned several historical, hand-drawn maps, and developed an algorithm capable of overlaying the old maps to the current ones—made possible by referencing older road networks and buildings—so as to automatically detect changes in

waterways. The resulting map tells us the areas where waterways used to be and which particular areas are at risk of flooding.

At present, maps of Manila City and Iloilo City have been successfully digitized and overlaid. These updated maps, along with the information from the Nationwide Operational Assessment of Hazards (Project NOAH), as well as the Philippine Institute of Volcanology and Seismology's (PHIVOLCS) liquefaction hazard map, form a clearer, more reliable, and actionable picture of water risks and hazards.

This project proves that looking to the past can warn us about potential risks in the future. The updated information can be useful for local government units issuing building permits, developers looking for secure places for their building projects, and anyone else who wishes to be informed about possible flooding hazards in the area where they work or reside.



● Manila (1908) map overlaid on Google maps using projective transform.



● The COIN staff carefully laying a fragile map on the NIJI-S Scanner at the UP Main Library.

# Staying Connected, Even Without the Internet

## Bayanihan Nets Program

**Dr. Roel M. Ocampo,**  
Project Leader,  
Electrical and  
Electronics  
Engineering  
Institute, University  
of the Philippines  
Diliman

All of us are familiar with the benefits of instant connectivity through the internet. Whether it is through email, instant messenger, social networking apps, or web-enabled audio and video calls, it is now easier than ever to reach other people, quickly and conveniently, despite physical distance.

However, for those living in far-flung communities, out of the range of cellphone towers and internet cables, or for communities that cannot afford internet connection and data plans, these advantages remain inaccessible. The Bayanihan Nets program is a way to give these communities the benefits of clear, convenient, and fast communication.

Bayanihan Nets is made up of a series of devices—similar to routers—which are installed around a community. These devices give local residents access to a local network, which functions like an internet connection but is limited to the community. Locals are able to communicate with each other over this

network, even without a data plan. These devices have been deployed and are being pilot-tested in the University of the Philippines – Diliman campus.

The Bayanihan Nets team designed a network protocol optimized for communities to share, meaning that many people are able to access it at once without it becoming too slow to use. This network functions independently of the internet, allowing members of the community to communicate even without internet access.

Aside from this, the team also provided tools that would help Bayanihan Nets users design simple applications that can be run on the network. These applications can be used for person-to-person communication, or to disseminate important information. Such applications can also be used by local schools to post announcements or directly message their students. Reliable as it is, Bayanihan Nets is indispensable for communications during emergencies.



Bayanihan Nets installation

# Mapping Out a New Path

## PHIL-LiDAR Programs 1 & 2

**Dr. Enrico C. Paringit  
and Dr. Ariel C.  
Blanco,**

Project Leaders,  
Training Center for  
Applied Geodesy and  
Photogrammetry,  
University of the  
Philippines Diliman

The Philippines is well-known for its incredible natural diversity. Its various environments—from mountains, to forests, to plains, as well as beaches and different types of coastal areas—serve as home to a wide range of species. The archipelagic nature of the country, however, poses a challenge for each province or city to manage the natural resources in their respective areas. It is also a challenge to prepare for natural hazards, such as flash floods, and mitigate the damage these could cause.

To better equip the decision-makers, Dr. Enrico C. Paringit and Dr. Ariel C. Blanco from the Training Center for Applied Geodesy and Photogrammetry of the University of the Philippines Diliman undertook two massive mapping initiatives in 2014 to create up-to-date, detailed, high-resolution maps of the entire country. Referred to as the PHIL-LiDAR programs 1 and 2, the mapping utilizes state-of-the-art light detection and ranging (LiDAR) technology, which documents various topographical features that are not easily captured by ordinary aerial photography.

The two projects are intended to complement the existing programs of national government agencies.

### Multidimensional output

Already on their third and final year, the two PHIL-LiDAR programs have 39 project components altogether. To execute a project of this scale, the PHIL-LiDAR teams engaged with technical

personnel from all across the country, teaming up with 16 Higher Education Institutions (HEIs). More than 900 scientists, researchers, and engineers in remote sensing technology, particularly LiDAR, were trained. Their collective efforts generated more than 200 three-dimensional (3D) flood hazard maps, and more than 1,500 resource maps, including 485 agriculture maps, 395 coastal maps, 501 forest maps, and 183 hydrological and renewable energy maps.

## How LiDAR Works

A LiDAR system is usually mounted on to an aircraft, like a plane or a helicopter. The aircraft flies over a certain area, sending laser pulses down to the ground. These pulses bounce off the ground, and a sensor detects the time it takes for them to return. That information is used to construct a three-dimensional map of the terrain. This is similar to how bats find their way in the dark using echoes, but instead of sound waves, LiDAR uses lasers. LiDAR is able to measure not just distance, but also the shape of its target.



The output of PHIL-LiDAR programs 1 and 2 will be crucial in conceptualizing various new urban developments, crafting science-based policies on food security and energy generation, and in long-term planning of communities for climate change mitigation and adaptation. For one, flood maps can provide information to the government on potentially dangerous places for developments. Communities in flood-prone areas could be better prepared for imminent disasters and be prioritized in emergency response and evacuation activities. Ultimately, these tools will be invaluable for the country to take action against avoidable risks.

### Strengthened linkages

While this work has concrete benefits for local governments all throughout the country, it has also made a significant

contribution to the state of research in the Philippines. PHIL-LiDAR not only offered training in important, applicable skills, the program also provided a basis for further research and development.

It has also given Filipino professionals opportunities for their work and talent to be recognized. Nine awards won from scientific conferences and publications—from the Philippines and abroad—acknowledges the excellence of research connected to PHIL-LiDAR. Through this project, the Philippines is becoming recognized as a leader in geospatial technology in Southeast Asia.

These programs also resulted in notable government-academe partnerships, successfully engaging and promoting synergy at various levels of government and private HEIs, local government units, and national government agencies.

## 16 IMPLEMENTING AGENCIES

The PHIL-LiDAR 1 and 2 programs are the culmination of years of work of hundreds of people all over the country. The massive undertaking tapped the best minds in the country's leading academic institutions:



More than a mapping project, these programs brought Filipino researchers and scientists together to devise science-based solutions for the country's progress.

# Powerful Threads

## *Fabrication of Supercapacitors Using Local Textile Fibers as Electrode Materials*

**Dr. Christina A. Binag,**  
Project Leader,  
Research Center for  
Natural and Applied  
Sciences, University  
of Santo Tomas

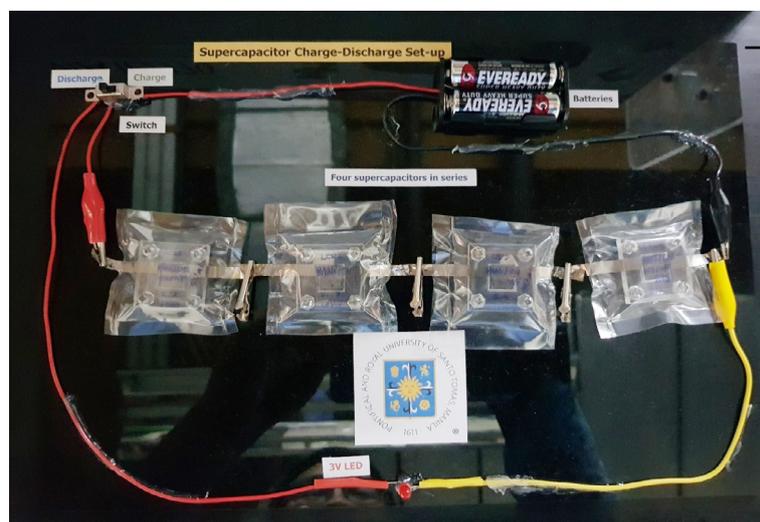
As the Philippines continues to develop, the demand for power rises alongside the growth of industry and the expansion of the community. The rising number of people using electricity creates a need to store power that can be made available at a moment's notice.

Supercapacitors can be a good storage option. Compared to batteries, they cannot store power for long periods of time, but they are able to deliver power faster. This makes them ideal transmitters for intermittent sources like renewable energy, which can help power far-flung communities that are not connected to the main power grid.

Dr. Christina A. Binag from the University of Santo Tomas is heading an effort to create supercapacitors using an unlikely material: textile fibers. Dr. Binag makes lightweight, flexible, and portable supercapacitors by incorporating piña and water hyacinth fibers into their

design. These plant fibers are woven with polyester and combined with a substance that can conduct electricity. The project was able to successfully use the treated fibers as electrodes, which connect the supercapacitor to other electrical components.

Incorporating indigenous textiles into supercapacitors has a side-benefit: it can be a form of adding value to ubiquitous resources. Piña fibers can be sourced from pineapple plantations, where they are often discarded as waste. Water hyacinth is also very common as it is an abundant, invasive water plant. Communities benefit not just from the sale of raw materials but also from the finished products that help provide power.



Supercapacitor charge-discharge setup using four flexible prototype devices in series

# Going Big by Going Small

## *Development of *Physarum polycephalum* Powered Actuators for a Microfluidic Mixer*

**Dr. Mark Nolan P. Confesor,**  
Project Leader,  
Iligan Institute  
of Technology,  
Mindanao State  
University

To remain relevant in the global scientific market, the Philippines needs its scientists to constantly innovate and adapt to new trends in technology. One of these trends is the Lab-on-Chip (LOC) technology, which incorporates complex laboratory processes like DNA sequencing or chemical synthesis into a single chip. LOC devices have a wide variety of applications in pharmaceutical industries, medicine, as well as biomedical and environmental research. The market for these devices is growing rapidly, expected to be valued at \$7.95 billion by 2022.

LOC devices are able to perform fast and accurate analyses and only require very small samples. They have been successfully used to instantly detect specific compounds and chemicals in water or blood at low volumes. Unsurprisingly, the main challenge in developing LOC devices is the design and fabrication of tiny components to perform procedures usually done by hand or by full-sized machines. An innovative solution to this concern involves incorporating a microorganism: *Physarum polycephalum*, also known as slime mold, into the device, where it acts as a biological robot.

Similar to sunflowers turning to face the sun, *Physarum polycephalum* naturally moves away from light and towards small electric fields. Harnessing these responses, the slime mold can be used to control microvalves and rotate microgears, which power LOC devices.

This is one of the first attempts to use *Physarum polycephalum* to power a microfluidic mixer. This development will help pave the way for the local design and production of LOC devices, giving the Philippines access to a growing lucrative market.



Optical system with electronics and mechanical support and designed sample holder, which is used to capture the response of *Physarum polycephalum* under illumination

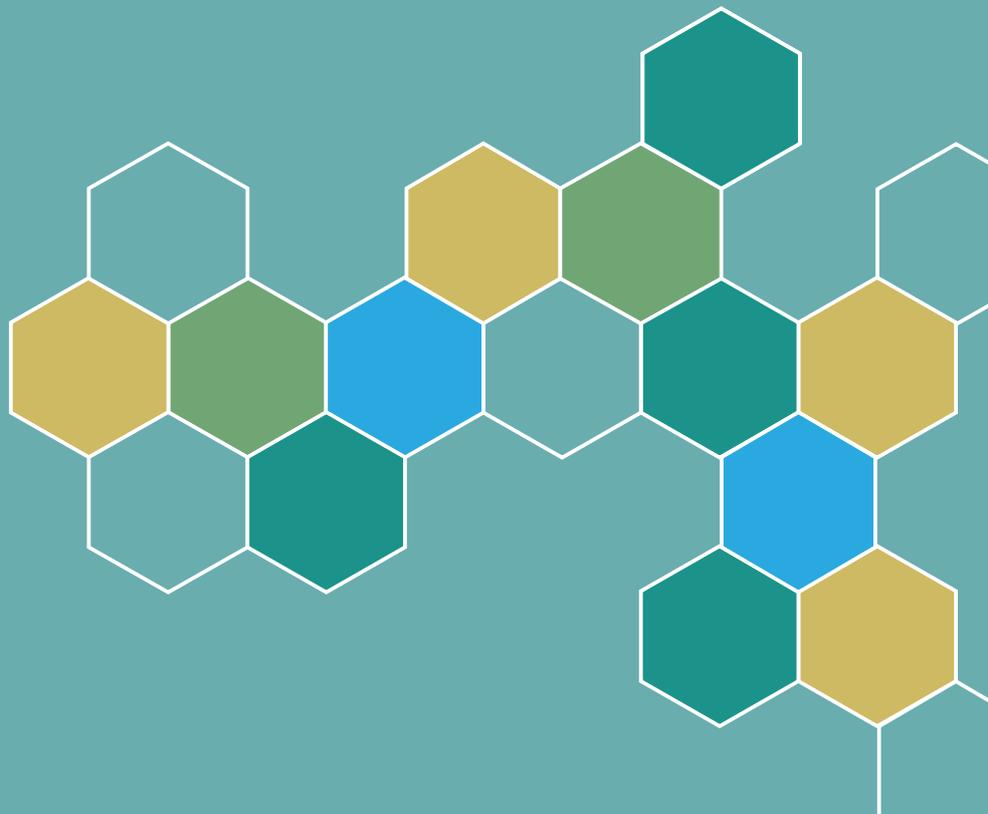


# New Areas of Research

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Science is a diverse field that is constantly shifting and evolving. As time passes, new trends emerge, and new issues become more relevant. One of PCIEERD's most important responsibilities is keeping up with these trends to make sure that the Philippines stays relevant in the global research and development community.

