

5G for Quality of Life and National Development

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Smart Beds



A Multi-parameter Vital Sign Monitoring System for Telemedicine Applications



Using 5G Signals to Control Drones



Communications Policy in the 5G Era



The Role of Chulalongkorn University in Creating
a 5G Technology Ecosystem

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A hand-drawn mind map centered around the theme "OUR BUSINESS". The central node is "OUR BUSINESS" at the top left, with a graph showing exponential growth. Branching out from this center are several key areas:

- TEAM**: Represented by a box labeled "VS%", a bar chart, and the word "SUCCESS" written vertically.
- QUALITY STRATEGY / VISION**: A section where "STRATEGY" and "VISION" lead down to "SUCCESS", which is further supported by "INNOVATION" and "RESEARCH".
- MARKETING**: Includes a lightbulb icon, a bar chart, and a large dollar sign.
- internet**: Features a car icon, a network diagram of computers, and a pie chart.
- CLOUD**: Shows a cloud icon, a laptop, and a server tower.
- MONEY**: Depicts stacks of cash, a lightbulb, and a pie chart labeled "25% time".
- Other Concepts**: Includes "WWW" with a sun icon, "CLOUD" with a cloud icon, "recycling" with a circular arrow, and "money recycling" with a house icon.

The drawing is done in a sketchy, illustrative style with various icons and graphs used to represent abstract business ideas.

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A group of business professionals in an office setting. In the foreground, a man in a dark suit and white shirt stands with his hands in his pockets, looking towards the camera. To his right, a woman in a dark blazer and light-colored top stands with her arms crossed, also looking towards the camera. In the background, several other people are visible, some standing and some sitting at desks, all in a professional office environment. The lighting is soft, and the overall tone is professional and modern.

254 Chulalongkorn Research Building, 4th Floor, Phayathai Road, Pathumwan, Bangkok 10330

Tel : 0-2218-2880 Fax : 0-2218-2859 : www.unisearch.chula.ac.th

Editor's note

Social and economic changes, including an ageing society and adapting towards a 'new normal' in the post-COVID-19 era has contributed to changes in the way of life of people all over the world. We are forced to adapt to such changes over a short period of time. With the help of advances in technology, we have been able to invent, innovate and create new ways to facilitate such changes. Examples of revolutions in service development may be found in every realm of human activity e.g., in service provision, commerce, and public health. These systems have been introduced to improve service efficiency and enhance convenience and quality of life.

5G technology is already impacting on our lives today and will become more inextricably intertwined with our daily lives and our future. As a platform technology, 5G has been introduced as the backbone of many systems and services to improve convenience and enhance quality of life. It allows simultaneous connection and collaboration among many devices and supports virtually instant data transmission for immediate data processing. The technology improves the accuracy of data and provides functionality on which innovative new services can be developed to further add to the efficiency of service delivery and quality of life.

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Contact Enquiries

Chula Unisearch, Chulalongkorn University
254 Chulalongkorn Research Building,
4th floor, Phayathai Road, Pathumwan,
Bangkok 10330
Tel: 0-2218-2880
Fax: 0-2218-2859
E-mail: unisearchjournal@gmail.com
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Smart Beds



**Gridsada Phanomchoeng, Ph.D.^{1,*}, Charoen Taweepolcharoen, M.D.²,
Aisawan Petchlorlian, M.D.³, Patchara Tunlayawasinpong⁴ and Research Team**

¹Department of Mechanical Engineering, Faculty of Engineering, Chulalongkorn University

²Department of Obstetrics and Gynecology, King Chulalongkorn Memorial Hospital

³Department of Internal Medicine, King Chulalongkorn Memorial Hospital

⁴Nurse Supervisor, Department of Nursing, King Chulalongkorn Memorial Hospital

*Corresponding author email: gridsada.phanomchoeng@gmail.com

Introduction

The advancement of medical technology increases life expectancy, resulting in an increasing number of elderly patients staying in hospitals. With an ageing global population, the supply of caregivers for the elderly cannot keep pace with rising demand. Standards of care for the elderly, both at home and in hospitals, are falling; heavier workloads are increasing levels of stress among carers and healthcare professionals alike.