To ensure that these new trends are addressed, PCIEERD has to continuously evolve as well. In 2017, PCIEERD introduced three new focus areas, which address significant new areas of research and development: artificial intelligence, data science, creative industries, and human security.



# Artificial Intelligence

Artificial intelligence (AI) research is a defining feature of today's scientific landscape. More than just running the virtual assistants in our phones, it is also being used to run cars, homes, and buildings. As developments in this area keep coming, AI will become more and more common, becoming integrated in more aspects of our daily lives.

PCIEERD wants to make sure that Filipino scientists, engineers, and programmers are well-armed to take on the challenges of AI development, and that the Philippines can be a global force in AI research. To this end, it has established an Artificial Intelligence program, which has already started laying the groundwork for a healthy AI development community in the country by engaging students, professors, and young professionals.

PCIEERD hosted an Artificial Intelligence Consultative Meeting and a Roundtable Discussion, with experts from the academe, government, and different private industries, to determine the best ways to jumpstart AI research by targeting priority needs in the country. As a result of the meeting, a series of projects directed toward information technology-business process outsourcing (IT-BPO), education, health, transportation and infrastructure, and agriculture and environment were conceptualized.

Aside from this, a summer school training program was opened to teach college professors, students, and government information technology practitioners about the theory and applications of machine learning. Fifty-two participants



Participants and organizers of the Deep Learning using TensorFlow and Machine Learning Training on July 10-14, 2017 in Google Philippines.



DOST Summer School on Artificial Intelligence held on June 3-9, 2018 with mentors from UP, DLSU, and ADMU.

from all over the country attended the program.

Another AI training program, the DOST Deep Learning using TensorFlow and Machine Learning Training was held in July 2017 at the headquarters of Google Philippines. This program—jointly organized by DOST-PCIEERD, Thinking Machines Data Science Inc., and Google Inc.—trained 35 qualified individuals on the current state of AI tools using the Tensorflow, a set of software tools that assists in the creation of neural networks and other AI applications.

Through this new program, PCIEERD has also taken the lead in procuring state-of-the-art AI and machine learning technology to boost the competitiveness of the Philippines' Business Process Outsourcing industry.

# Data Science

Gathering and storing information is one thing; analyzing patterns, predicting outcomes, and extracting insight from the collated data, is something else. Data science derives meaning from massive amounts of data to create something of value. Among the practical applications of data science for example, is the mundane task of road navigation via a navigation app, which collects data from online maps, as well as user tips based on real-time traffic observations uploaded using their mobile phones, to map out the best possible commuting route.

Data science is the study of gaining actionable knowledge and insights from large data sets. Any decision-making process benefits from data science. It can be invaluable to any field that relies on data, including science, technology, business, government, medicine, security, and so much more.

Recognizing the vital role of data science in today's knowledge economy, PCIEERD established a Data Science program. One of the first projects of this new program is an online data science training course to develop the Filipino human resource capabilities in this field. This course features four modules from the Johns Hopkins University's Data Science specialization, namely: 1) The Data Scientist's Toolbox; 2) R Programming; 3) Getting and Cleaning Data; and 4) Explanatory Data Analysis.

To create this training course, DOST and PCIEERD partnered up with Moocs PH ([www.moocs.ph](http://www.moocs.ph)), a local online learning platform, and Coursera ([www.coursera](http://www.coursera).

org), which offers lessons and courses from top international universities online. There was overwhelming interest on the program, with over 1,000 applicants from the academe, government, and private industries, as well as undergraduate and graduate students. A total of 353 applicants were accepted, into the program. The program is going strong, with trainees having finished the second of the four modules in December of 2017.



***Data scientists are some of the most highly demanded professionals today. Developing a community of highly skilled Filipino data scientists will ensure that the Philippines is a globally recognized force in today's data-driven world.***

# Creative Industries

Many Filipinos are known for their creative talent and technical skill. However, there may not always be adequate support for them to develop their talents and show them off to the world.

For this, PCIEERD established the Creative Industries program. It will help nurture the natural talent of Filipinos by funding projects and initiatives that support the country's creative industries, like game development, animation, music, culture and the arts, furniture design, interior design, and many more.

Under the new program, training will help Filipino creatives further develop their skills and talents to be more competitive. Filipino artists may also avail of platforms to showcase their work, allowing them the opportunity to reach a wider—possibly international—audience. This support for creative work in the country is expected to open up more jobs for artists, designers, musicians, and other cultural workers.

One of the first programs of the Creative Industries program is the Industry Defined 2D Basic Animation Course in partnership with Toon City Academy. This is a 12-week, intensive basic animation workshop, open to graduating students of animation-related courses at the University of Iloilo and the University of Pangasinan. Participants will be given on-the-job training as part of their university's internship program. At the end of the course, students will be ready for actual work in the animation field.

As more programs are rolled out, the Creative Industries program is expected to help Filipino talent become more recognized globally.



*Under the new program, training will help Filipino creatives further develop their skills and talents to be more competitive.*



● A closer look on how a trainee worked on her strategy in accomplishing her bouncing ball exercise.



● 2D Basic Animation trainees in action while finishing their weekly exercises.

# Human Security

Human security is a new way of thinking about the safety and well-being of the citizens of a nation. Rather than being concerned with the safety of the country at large, human security focuses on the safety of each individual person, seeking to protect their fundamental rights. This does not only mean protecting people from wars and military conflicts, it also means protecting every individual from poverty, hunger, disease, and other dangers.

To achieve this holistic view of security in the Philippines, inputs from different sectors are needed, including contributions and innovations from the local scientific community. To facilitate this, PCIEERD has established the Human Security program, which will develop scientific projects and partnerships to contribute to the security of all Filipinos. This decision is in line with DOST's Harmonized National R&D Agenda 2017-2022, which lists human security as a priority development area, covering four main areas:

- Food security: Ensuring that there is sufficient, safe, and nutritious food accessible to everyone
- Biosecurity: Protection against biological weapons
- Cybersecurity: Protecting classified information of national political or economic importance
- Others: Other projects seeking to protect life, resources, and to help the country achieve self-reliance in defense

In 2017, DOST entered into an agreement with the Department of National Defense and the National Security Council to

help achieve the goals of the program. Working with these government agencies is a first step for PCIEERD in using science and technology to help keep Filipinos safe.



DOST and the Department of National Defense (DND) formalized their partnership to achieve a Self-Reliant Defense Posture through a Memorandum of Understanding.



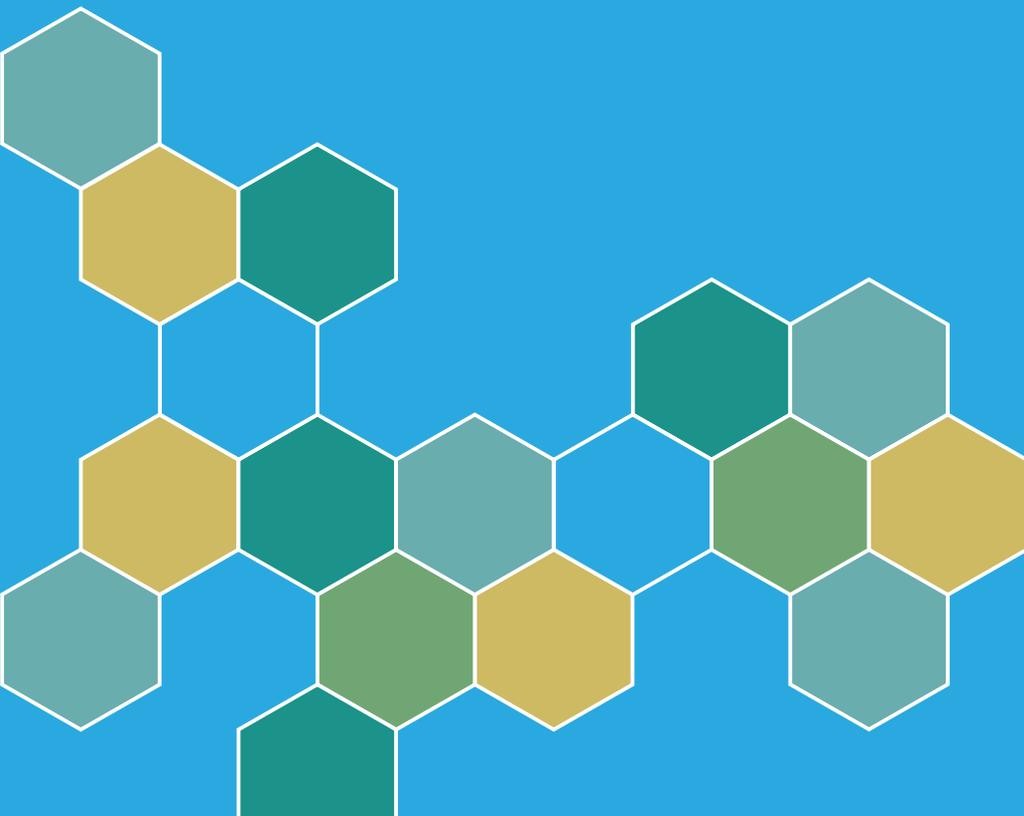
A Memorandum of Agreement was signed between DOST, led by Fortunato T. de la Peña, and National Security Council (NSC) represented by Adviser and Director General Hermogenes Esperon, Jr. Through the partnership, the parties aim to come up with innovative products and services in support of security-related endeavors.



# Support for Technology Transfer

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Beyond research, PCIEERD seeks to bring the latest technology to the mainstream audience, and/or to niche markets where it is most needed. The culmination of scientific work is when it crosses over to industry and entrepreneurship, and reaches the beneficiary or consumer. Good work is not only recognized--it becomes a vital part of everyday life.



# A Head Start for Tech Startups

With the rise of more daringly entrepreneurial generations, along with the widespread usage of the internet and proliferation of technological development, more and more technology startups are popping up, hoping to be the next big thing. However, not all of these newly established enterprises make it, especially in the very competitive business environment.

To give Filipino technology startups a huge boost, DOST and PCIEERD launched the Startup Research Grant Program in August 2017.

The Php 61 million research grant program provided the much needed financial support to selected local startups that required assistance in improving their prototypes, conducting feasibility studies, validating user and market requirements, producing to scale, joining international startup events, and

protecting their intellectual property rights. Beneficiaries were also granted access to DOST and PCIEERD's extensive knowledge network, research and development centers, and Technology Business Incubation services.

Local startups applied to either of two fund tracks: Idea-to-Technology (i2Tech) and Innovate and Scale (iScale) Assistance programs. With i2Tech, DTI-registered businesses with early stage prototypes received a pre-incubation grant that would help them in product improvement, market testing, data gathering, and business modelling, among others. With iScale, more developed SEC (Securities and Exchange Commission)-registered startups with a minimum viable product, were awarded funds from both the grant and outside investors. These funds would aid them in expanding operations, testing for certifications, and product rollout.



Startups with projects under the Council's Startup Research Grant Program

From the numerous proposals submitted to the agency, 15 tech startups were awarded with a research grant for the following projects:

### 1 Grayscale Marketing

Grayscale Marketing, a web and ICT development service provider, is working on the Smart Vision Project that aims to produce smart eyeglasses for visually impaired persons.

### 2 Easybus PH Inc.

Easybus PH Inc.'s Digital Bus Booking Platform is an easy-to-adopt centralized platform that connects the booking officer, conductor, and passengers. With it, bus operators will be able to avoid issues such as double bookings, terminal congestion, and miscommunication that the manual booking process is prone to.

### 3 MachiBox Inc.

MachiBox Inc.'s simple-yet-educational, easy-to-code, and cost-effective MachiBox Robotics Kit exposes students and beginners to robotics and makes it easier for them to learn how to code, without the usually high price tag.

### 4 Retailgate

Retailgate specializes in applying technology and artificial intelligence to data gathering and retail analytics. Through its consumer behavior tracking services, companies can make more informed business decisions, especially with regard to their product offerings and marketing strategies, to better serve their clientele.

### 5 Rurok Industries Inc.

Rurok Industries Inc.'s Rurok Bikes are locally designed, high-performance bicycles that can compete in the global market. Its first product, the Rurok Cordillera, was developed end-2015. To date, it is developing its next prototype bicycle: the Rurok Kanlaon.

### 6 Farmwatch Solutions Inc.

Farmwatch Solutions Inc. provides smarter farm monitoring solutions in the Philippines.

### 7 Tactiles

Tactiles developed the "IQUBE," which is an app-powered educational toy that teaches kids about electricity.

### 8 EduSuite

EduSuite is a next-generation campus management system that saves time and prevents costly mistakes by using artificial intelligence to co-manage the campus.

### 9 Futuristic Aviation and Maritime Enterprise, Inc.

Futuristic Aviation and Maritime Enterprise, Inc. (FAME) developed a vehicle monitoring platform, which uses transponders to locate and identify aircraft, boats, and land vehicles.

### Nanotronics Inc.

10

Nanotronics Inc. focuses on trading and distribution of advanced materials in the semiconductor industry like the bare copper and palladium coated copper bonding wires, and silver alloy bonding wires, which are being used in the semiconductor integrated circuit assembly here and in Thailand.

### Restograph

11

Restograph is a restaurant management software that connects directly with point-of-sale (POS) systems to provide real-time sales analytics and granular views of daily operations, with descriptive, predictive, and prescriptive elements for data analytics.

### Senti

12

Senti provides social media monitoring services that are focused on understanding Filipino. To process social media posts better, the company has developed a machine learning-based language classifier that automatically detects the language of any document.

### Kinovett Scientific Solutions Co.

13

Kinovett Scientific Solutions Co. developed biotechnology kits that teach basic scientific principles and, at the same time, provide students with the opportunity to learn through hands-on activities.

### Smartfox Data Solutions Inc.

14

Smartfox Data Solutions Inc. is a silicon internet protocol (IP) and design services provider committed to providing solutions for data acquisition, processing, and storage demands.

### Cropital Inc.

15

Cropital Inc. is a social enterprise that developed a crowdfunding platform for farmers, so that they can gain access to scalable and sustainable financing. Cropital is a globally recognized organization supported by institutions in the United States, Netherlands, Malaysia, and the Philippines.



# Launching HEIs into the World of Technopreneurship

## *Higher Education Institution Readiness for Innovation & Technopreneurship (HEIRIT) Development Program for Starting TBIs*

**Prof. Nestor O. Rañeses,**  
Project Leader,  
National Engineering  
Center, University of  
the Philippines

According to the 2017 Philippine Startup Survey conducted by QBO Philippines and PwC Philippines, over 300 startups were formed from 2012 to 2017. For these smaller-scale enterprises to survive, thrive, and succeed, a healthy startup environment needs to be developed, with the necessary support systems in place.

In the survey report, “Off to a great start: The Philippine startup ecosystem,” DOST Secretary Fortunato T. de La Peña said that, “...the DOST shall help in creating and sustaining an entrepreneurial culture and encourage young Filipinos to venture and start their companies locally with the help and support of our technology business incubators (TBIs), with all the mechanisms that we have set up for this purpose.”

The first generation of TBIs in the Philippines was introduced in 1997. The second generation, which involved Higher Education Institutions (HEIs), started with the University of the Philippines (UP) Enterprise in 2009, the UP Cebu Incubator in IT in 2010, followed by 13 more TBIs all over the country. To date, each incubator supports five to 15 startup companies.

Seeing how university-based TBIs have had a great impact on strengthening the local startup community, the department, through PCIEERD, implemented the *Higher Education Institution Readiness for Innovation and Technopreneurship (HEIRIT) Development Program for Starting TBIs* in November 2017.



MOU signing to undergo the HEIRIT Development Program of 20 universities represented by their respective head of institutions



State universities and colleges (SUCs) from all over the Philippines were invited to apply in the intensive one-year training and mentoring program that would guide and equip their personnel in becoming TBI Project Leaders and Managers for future incubators. InfoDev of Singapore, through PSG-Science and Technology Entrepreneurial Park (PSG-STEP), was tapped to conduct the program, using the validated Training Modules of the World Bank.

A total of 20 universities were selected for the development program:

- Adamson University
- Bicol University
- Bulacan State University
- Cagayan State University
- Cebu Institute of Technology University
- Holy Angel University
- Iloilo Science and Technology University
- Mapúa University
- Miriam College (formerly Maryknoll)
- Nueva Vizcaya State University
- Saint Louis University, Baguio City
- Silliman University
- Technological Institute of the Philippines
- Technological University of the Philippines-Visayas
- University of Mindanao
- University of San Carlos
- University of Santo Tomas
- University of Southeastern Philippines
- University of the Cordilleras
- University of the Philippines Mindanao

The shortlisted SUCs are expected to plan, implement, and build startups in their own communities and nurture a culture of technopreneurship after the program, with the potential of having their schools' research and development efforts translated into real-world application.

With more HEIs equipped to become TBIs, the future is bright for a more developed, vibrant, and dynamic startup ecosystem for the country.



Prof. Nestor Rañeses presents the objectives, requirements, targets, and deliverables of the HEIRIT Development Program

# Kickstarting Startups

## Technology Business Incubation Program

**P**CIEERD is an integral participant in DOST's Technology Business Incubation Program. This program helps put up technology business incubators (TBIs), which encourage local innovation and the creation of new technology. DOST provides resources and support for the creation of these TBIs, support the local community of thinkers, creators, and inventors by creating jobs, nurturing entrepreneurs, and promoting public-private partnerships.

Since 2009, PCIEERD has contributed Php 88 million to TBIs, and has helped create over 200 startups. The Council provides funding for the first two years of a TBI's operation, which will cover its opening and initial operations. Currently, there are 20 TBIs being supported by DOST; 14 through PCIEERD and six through the Philippine Council for Agriculture, Aquatic and Natural Resources Development (PCAARRD).

In 2017, three TBIs were launched:

### The QBO Innovation Hub

The QBO Innovation Hub is a partnership between DOST, the Department of Trade and Industry (DTI), IdeaSpace Foundation, and J.P. Morgan. It provides working spaces as well as programs and events, all geared towards supporting aspiring entrepreneurs. It will also give entrepreneurs access to a network of corporations, investors, academic institutions, and government agencies which will be able to support their work.

### The University of Science and Technology of Southern Philippines Digital Incubation Hub

This Digital Incubation Hub is the first TBI in Cagayan de Oro, focusing on multimedia development. The TBI will be able to support local startups seeking to develop software, applications, and other multimedia projects, by providing training as well as offices and work spaces.

### The Asian Institute of Management - Dado Banatao Incubator

This TBI seeks to help startups develop by sharing with them some of AIM's exhaustive knowledge through training and mentorship at no added cost, so long as the startups produce quality work. The Dado Banatao Incubator will also leverage AIM's expertise to help entrepreneurs create businesses that will grow and scale up throughout the Philippines and Southeast Asia.



Ribbon cutting during the launching of AIM-Dado Banatao Technology Business Incubator on August 10, 2017 led by (from left) PCIEERD Executive Director Dr. Carlos Primo David, DOST Secretary Fortunato T. de la Peña, AIM President Dr. Jikyeong Kang, and PhilDev Foundation Chairman Engr. Diosdado P. Banatao.

# Turn on the CharM

## *Piloting and Market Validation of the UP Technologies on Rapid Electric Vehicle Charging or CharM (Charging in Minutes) in Cauayan City, Isabela*

**Dr. Precila C. Delima,**  
Project Leader,  
Isabela State  
University

**Mr. Victor Gruet,**  
Project  
Leader, EIAPI  
(co-implementing  
agency)

**E**lectric vehicles (also known as e-vehicles) have yet to experience a surge in usage on Philippine streets. But with the country pursuing its sustainable development goals and fulfilling its commitment to the Paris Agreement to lower carbon emissions, it will only be a matter of time before electric transport becomes an important part of the local transportation scene.

With that scenario in mind, the installation of battery-charging stations for e-vehicles will be needed to support such growth. Not only do these stations need to be plentiful to serve the projected demand, they must also be quick-charging, to keep up with our fast-paced lifestyle. PCIEERD supported researchers from the Electrical and Electronics Engineering Institute (EEEI) of the University of the Philippines-Diliman in developing the Rapid Electric Vehicle Charging or CharM (Charging in Minutes) System, which can charge e-vehicles under 30 minutes, compared to traditional systems that require four to six hours.

Last May 22, 2017, the CharM Project was commercially launched with a motorcade of electric tricycles (or e-trikes) in Cauayan City, Isabela. Various models and prototypes of e-trikes from

the Isabela State University (ISU), ROPALI Group of Companies, and BEMAC Electric Transportation Philippines Inc. were part of the parade. With the pilot introduction of the CharM charging station, located near the ISU-Cauayan City entrance, the locally developed technology's economic, social, and environmental impact can be validated, its financial feasibility measured, and its appropriate business model determined.

As a DOST Smarter City awardee, Cauayan City's predisposition to use Information communication technology (ICT) in providing innovative and efficient services to its constituents made it an ideal venue for the launch. Not only would the CharM Project modernize the city's transport sector, it would also promote the growth and adoption of these local technologies in the region, open opportunities to local e-vehicle fabricators and tricycle drivers, and provide a more earth-friendly solution to the community.

DOST Region 2 Director Sancho P. Maborang mentioned that replacing 100,000 gasoline-powered tricycles with electric ones could reduce carbon dioxide emissions by 260,000 tons.

# Eco-Sep: Ready for the Big Time

## *Pilot Plant for the Production of Organomineral Products for Effective Wastewater Treatment and Septic System Management*

**Dr. Merlinda A. Palencia,**  
Project Leader,  
Adamson University

The Eco-Friendly Septic Tank System (or Eco-Sep) is an easily deployable, low-cost, and self-sustaining wastewater treatment system developed by Adamson University, with the support of PCIEERD. Central to the system is Vigormin, a white powder mixture of naturally occurring organominerals that stimulate the growth of indigenous aerobic microorganisms, facilitate efficient decomposition (especially of organic pollutants), neutralize and remove strong odors of decaying material, and also absorb heavy metals that may be present in the wastewater.

When Eco-Sep was field-tested in 2015, it received positive response from the public. After its successful validation in temporary shelters in Leyte and select establishments in Boracay, PCIEERD and

project leader Dr. Merlinda A. Palencia, saw the far-reaching commercial potential of the technology. Thus, the plan to create a production plant for Vigormin was formed in March 2016. The groundbreaking ceremony for the facility was held in June 2016 in a 1.3-hectare property in Banjo Laurel, Barangay Bagbag, Tanauan City, Batangas.

At that time, analysis of mineral rock samples from suppliers were completed, plant personnel hired, equipment delivered, 15 product demonstration and presentations conducted, and potential partnerships with distributors from all over the country explored.

After the scalability, feasibility, and profitability studies of the project were validated, the pilot plant of Vigormin



Sec. FTP talks about the Eco-Sep Technology during the Inauguration of the Vigormin Pilot Plant in Tanauan, Batangas.

Organo Minerals was inaugurated in May 2017. Thanks to the optimized processes that have increased capacity without affecting the effectivity of the organominerals, the facility has been producing four (4) metric tons of Vigormin per day, which has led to the heightened promotion of the technology through product samples and treatment demonstrations.

On September 21, 2017, the Eco-Sep System was installed in three pilot sites in Barangay General Luna, Siargao Island, Surigao del Norte: Traveler's Beach Resort, General Luna Market, and General Luna High School. Eco-Sep helps protect the groundwater and

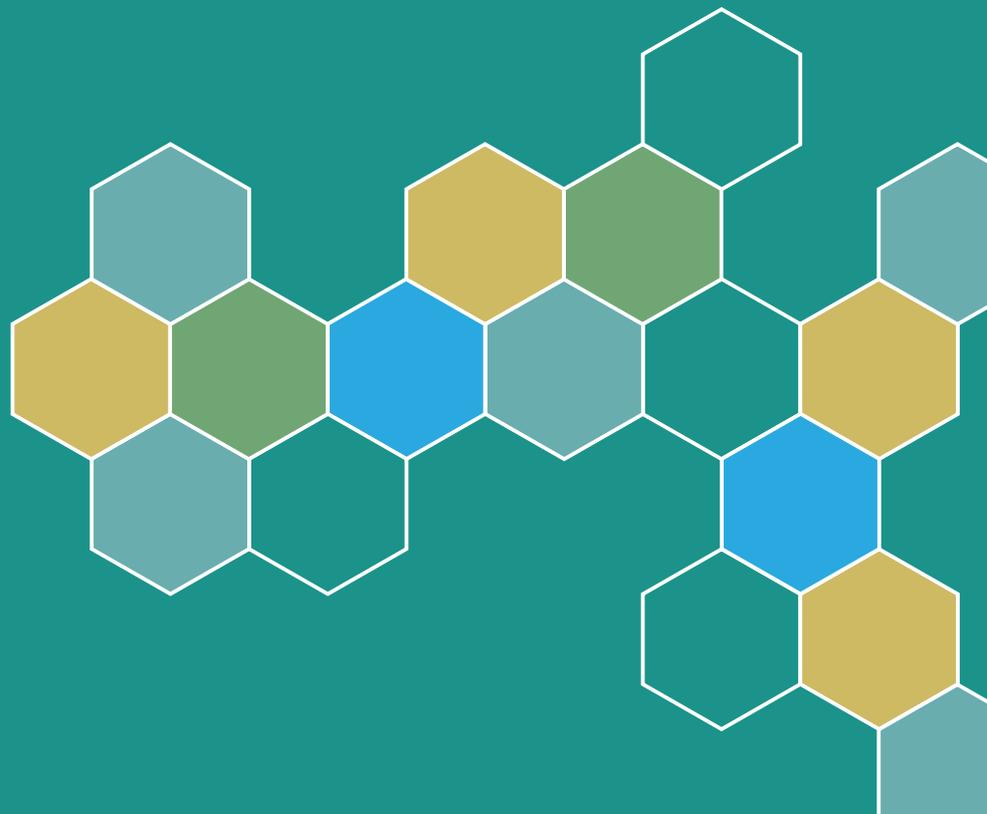
seawater near the installation sites from being contaminated. This is particularly important in Siargao Island, a surf spot whose pristine waters are the main tourism draw. With the significant impact of the Eco-Sep in these establishments, the project proponents foresee an uptake in the installation of this environment-friendly and economic wastewater treatment solution for local government units, households, and commercial establishments in and beyond the island.

# Capacity Building

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Aside from supporting individual research efforts, PCIEERD also seeks to support researchers, laboratories, and research institutions.

This initiative helps bolster local research by training researchers, giving platforms to young and aspiring scientists, and providing scientists with the facilities they need. This will help drive people to work in science and technology and improve the work already being done, making for a better research environment for the entire country.



# Starting Them Young

## *Young Innovators Program*

One of PCIEERD's goals is to give a push to the country's development through science, technology, and research efforts in the industry, energy and emerging technology sectors. This means not only supporting established researchers and large, complex projects, but also providing support and opportunities for young scientists who pursue smaller, but no less innovative projects.

The Young Innovators Program (YIP) is a new program seeking to accomplish exactly that. It kickstarted with an open call for applications in February 2017, for high school, undergraduate, and masters students under the age of 30 to submit their research ideas.

PCIEERD was looking to accept the most innovative and interesting ideas into the program. In the end, five research teams, and two individuals were chosen to take part in the inaugural of YIP. The accepted applicants received grants of up to Php 400,000 for research and development, as well as monthly stipends.

A team from Saint Cecilia's College in Cebu is working to develop a high-altitude balloon with a life support system for mice and crickets, to gain insights into possible life support systems for spaceflight. Students from Mapua Senior Science High School are working on Project FLAME, a system that uses thermal cameras to automatically detect fires, while students of Philippine Science



MOA signing between PCIEERD and YIP grantee, Modesto Remo, student from the University of Nueva Caceres, with his adviser, Ms. Sharmie Abalayan and their Deputy Principal, Mr. Joey Neil Caraya



Engr. Ermie M. Bacarra congratulating Mr. Modesto Remo after the MOA signing



YIP Awarding during the PCIEERD's 7th Anniversary. (From left: Engr. Ermie M. Bacarra, Chief SRS of HRIDD, YIP awardees Mr. Mark Keanu James Exconde and Mr. Joshua Kevin Uy with their Adviser, Dr. Jill Manapat, DOST Secretary Fortunato T. de la Peña, and PCIEERD's Executive Director, Dr. Carlos Primo C. David)

High School – Central Luzon Campus are developing a robotic arm that will mimic the actions of a user's arm.

On the collegiate level, researchers from The University of the Philippines - Diliman are looking to develop a sustainable, locally sourced 3D printing polymer with bamboo fibers. Meanwhile, the team from Colegio de Dagupan is working on a pair of remote-controlled, fingerprint-activated security drones.

Aside from these research teams, two individuals were also accepted into the program: 13-year-old Isabel Sieh from International School Manila is developing Sustainability: WattAbout, an app that gamifies sustainable practices; and 14-year-old Modesto Remo Jr., from the University of Nueva Caceres in Camarines Sur, is developing a device that will generate energy as its user walks.

These innovators are only the first batch in a program that will make science and research much more accessible. By encouraging younger people to get

involved and pursue their scientific interests, YIP is helping to ensure the future of Philippine science.



***This means not only supporting established researchers and large, complex projects, but also providing support and opportunities for young scientists who pursue smaller, but no less innovative projects.***

# Strong Foundations for Science

## *Infrastructure Development Program*

**P**CIERD, through its various individual capacity building programs, helps capacitate individuals and facilitate outstanding, innovative projects through support and funding. But aside from supporting individual research projects, it also enables universities and other research institutions to perform quality research.

Through its Infrastructure Development Program (IDP), PCIEERD helps set up or upgrade laboratories in universities and research institutions around the country by providing funding, which the institutions can then use to purchase important technology like advanced technical equipment and specialized software. The program also offers small research grants so as to allow institutions to demonstrate their capability to use the newly purchased equipment.

Since 2015, the project has helped set up and upgrade 14 laboratories all over the country, amounting to a total investment of Php 66.93 million.

These, and other labs supported by PCIEERD, give researchers a solid foundation for their work, and allow them to conduct their research to the best of their abilities. These facilities can also serve to open up new research possibilities, by helping scientists overcome technological restrictions, and allowing them to learn new methods and techniques.

Only two years into the program, beneficiaries are already feeling the effects. Aside from improving the quality of their own research, they were able to share their facilities with other academics and industry practitioners, strengthening their relationships, and the Philippine research and development sector as a whole.

### IMPACTS OF IDP

In 2017, the IDP provided grants to the following institutions:

#### **University of San Jose-Recoletos**

*Established: Center for Energy Harvesting Materials Research*

- Enhanced capability to conduct advanced researches in materials engineering
- Improved ability to engage semiconductor industries, among others, not only in advanced materials test services (microscopy and chemical analysis), but also materials research
- Opened a new course, Bachelor of Science in Materials Engineering, starting SY 2019-2020
- Expanded linkages with other universities in Visayas and Mindanao, through shared laboratory services

### Pampanga State Agricultural University

*Established: PSAU Bioenergy Laboratory*

- Outfitted with new equipment and accessories, including a pyrolyzer (batch type pressure reactor), bomb calorimeter, muffle furnace, drying oven (lab size, gravimetric convection type), and digital analytical balance
- Improved research capabilities of faculty and students, and increased their potential to contribute to innovation and R&D

### Caraga State University

*Established: Materials Science and Polymer Chemistry Laboratory*

- Outfitted with new equipment, including a Fourier-transform infrared spectrometer (FT-IR), voltammetric analyzer, high performance liquid chromatography, cyanide ion selective electrode, cyanide distillation set-up
- Supported senior high students in their research and immersion curriculum subjects

### Northwest Samar State University

*Established: Future Building Materials and Structures*

- Outfitted with new equipment, including a set comprised of scale beam, column, wall testing set-up system, including high temperature resistance furnace, and table-mounted cutter
- Expanded curricular offerings in postgraduate level (Master and PhD degrees in Engineering) with strong emphasis on experimental research

### Polytechnic University of the Philippines

*Established: Sensors and Mechatronics Laboratory*

- Outfitted with electro-pneumatics training set (basic), pneumatics training set (basic), robotics trainer, programmable logic controller trainer, i-Learning software, distributing station and testing station, two new air-conditioning units, and eight computers
- Serviced small industry through <the invention?> of automated tokwa slicer and coconut harvester

### Southern Leyte State University

*Established: Geographic Information System (GIS) Technology Laboratory*

- Outfitted with 30 units of desktop computers, rack mount server with dual monitor, UPS unit, two units of back-up external hard drive, two units of gigabit switch with 24 ports each, LAN Network materials and Accessories, 15 units of handheld GPS, and an audio-visual system
- Prepared the curriculum for Bachelor of Science in GIS for submission to CHED for course accreditation



• Dr. Nancy Flores, Executive Vice President of the University of the Cordilleras, enjoys its faculty and researchers to conduct collaborative research to maximize the use of the GIS Innolab funded by PCIEERD.

# Better Scientists for Better Science

## Human Resources Development Program

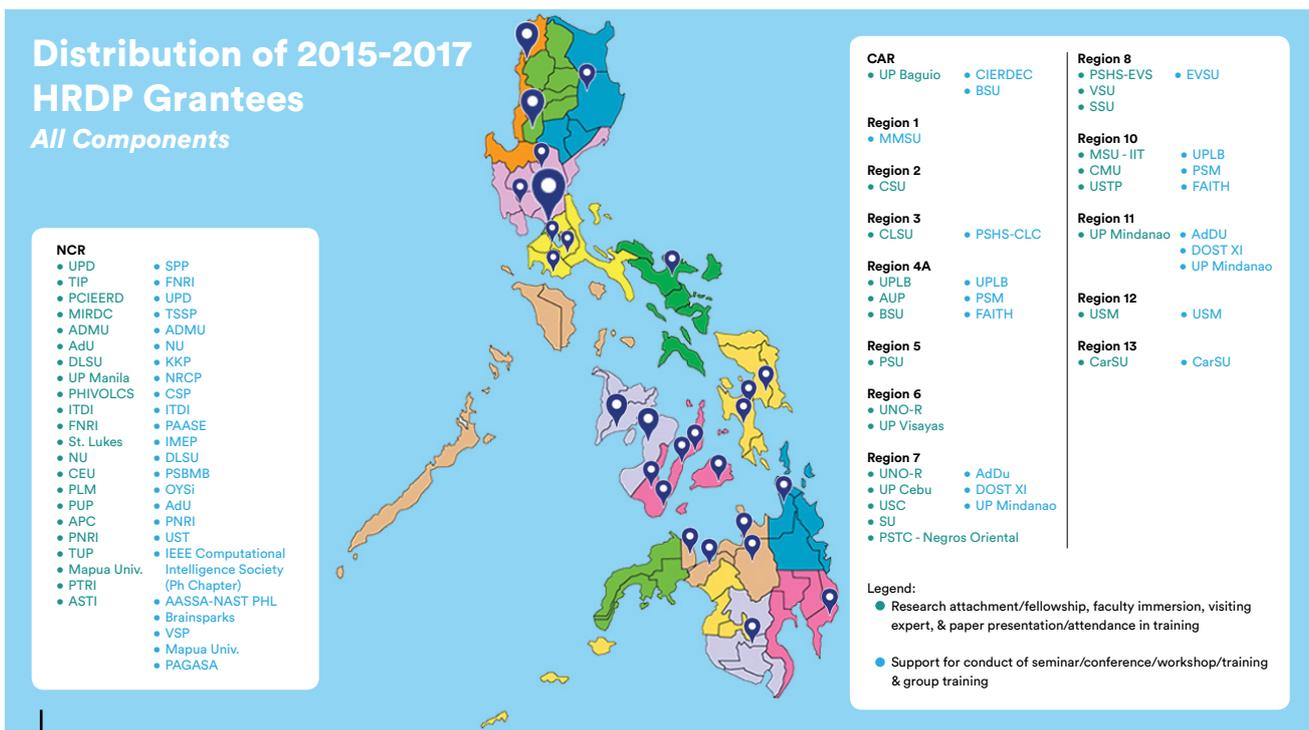
The most important part of scientific development is the presence of a community of people innovating and driving science forward. Through its Human Resources Development Program (HRDP), PCIEERD hopes to arm scientists and researchers with the skills necessary to innovate, complete their research, and be productive members of the local and international scientific communities.

The different components of the HRDP include access to international subject matter experts, assistance and mentorship programs for established and upcoming researchers, financial assistance for scientists to participate in scientific conferences and other events,

and assistance for research institutions to conduct their own scientific activities. The PCIEERD HRDP also reaches out to aspiring young researchers through its Young Innovators Program (YIP).



Dr. A.K. Nandakumaraan, Visiting Expert, while mentoring the participants of the 2017 International Summer School on Multi-scale Analysis Techniques and Applications (ISSMAMA) held on July 20-22, 2017 at the University of the Philippines—Los Baños



Distribution of Grantees from 2015 - 2017

# Open Laboratories

## ADMATEL-EPDC grant

Local researchers, especially students, require access to certain technology and specialized facilities. However, Filipino research projects are often limited by a lack of access to technology — either because it is locally unavailable or too expensive to acquire.

To help address this problem, PCIEERD established a grant that gives researchers—especially undergraduate and graduate students—access to the Advanced Device and Materials Testing Laboratory (ADMATEL) and the Electronics Product Development Center (EPDC). ADMATEL and EPDC

are facilities that house advanced equipment, allowing researchers to perform complex tests and analyses to push their research forward.

The ADMATEL-EPDC grant gives successful applicants a Php 250,000 subsidy to pursue data gathering, materials analysis, and project prototype testing. The new grant, as well as the ADMATEL and EPDC facilities, represent some of the country’s best efforts in developing world-class technology and laboratories, and staying globally competitive in scientific research.



Batch 5 of the ADMATEL-EPDC Grant

In 2017, 13 projects were funded with the ADMATEL-EPDC grant:

1. Photoelectrochemical Activity of Low Temperature Anodized Titania (TiO<sub>2</sub>) Nanotubes
2. Preparation, Characterization and Anti-Bacterial Activity of Gentamicin-Loaded Chitin Nanogel Against Multi-Drug Resistant Clinical Isolates
3. Fabrication of Chitosan-Based Dye-Incorporated Core Shell Particles as Carbon Dioxide Indicator for Food Quality Monitoring
4. Preparation and Characterization of Carbon Nanodots from Natural Polysaccharide and its Application as Photo Sensitizer in Solar Cell
5. Synthesis of Nanosilver-Coated Geopolymer Spheres from Volcanic Ash and Baluko Shells for Antimicrobial Applications
6. Fire and Heat Resistance Testing of Geopolymer Composites Derived from Volcanic Ash, Red Clay, and Baluko Waste Seashell
7. Synthesis and Characterization of Novel Cationic Starch Polyelectrolyte and its Application as Flocculating Agent
8. Synthesis and Characterization of Doped Calcium-Aluminum (Ca-Al) Hydrotalcite Antimicrobial Applications
9. Potentiodynamic Polarization Study to Determine the Corrosion Susceptibility of 316L Stainless Steel Pins in Simulated Body Fluid
10. A Comparative Study of Mechanically Extracted Cellulose Nanofibers and Acid-Hydrolyzed Nanocellulose from Various Chemically and Semi-Chemically Treated Kawayan Kiling (*Bambusa vulgaris*) Pulp
11. Antibacterial Effects of Polypyrrole Hybrid Composites for Foodborne Bacteria
12. Preparation and Characterization of Fluorescent Thin Film Poly(ethylene glycol)/Chitosan Hydrogel for Biosensor Application
13. Fabrication of Copper Oxide Electrode for Supercapacitor Application

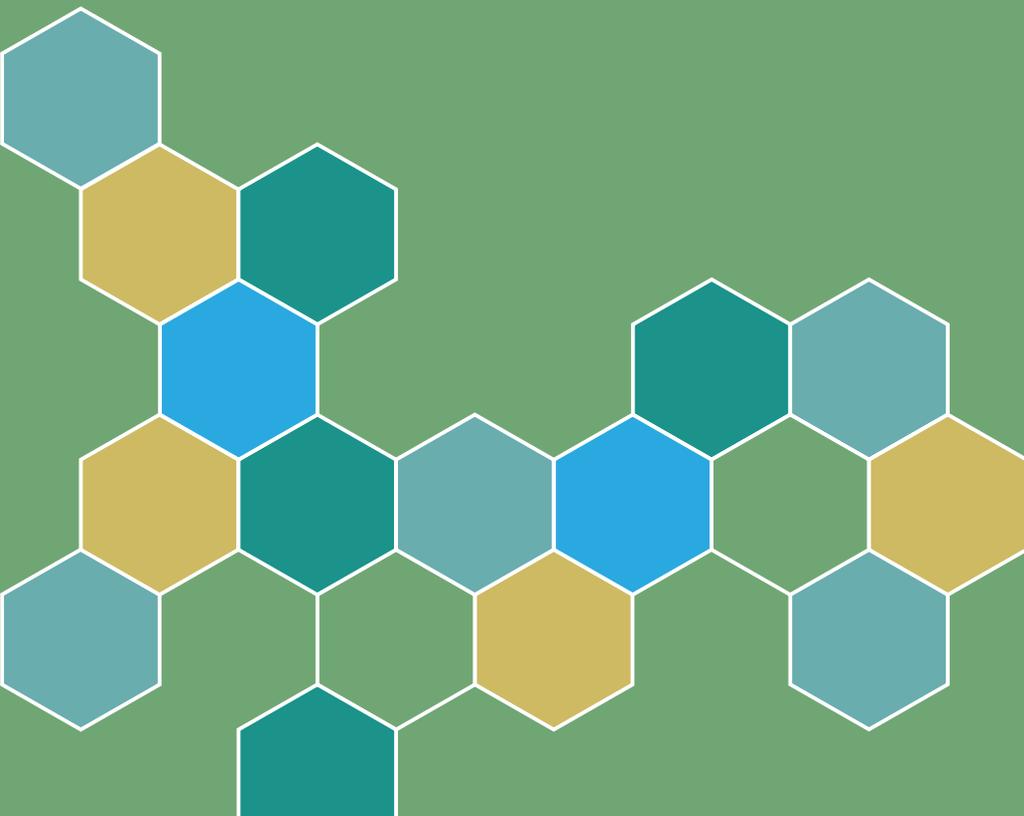
# Support to Policy Development

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Scientific research is not only useful for developing new technology. The insights gained from research can be used in policy-making. This will allow local lawmakers to draft laws and create initiatives that are based on facts and research.

This section will highlight PCIEERD's contribution to the country's policy development, providing facts, data, and a scientific mindset to ensure that the nation's leaders make informed decisions.

PCIEERD is strengthening its policy formulation to give relevant inputs to policymakers.



# Policy Brief on Mining Projects in Mindanao

Over half of the entire country's mineral wealth can be found in Mindanao, with almost 50% of gold and 65% of nickel reserves. Developing mining in Mindanao can contribute to the growth of the mining industry, help provide jobs to local communities, and boost the economy.

However, developing the mining industry needs to be carefully balanced with preserving biodiversity and improving resilience to climate change. To that end, PCIEERD funded a study, surveying species in key areas around Mindanao. The study categorized the species according to the International Union for Conservation of Nature's (IUCN) Red List of Threatened Species. These species are part of complex ecosystems, and disrupting these ecosystems could have unforeseen effects, especially for communities that live close to mining areas.

The study found a total of 82 threatened plant and animal species according to IUCN's Red List, including 11 critically endangered plants, threatened birds that prefer mature forests over younger ones, and many more species that are at risk due to mining developments. The study also found several high conservation value areas—areas that are particularly high in biodiversity, in this case mostly mature forests—that overlap with mining concessions.

There are many ways to help preserve biodiversity, but few will be more effective than well-thought out policy decisions. Results of the study were

used as basis for a policy brief on mining projects, to provide policy makers with key facts and relevant data for them to craft effective laws that deal with protecting the environment from possible negative impacts of mining projects.

Aside from presenting the data found in the study, PCIEERD developed tools and recommendations:

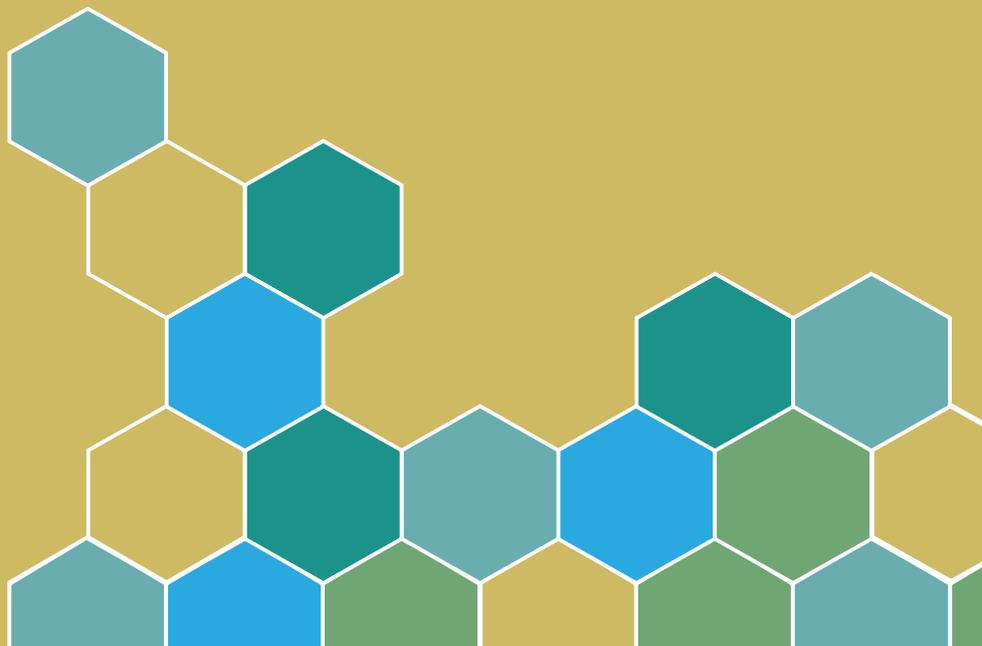
- a) integrating climate change mitigation into Mindanao's biodiversity planning;
- b) allocating resources to biodiversity;
- c) prioritizing biodiversity in mining laws;
- d) formulating policies that are based on proper research; and
- e) engaging local governments and communities in monitoring possible negative effects of mining projects on the environment.



Some of the threatened species in key areas around Mindanao

# Information Dissemination

PCIEERD ensures that the advancements that local scientists have accomplished are given due attention, to educate the public on what the Filipino is capable of, and promote our homegrown technologies to potential adopters. While necessity is the mother of invention, inspiration fuels creativity. Teaching children about the first Filipino satellite in space, for example, could light the spark that makes stargazers into astronauts.



# Engaging the Youth

## Discover DIWATA-1 Exhibit, Museo Pambata *Started November 18, 2017*

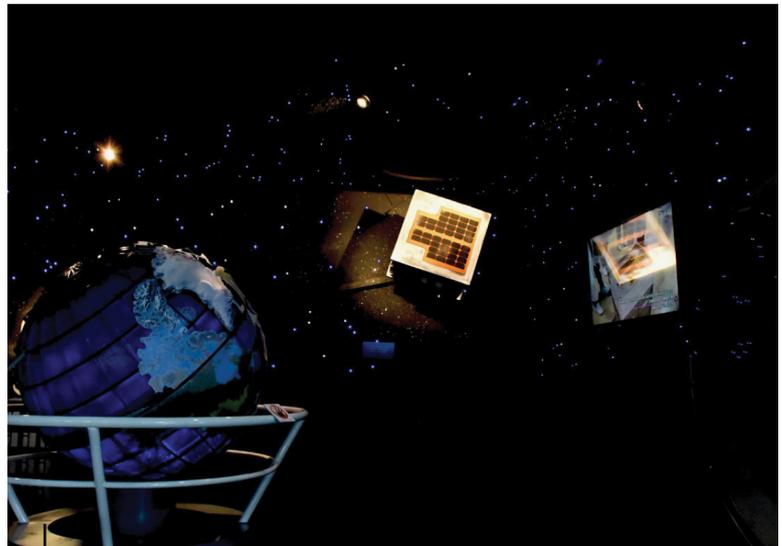
**P**CIEERD is proud to have been instrumental in bringing DIWATA 1—the first Filipino microsatellite, made by an all-Filipino team of scientists and engineers—to space. Its successful launch in March 2016 was one of the crowning achievements of Philippine science.

To share this achievement with the youth, and to give them an idea of why science is important, and the things that can be achieved through science, PCIEERD has teamed up with Museo Pambata, an interactive children’s museum to develop Discover DIWATA 1.

Discover DIWATA 1 is an interactive exhibit, allowing children to pretend they are ground controllers, assisting in the launch of the microsatellite. They are able to play in a constructed control room, and learn all about DIWATA 1, and its mission in space. The exhibit was launched in Museo Pambata on November 18, 2017.



Discover Diwata-1: a new attraction at Museo Pambata to encourage space learning for kids



Some of the exhibits displayed on DIWATA-1 at the Museo Pambata

# Science on the Move, Science Works!

## Philippine Science Centrum Traveling Exhibit

**P**CIERD took part in making the Science on the Move, and Science Works! Philippine Science Centrum Travelling Exhibits project a possibility. The activity helped introduce science concepts to the children of Mindanao, through informative exhibits and insightful activities.

In partnership with the Department of Education and various DOST offices across Mindanao, the project brought together over 500 students per day who were able to explore and enjoy the entire activation. Moreover, it also sought to be a helpful tool in complementing the K to 12 science curriculum.

The project lasted for a duration of five months in Region XII (SOCCSKSARGEN) and the Autonomous Region of Muslim Mindanao, with its official launch last July 3, and closing last December 8, 2017.



Student and teacher visitors at the Tenorio Elementary School, Datu Odin Sinsuat, Maguindanao



Students try out the interactive exhibit at Dadingas Elementary School, General Santos



Student tries the Van De Graaff Generator at the Shariff Aguak Central School, Shariff Aguak, Maguindanao

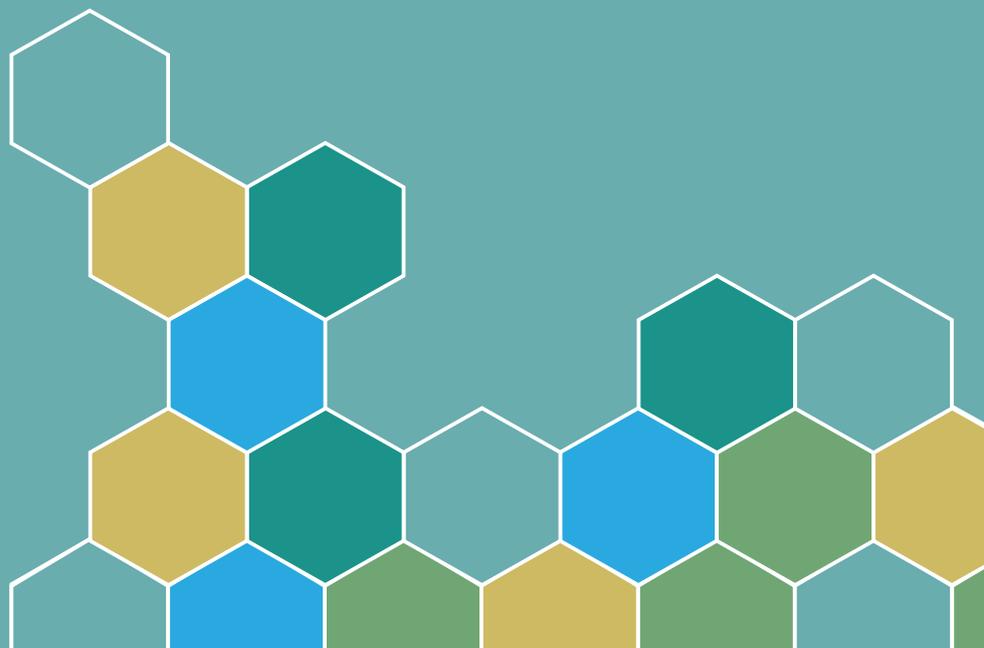


# Events

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PCIEERD organizes events with the end in mind of widening the reach of science and technology, encouraging scientific thinking and innovation, providing a platform for inventions, and ensuring that like-minded individuals get the opportunity to network with each other.

Fostering a culture of innovation also means participating in events to increase exposure to new ideas, strengthen linkages, and show solidarity and support with the scientific community. PCIEERD invests both time and money on this advocacy.



# 7 Years of PCIEERD

June 29, 2017

On June 29, 2017, PCIEERD celebrated its 7th anniversary, commemorating the merging of the Philippine Council for Advanced Science and Technology Research and Development (PCASTRD) and the Philippine Council for Industry and Energy Research and Development (PCIERD) into the Philippine Council for Industry, Energy and Emerging Technology Research and Development in 2010.

This year's celebration was bannered by the theme, "Shifting Gears, Driving Change, Transforming Lives," to recognize the many changes the Council has undergone to better serve the Filipino people, including the new name, the Innovation Council, as well as the establishment of several new projects and initiatives.

The 7th anniversary also served to launch several of PCIEERD's new projects:

- **MSME Support Program** which aims to improve the quality and competitiveness of local MSMEs by partnering them with Korean MSMEs through the World Friends Advisor Program of the National IT Industry Promotion Agency of South Korea;
- **Young Innovators Program** which engages with young researchers and funds their projects and studies that are in line with the Council's priority areas;
- **Regional R&D Immersion Program**, also known as the Gabay Probinsya Program, assigns PCIEERD managers to regional offices to help gather information about these regions, conduct lectures, and promote PCIEERD programs; and



The people behind the Innovation Council, DOST-PCIEERD, during its 7th Anniversary Celebration in PICC, Pasay City.

- **e-Governance System**, a web-based tool that provides automated government management, and administration and analytic systems to enhance citizen participation and social and economic opportunities.

Aside from the expanded sectoral coverage and new programs of PCIEERD,

new linkages were also signed through Memorandum of Agreement with the National Security Council (NSC) for security-related endeavors, and the Mindanao Development Authority (MinDA) to strengthen the R&D capability and support in the development of critical infrastructures in Mindanao.

## 2016 Outstanding Employees



CLARINDA G. REYES  
*Outstanding Senior Project Manager*



KRISTINA PAULA Y. ANACLETO  
*Outstanding Junior Project Manager*



CARLOTA P. SANCHO  
*Outstanding Senior Support Personnel*



ALLEN Z. MANIBOG  
*Outstanding Junior Support Personnel*



BIANCA G. IGNACIO  
*Outstanding Technical Contractual Personnel*



RODOLFO A. VELOSO, JR.  
*Outstanding Support Contractual Personnel*



# National TBI Summit

*November 23-24, 2017*

The 14 PCIEERD Technology Business Incubators (TBIs) represent one of PCIEERD's largest contributions to Filipino startups, and Filipino businesses in general. TBIs are valuable ways for startups to get their bearings, develop their technology, and work out their operations. Through the National TBI Summit, PCIEERD sought to help these startups develop their capabilities even further, by giving them a platform to interact with other government agencies, as well as the private sector, including larger corporations and private incubators.

The first ever National TBI Summit was a two-day event, from November 23 to 24, 2017, held at the Cebu Parklane International Hotel, in Cebu City. The event, organized by PCIEERD and hosted by the University of the Philippines Cebu, gathered all 14 PCIEERD TBIs for all over the country together for the first time. Through this event, the TBIs were able to network with and learn from each other, as well as renowned business and TBI experts from the Philippines, and abroad.



The RITTD team all smiles together with Secretary Fortunato T. De la Peña during the 1st National TBI Summit held last November 23-24, 2017.



Plenary session with the existing TBI Managers / Project Leader. (From left: Atty. Liza D. Corro, Chancellor of UP-Cebu; Dr. Jinky B. Bornales, Vice Chancellor for Research and Extension of MSU-IIT; Dr. Luis G. Sison, Director of UP-TTBD and Program Leader for UP Enterprise Center for Technopreneurship and UPScale Innovation Hub; Engr. Albertson D. Amante, Vice President for Research Development and Extension Services; and Ms. Maria Lourdes Tina A. Amper, Founder of Tech Talks.ph.)

# Tech in Asia Singapore 2017

May 16-19, 2017

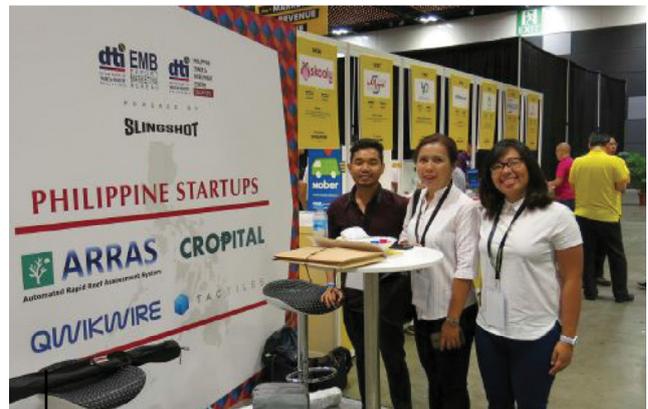
**T**ech in Asia Singapore is an annual event that gathers entrepreneurs, startups, technology leaders, and inventors from all over Asia, providing an avenue for networking and exchange of ideas.

As part of PCIEERD's continuous effort to support Filipino technology startups, it nominated delegates to participate in the event. Six delegates from the UP Enterprise, one of the TBLs supported by the Council, attended the Conference from May 16-19, 2017 in Singapore.

These delegates were given the opportunity to learn from experts and industry leaders, make pitches to investors, network with fellow startups and entrepreneurs, and participate in various other activities. The UP Enterprise was also able to setup a booth to showcase their technologies to attract customers, inventors, and possible partners.



Engr. Aaron T. Hilomen explaining the ARRAS technology to visitors during the Tech in Asia Conference in Singapore last May 16-19, 2017.



The Philippine delegation from the UP Enterprise (From left: Mr. Ruel T. Amparo of Cropital; Ms. Cherry Cubacub of ARRAS; and Ms. Lindey Vivas of Cropital) during the Tech in Asia Conference in Singapore last May 16-19, 2017.

# Taipei International Invention Show & Technomart

September 28-30, 2017

Startups are always looking for ways to gain exposure and platforms to show off their products. The Taipei International Invention Show and Technomart is a great opportunity for growing technological businesses to do just that. The show features local technology startups from Taiwan, as well as startups and tech companies from other countries.

PCIEERD was invited to be an exhibitor in the 2017 event, which was held in September at the TAIPEI World Trade Center Exhibition Hall.

Two teams were nominated to represent PCIEERD, and the Philippines, at this Convention:

\* **MULAVE STUDIO PH CO.**, a multimedia arts and visual effects studio based in Iloilo. They provide high-quality marketing materials using elements of graphic design and illustration, animation, photography, film, and multimedia production.

\* **GENII HUT**, a software solutions company based in Cebu. They develop applications—mainly web, IOS and android—to help with accounting for personal finance or company payroll, among other tasks. Their business ventures entail the use of different kinds of technology.



Mr. Rayjand Gellamucho, CEO of Mulave Studio, delivers a pitch at the Taipei International Invention Show 2017.



Philippines' booth was represented by Engr. Edward Paul H. Apigo (right) and Engr. Earvin Jay L. Enriquez (left) of PCIEERD at the Taipei International Invention Show 2017.

# A Global Stage for Philippine Tech: Startup World Cup 2018

*Philippine Regional Qualifier: October 20, 2017*

*Finals: May 11, 2018*

The Startup World Cup is an annual, global event organized by Fenox Venture Capital, that invites startups from all over the world to show off their technology and compete for a \$1,000,000 grand prize investment into their company.

The Philippine regional qualifier for the World Cup was held on October 20, 2017 during the Slingshot: ASEAN Startup and Innovation Summit, where STORM, a local startup that provides

digital benefits management systems for employees, emerged victorious. STORM will go on to represent the Philippines at the main event of the Startup World Cup, on May 11, 2018 in San Francisco, California.

PCIEERD was one of the main sponsors for the Philippine event, and will continue to support Philippine startups as they compete for the top spot at the finals in San Francisco. The Council will also assist in choosing four other teams to represent the country at the finals.

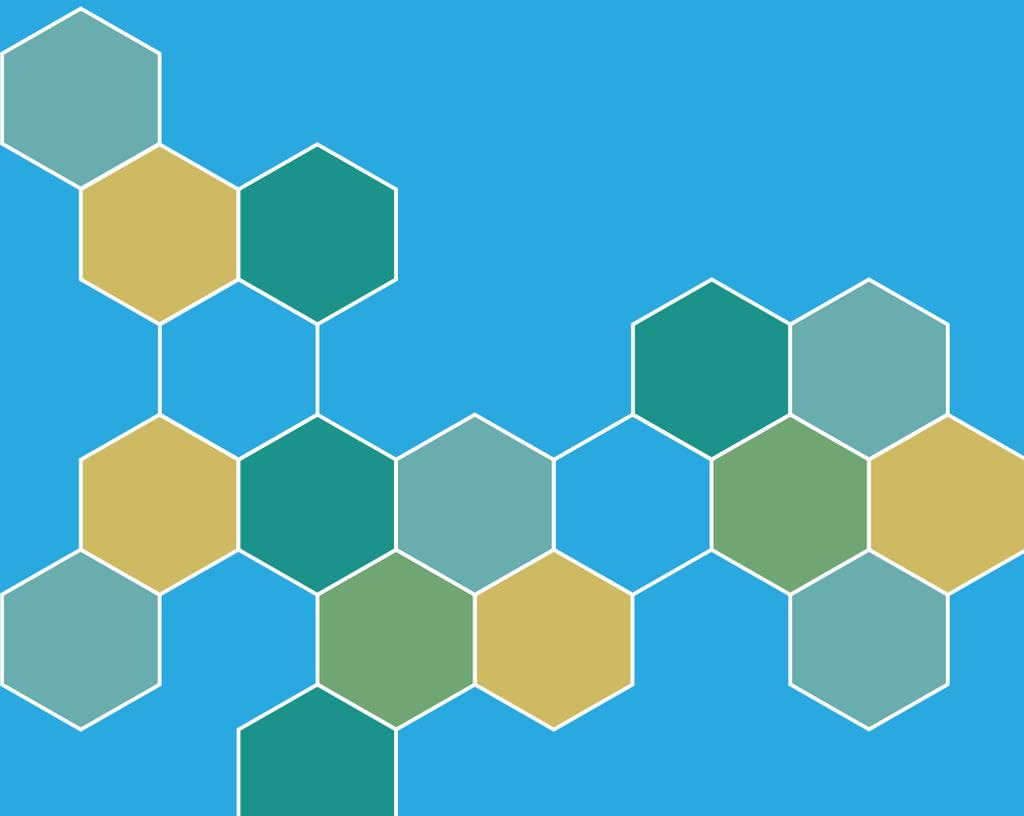


● Storm Technologies Inc. is the grand winner of the Startup World Cup Regional Finals and will represent the Philippines during the Startup World Cup 2018 to be held in San Francisco on May 2018.



# Partnerships

One of the strategies that PCIEERD maintains is nurturing its partnerships with government agencies, local and foreign scientific organizations, and the private sector. It also endeavors to establish new partnerships, as it builds up its new sectors. Such partnerships are rooted in knowledge-sharing and R&D support.



## LOCAL NETWORKS



### Department of Budget and Management (DBM)

The high-resolution images of PCIEERD's Digital Data and Imaging Technology from the Disaster Risk and Exposure Assessment for Mitigation (DREAM) LiDAR Program are being utilized in the monitoring of the National Greening Program, one of DBM's high value projects. Soon DBM may also be tapping into the resources of DOST-trained Higher Education Institutions.



### Office of Civil Defense (OCD)

Through the Climate and Disasters Resilient Communities Program: R&D Support to the Philippine Civil Defense Initiatives, PCIEERD is assisting the OCD in achieving its goal of building disaster-resilient and climate-adaptive communities through knowledge-sharing, technology transfer, and research and development. LiDAR data, hydrometeorological data, and active faults' information have been significant to the development plans and design of the program.



### Mindanao Development Authority (MinDA)

The joint cooperation between DOST and MinDA revolves around the Disasters and Climate Adaptive Development Initiative (DCADI) Program for Mindanao. This science and technology-based research and development project utilizes the most detailed and updated datasets, taking into consideration climate change trends and disaster risk reduction principles, to help plan, design, develop, and operate critical infrastructure in the region.



### Department of Environment and Natural Resources (DENR)

PCIEERD, in collaboration with the DENR-Biodiversity Management Bureau, is assessing seagrass beds, mangrove forests, and coral reefs for its potential and actual blue carbon stocks (i.e., carbon sequestered in coastal ecosystems and oceans) through the Integrated Assessment and Modelling of Blue Carbon Ecosystems for Conservation and Adaptive Management (IAMBlueCECAM) Program. The PHIL-LiDAR team of PCIEERD also received funding from DENR's Mines and Geosciences Bureau for the transfer of technology and harmonization of flood hazard maps.



### Department of Interior and Local Government (DILG)

Through knowledge transfer and technical support, PCIEERD is aiding the DILG in using LiDAR for its Local Climate Change Adaptation Plans and Comprehensive Land-Use Plans. In Cebu, the provincial government, UP Diliman, and DOST through PCIEERD will embark on a flood hazard mapping project of additional river basins for the region.



### Department of National Defense (DND)

To support the DND in its goal of achieving a Self-Reliant Defense Posture (SRDP) for the country, PCIEERD makes use of its research and development institutions in strengthening national defense capabilities and contributing to local defense industries. Other identified areas of partnership include the development of technologies for humanitarian assistance/disaster relief and life support and the usage of national aviation and space technology for intelligence, surveillance, and reconnaissance.



## Department of Energy (DOE)

PCIEERD is cooperating with DOE to implement Science and Technology Activities for Energy Applications (SETA). The objective of this cooperation is to create a technology development plan for the energy sector and to support the local adoption of new and emerging technologies through research and development.



## Maritime Industry Authority (MARINA)

PCIEERD is working closely with MARINA to prepare the Ten Year Maritime Industry Development Plans (MIDP) and the National Maritime Transport Policy (NMTP). Under these two, various science and technology-based initiatives will focus on the following key areas: alternative fuels and energy efficient transportation technologies; renewable energy technologies and innovations; and new and emerging technologies in maritime/marine transport, modernization of vehicle fleets, and Intelligent Transport Systems for maritime use.



## National Security Council (NSC)

PCIEERD will be directing R&D to several academic and research institutions to address the scientific and technological gap in the National Security Council. Through the R&D Program, S&T intervention for Human Security, the partnership aims to provide the framework for scientific and technological collaboration between the parties, to come up with innovative products and services in support of security-related endeavors.



## Department of Public Works and Highways (DPWH), National Irrigation Administration (NIA), and National Water Resources Board (NWRB)



## Revolution Precrafted (Revo)

Innovative technology solutions and cutting-edge research and development in the area of materials science and construction engineering are just some of the things that PCIEERD brings to the table in its partnership with prefabricated designer homes construction pioneer, Revo. Aside from helping improve and optimize Revo's operations, systems, and products, PCIEERD sees this collaboration as contributing to the economic and industrial development of the country.

Through the Climate Resilient Infrastructure Initiative (CRII) Program, PCIEERD will provide science-based information and R&D support (i.e., expertise, tools, and datasets) to the DPWH, NWRB, and NIA to aid them in critical infrastructure development, water resources planning, and irrigation operation and planning, respectively. This will support and upgrade the operation and activities of the agencies involved. The Innovation Council also supports the DPWH through trainings for its personnel in understanding and applying LiDAR technology.

## INTERNATIONAL LINKAGES



**Kyushu Institute of  
Technology (Kyutech)**

The Cooperative Research Agreement is in connection with PCIEERD's application for participation in the "Joint Global Multi-Nation Birds", a cooperative research program on small satellite development, testing, and operation. The undertaking is a component activity of the DOST-GIA funded PhI-Microsat: Development of Philippine Scientific Earth Observation Microsatellite, Project 1 – Microsatellite Bus Development.



**Research Councils UK  
(RCUK)**

A Memorandum of Understanding (MoU) with the RCUK includes the maintenance and development of cooperative research activities in the field of energy – food – water nexus research as part of the "Newton Agham Fund". The said MoU is in place for the entire Newton Fund period: from March 1, 2016 to March 31, 2021.



**Tohoku University (TU)**



**Hokkaido University  
(HU)**

The agreement was entered into with regard to the implementation of the PhI-Microsat: Development of Philippine Scientific Earth Observation Microsatellite.



This collaboration between PCIEERD and UK's National Environment Research Council is for the implementation of the Understanding of the Impacts of Hydrometeorological Hazards in the Philippines under the PH-UK Newton Agham Joint Cooperation Program. The aim of the program is to improve understanding of the impacts of hydrometeorological hazards, such as floods, droughts, landslides, and storm surges in the Philippines. The focus is on identifying, characterizing, and predicting the environmental variables that influence the occurrence, impact, severity, and duration of hydrometeorological hazards in the Philippines to enable increased preparedness and resilience to future disasters.

# Support to Regional Consortia

PCIEERD ensures that the country's growth is inclusive through the Regional Consortia. This is not limited to collaborating with them on projects, but also strengthening their expertise and capabilities.

The Regional Consortia play key roles in planning regional development initiatives, determining that these initiatives are aligned with PCIEERD's sectors and goals, and ensuring that research and development lie at the heart of these initiatives. Each consortium is made up of researchers, planners, and policy makers, who all share their expertise to strengthen the research and development capabilities of the different regions.

In 2017, PCIEERD was able to provide support for several Strategic Planning Workshops for different consortia. These workshops help the consortia strategize, plan, execute, and evaluate their projects. Alongside these workshops, Research, Development, and Extension (RDE) symposia, and R&D Regional Contests were also supported. These accomplishments are listed below.

MONTH	REGION	CONSORTIA	ACTIVITIES
JANUARY	CAR	CIERDEC	Strategic Planning Workshop
MARCH	Region 4A	STCIERD	Strategic Planning Meeting
APRIL	Region V	BCIEERD	NORMINCIEERD consortium meeting and at MSU-IIT, Cagayan de Oro City
MAY	CAR	CIERDEC	Focus Group Discussion (FGD) meeting for CIERDEC Programs and Activities
JUNE	Region V	BCIEERD	Memorandum of Agreement (MOA) Signing for the approved eGov System Project of CSPC at the office of the Mayors of Nabua and Bula Camarines Sur respectively, and conducted Proposal Packaging Workshop at CSPC, Nabua, Camarines Sur
	Region 4A	STCIERD	Pre-screening of entries for the STCIERD 3rd R&D competition: S&T forum and competition in industry and energy research and development Region IV-A
JULY	Region VIII	EVCIEERD	Organizational Meeting and presentation of accomplishment held at PCIEERD. EVCIEERD
SEPTEMBER	Region IX	CVCIEERD	Organizational Meeting: Revival of the Central Visayas Consortium for Industry, Energy and Emerging Technology (CVCIEERD)
	Region II	CVIERDEC	Strategic Planning cum Research Proposal Coaching/Writing at Cagayan State University, Tuguegarao City, Cagayan
	CAR	CIERDEC	7th HAARRDEC-CIERDEC Joint RDE Symposium - Done by Consortium
	Region XI	DRIEERDC	DRIEERDC Orientation Workshop, Presentation of Current Initiatives of DRIEERDC members, Proposal Writeshop and DRIEERDC MOA Signing
NOVEMBER	CAR	CIERDEC	DOST-CAR 2017 Regional Invention Contests and Exhibits (RICE)
	Region VI	WVCIEERD	Assisted PCIEERD SME Support Committee and meeting with SME for possible project/ collaboration with WVCIEERD member institutions
	CARAGA	EMIEERALD	Strategic Planning workshop and orientation with the old/new member institutions.

PCIEERD also conducted several Proposal Development and Packaging Writeshops, as well as Focus Group Discussions in different parts of the country, found in the following table.

MONTH	REGION	CONSORTIA	ACTIVITIES
MARCH	Region V	BCIEERD	Proposal Packaging at Camarines Sur Polytechnic College (CSPC), Nabua, Camarines Sur.
APRIL			Proposal Packaging at CBSUA, Naga City, Camarines Sur.
AUGUST	Region III	ICIEERD	Engineering Proposal Writeshop 2017
			Research Proposal Development Workshop in Tomas Del Rosario College, San Jose, Balanga City
SEPTEMBER			R&D Proposal Writeshop for DRIEERDC at Davao City

Through these events, as well as through GRANTS, PCIEERD was able to support 21 projects.

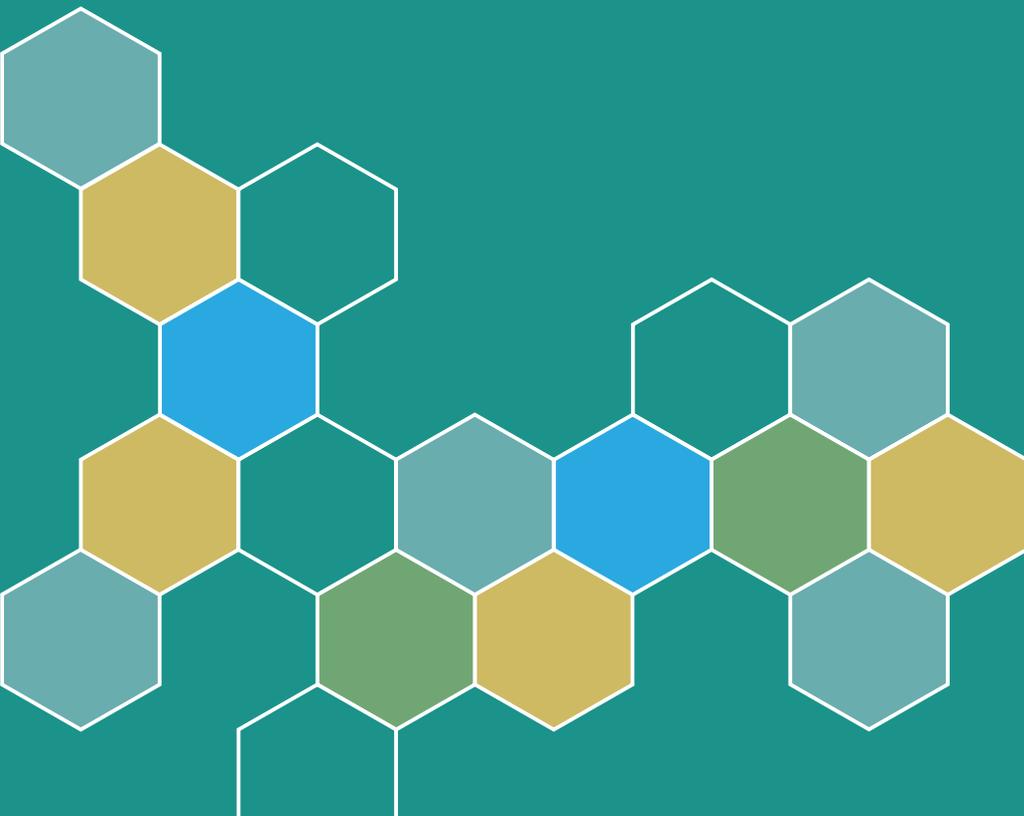
REGION	CONSORTIA	PROJECT TITLE
REGION 1	ICIERD	1. Design and Development of Processing Machineries for Honey Products and Intermediate Products (DMMMSU)
		2. Development of Sewing Machine for Softbroom and other Materials/Commodities (DMMMSU)
		3. Utilization of Industrial By-product Currimao Steel Slag as Green Concrete (MMSU)
REGION 2	CVIEERDEC	4. Development of Food Products from DOST Developed Food Processing Equipment Utilizing Cagayan Valley Local Resources (Cagayan State University-Caritan Campus)
		5. Benchmarking Potentials of Solar Energy for Irrigation Development in Cagayan Valley (Isabela State University)
CAR	CIERDEC	6. Development of Freeze-Dried Local Alternative Flavour for Ice Cream (Benguet State University)
		7. Development of a Shelf-Stable fermented Heirloom Rice “Bunubudan” (Benguet State University)
REGION 4A	STCIERDC	8. Design and Development of a PLC-Based High Capacity Tissue Culture Growth Chamber (Cavite State University)
REGION 4B	STIRDC	9. Development of Bottom Housing System for Abalone Farming (Western Philippine University, Palawan)
		10. Development of Food and Non-Food Products from Abalone (Marinduque State University)
REGION V	BCIEERD	11. Development of e-Governance System through ICT (Camarines Sur Polytechnic Colleges, Nabua, Camarines Sur)
		12. Coconut Grater and Juicer in one (Bicol State College of Applied Science and Technology, Naga, Camarines Sur)
		13. Dehydrated Indigenous Fruits as Snack Food (Mariners Polytechnic College, Naga City, Camarines Sur)

REGION	CONSORTIA	PROJECT TITLE
<b>REGION V</b>	BCIEERD	14. Development and Evaluation of Dual Heater- Source Multi Commodity Food Dryer (Bicol University, Legazpi City, Albay)
		15. Measuring Disaster Resiliency of Rural Livelihoods and Industries in Flood-Prone Barangays in Camarines Sur: Framework and Tools (Central Bicol State University of Agriculture, Pili, Camarines Sur)
		16. Portable Perlite Expander Machine for Small-Scale Industries (Camarines Sur Polytechnic Colleges, Nabua, Camarines Sur)
		17. Development of Value-added Food Products from Sweet Potato, Coco Yum and Cacao (Bicol University, Legaspi City)
		18. Processing Velvet Apple into Various Food Products in Bicol Region (Mariners Polytechnic College, Legaspi City)
<b>REGION VI</b>	WVCIERD	19. Development of Herbasalt for Dried Fish Production (NONESCOST)
		20. Development of Biomass and Electric-powered Tray Fish Dryer (Capiz State University)
		21. Juan Meal: A High Protein Fish-based Food Bar for Disaster Stricken Communities (UPV-CFOS, Miag-ao)





# Financial Report



# Financial Report

The 2017 General Appropriations Act No. 10924 includes PCIEERD Budget amounting to Eight Hundred Forty-Nine Million Six Hundred Six Thousand Pesos (Php 849,606,000.00). This is 23% higher than the Council's 2016 approved budget. The breakdown are as follows: Personnel Services with Php 58,015,000.00, Maintenance and Other Operating Expenses with Php 786,695,000.00, and Capital Outlay with Php 4,896,000.00. The largest portion of PCIEERD's budget was allotted for Financial Assistance to government and non-government organizations.

For 2017, PCIEERD was able to utilize 98% of its fund under the Council's thrusts and programs amounting to Two Billion Two Hundred Seven Million One Hundred Forty-six Thousand Seven Hundred Thirty-one (Php 2,207,146,731); Php 1,503,359,732 under DOST-GIA and Php 703,787,000 under PCIEERD-GIA. Breakdown of expenses is shown in the illustration.

PCIEERD has also generated funds amounting to Two Hundred Twenty-One Million Six Hundred Ninety-Nine Thousand Six Hundred Ninety-Nine Pesos (Php 221,699,699.00) project funds from external sources. This fund is for the implementation of various projects of DOST R&D and service institutes, DOST Regional Offices and Attached Agencies, Department of Trade and Industry (DTI), National Water Resources Board (NWRB), Philippine National Oil Company (PNOC) and for the monitoring and evaluation of proposals and projects.

Breakdown of Allotment, Obligations, and Balances:

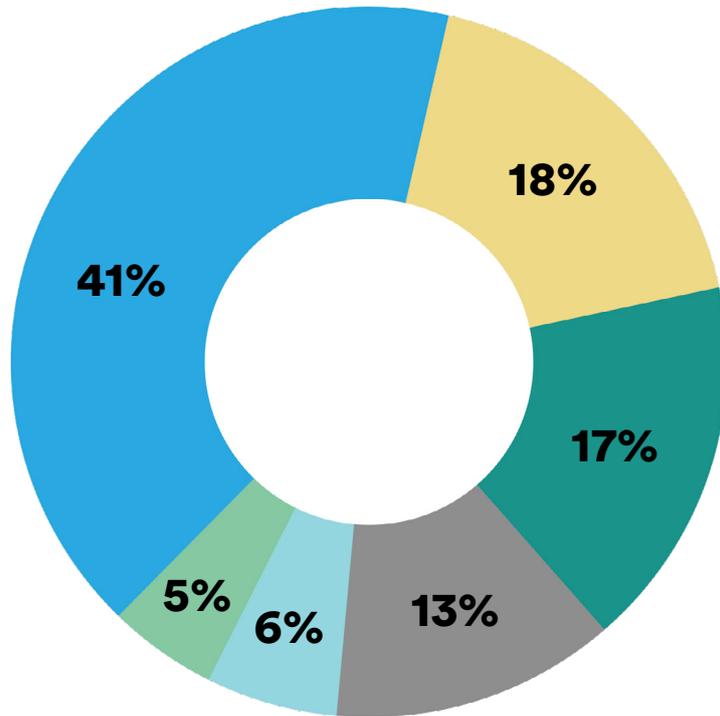
## A. By Programs/Activity

PROGRAM	ALLOTMENT	OBLIGATIONS	BALANCES
General Administration Services	95,144,000.00	87,999,195.50	7,144,804.50
MFO 1: R&D Policy and Planning Services	68,058,917.00	67,156,245.20	902,671.80
MFO 2: R&D Management Services	682,254,083.00	678,719,106.53	3,534,976.47
Locally-Funded Projects	4,149,000.00	2,905,972.36	1,243,027.64
<b>TOTAL</b>	<b>849,606,000.00</b>	<b>836,780,519.59</b>	<b>12,825,480.41</b>

## B. By Expense Class

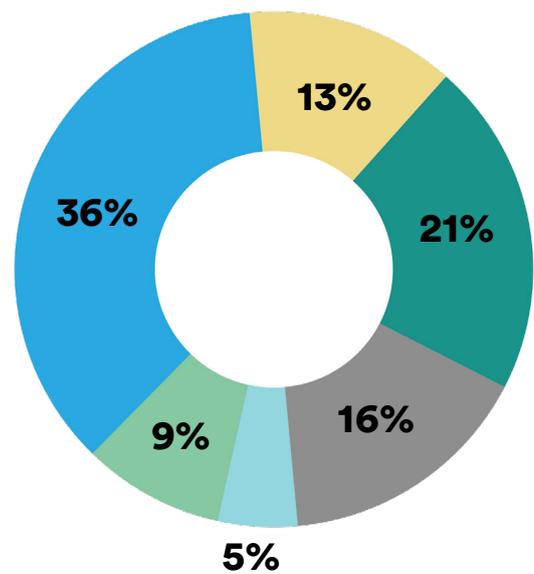
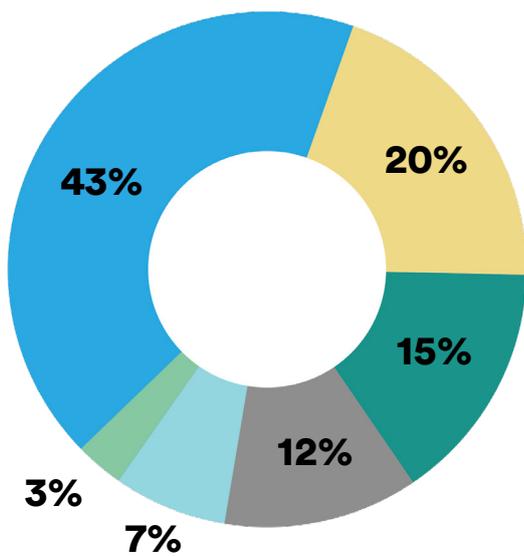
PROGRAM	ALLOTMENT	OBLIGATIONS	BALANCES
Personnel Services	58,015,000.00	52,805,081.90	5,209,918.10
Maintenance and Other Operating Expenses	786,695,000.00	780,236,029.75	6,458,970.25
Capital Outlay	4,896,000.00	3,739,407.94	1,156,592.06
<b>TOTAL</b>	<b>849,606,000.00</b>	<b>836,780,519.59</b>	<b>12,825,480.41</b>

2017 Total GIA Investment (DOST & PCIEERD) = 2,207,146,731



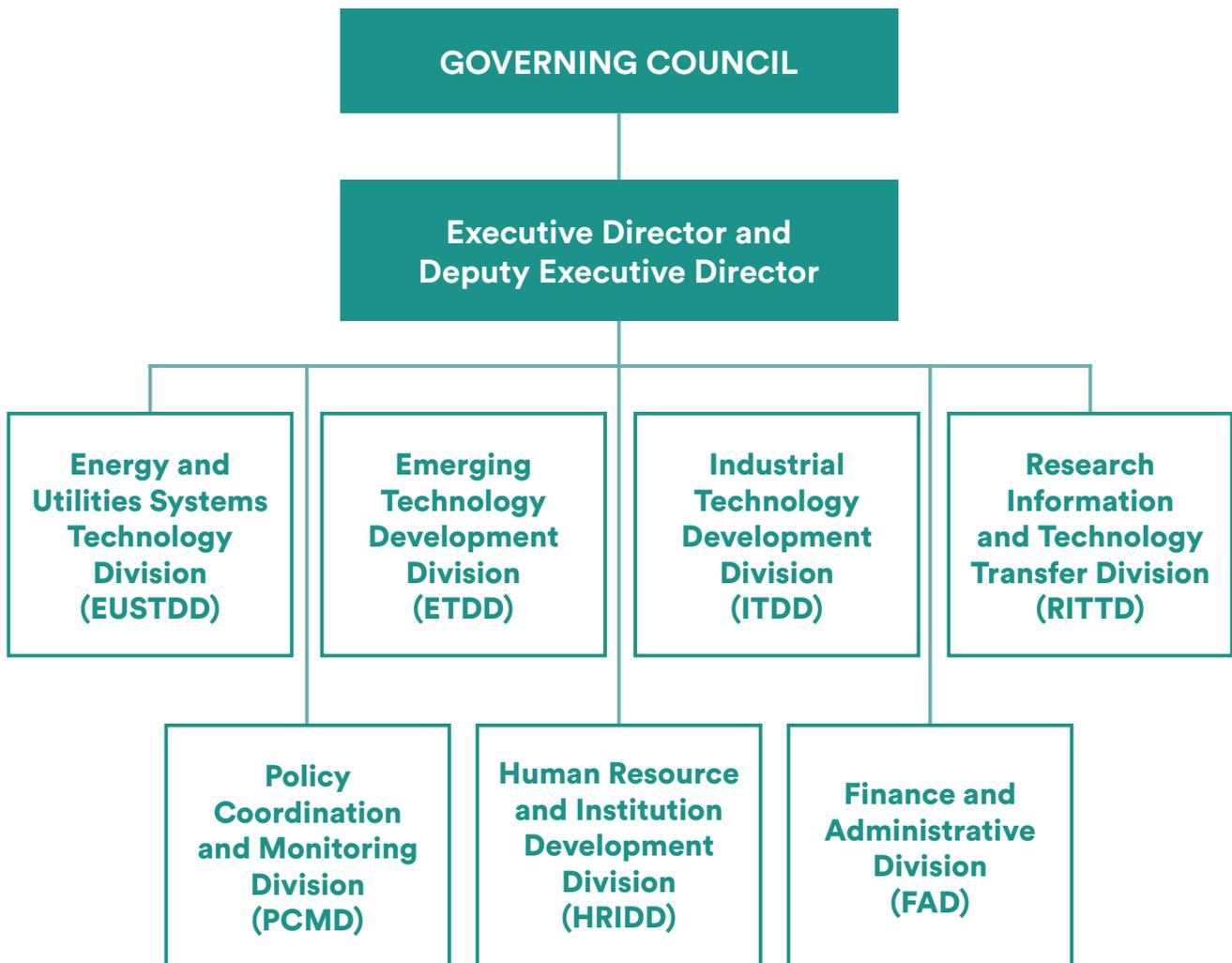
DOST - GIA = 1,503,359,732

PCIEERD - GIA = 703,787,000



- Industry & Emerging Technologies
- CCA-DRR & Environment
- Space Technology Applications
- Tech Trans, Info Dissemination
- Energy & Transportation
- HRD

# Organizational Structure



## The PCIEERD Management Team

**Dr. Carlos Primo C. David**  
*Executive Director*

**Engr. Raul C. Sabularse**  
*Deputy Executive Director*

**Engr. Nonilo A. Peña**  
*Chief, Energy and Utilities Systems  
Technology Development Division (EUSTDD)*

**Edna C. Nacienceno**  
*Chief, Emerging Technology Development  
Division (ETDD)*

**Engr. Niñaliza H. Escorial**  
*Chief, Industrial Technology Development  
Division (ITDD)*

**Russell M. Pili**  
*Chief, Research Information and Technology  
Transfer Division (RITTD)*

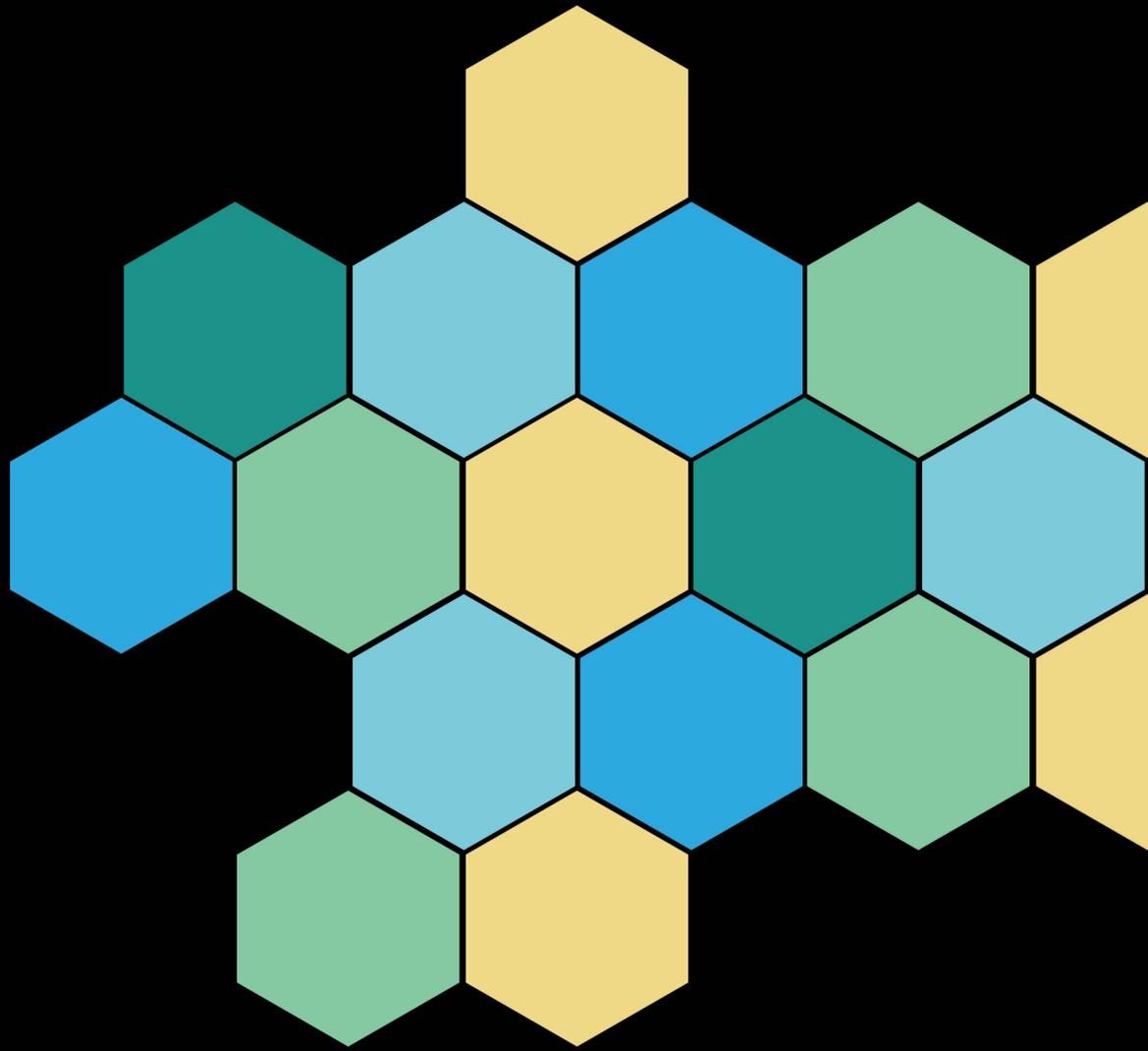
**Grace F. Estillore**  
*Chief, Policy Coordination and Monitoring  
Division (PCMD)*

**Engr. Ermie M. Bacarra**  
*Chief, Human Resource and Institution  
Development Division (HRIDD)*

**Sonia P. Cabangon**  
*Chief Administrative Officer, Finance and  
Administrative Division (FAD)*

**Carlota P. Sancho**  
*Senior SRS  
PMT Secretariat*





DEPARTMENT OF SCIENCE AND TECHNOLOGY  
PHILIPPINE COUNCIL  
FOR INDUSTRY, ENERGY,  
AND EMERGING TECHNOLOGY  
RESEARCH AND DEVELOPMENT  
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