Additional problems have also arisen in providing care and support for the elderly. Balance problems leading to falls especially in getting up from bed, have increased in frequency. A study by Capezuti et al. (2009) found that fall rates increase with age, with 30% of the population aged over 65 having a chance of falling at least once a year, with the risk of falling increasing to 50% for those over 80 (Vaziri et al., 2017, Kannus et al., 2005). Falls cause pain, distress, injury, loss of independence, loss of confidence, depression and mortality. At the same time, it also indirectly affects the way of life of their family, including care costs, family expenses and budget of the national health system.

Conclusion

Falls in the elderly population and patients who struggle to care for themselves affect their quality of life, family expenses as well as the national health budget. Falling accidents often occur around getting in and out of bed. Therefore, an effective and important way to mitigate this problem is to develop a specific fall prevention system for the bed especially a system where a combination of sensor technology is employed for monitoring the getting in and out of bed. The system is equipped with several monitoring sensors that can trigger an alarm. The system also integrates with other devices to prevent falls and accidents which will greatly benefit both the elderly and elderly patients and their families and reduce the burden on the healthcare system.

A Multi-parameter Vital Sign Monitoring System for Telemedicine Applications



**Arporn Teeramongkonrasmee^{1,*},
Apiwat Lek-uthai¹,
Oruma Chutinate³,
and Pakpum Somboon²**

¹Department of Electrical Engineering, Faculty of Engineering, Chulalongkorn University

²Biomedical Engineering Program, Faculty of Engineering, Chulalongkorn University

³King Chulalongkorn Memorial Hospital, The Thai Red Cross Society

*Corresponding author email: Arporn.T@chula.ac.th



Introduction

Human society is in a dynamic state and facing numerous new problems, including a rapidly aging global population and impacts from the Covid-19 pandemic. In terms of meeting healthcare needs, increasing the number of hospitals and healthcare professionals may not be the answer. The healthcare system needs to transform from a hospital-centric curative approach to a preventive or person-centric perspective. However, with rapid advancements in communication technology, information technology, and electronics, etc., it is today possible to design systems capable of collecting, transferring, and diagnosing health parameters or vital signs remotely from homes or workplaces. The new health monitoring system works outside the hospital environment; it communicates and integrates with healthcare providers to enhance the quality of healthcare delivery. In this article, a multi-parameter vital sign monitoring system using communication networks for telemedicine will be discussed in detail.

Conclusions and recommendations

A multi-parameter vital sign monitoring system for telemedicine was developed and designed for use outside the hospital, e.g., at home. It was designed to serve the needs of elderly patients, especially outpatients with chronic conditions and those who are convalescing after medical treatment. Vital signs with the collected time are collected and stored automatically on the server to monitor the patient's condition, while the monitoring system's communication function allows the patient to consult directly and virtually with a doctor, saving time and reducing unnecessary hospital visits. The system already supports the monitoring of complex categories of vital signs; it is nevertheless constantly being improved to improve its flexibility in order to allow tailoring to the individual needs of specific patients. The development has advanced to the pilot stage with outpatients, which will generate additional data to improve the system and its value to patients and doctors alike.

Using 5G Signals to Control Drones

Assist. Prof. Manop Wongsaisuan, D.Eng.¹

Sirichai Pornsarayouth, Ph.D.^{2,*}

¹Department of Electrical Engineering, Faculty of Engineering, Chulalongkorn University

²HiveGround Co., Ltd.

*Corresponding author email: sirichai.p@hiveground.com

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Introduction

Robots and automation play an increasingly important role in our daily lives today. Drones and autonomous robots offer a highly visible example, finding new applications in providing services and offering convenience to us all. One of the constraints on autonomous drone/robot control is the transmission latency inherent in the communication network. The latency is manifested as a delay in receiving incoming data from various sensors, processing, and transmitting the output from the processor to actuators of drones and autonomous robots. Traditionally, 3G/4G wireless communication had high latency that hampered smoothness of the control signal. The arrival of 5G technology virtually removes transmission latency, opening up new opportunities for applications of drones/robots communicating and collaborating in real-time.

Conclusion

Drones have already found multiple applications and are well integrated into many business models for service delivery. Upgrading the network and drone control to benefit from 5G requires investment in 5G-ready devices and infrastructure. Thus, a cost-benefit analysis must be considered to ensure the additional benefits of 5G are business-critical.

Communications Policy in the 5G Era

Assist. Prof. Piyabutr Boonaramrueng, Ph.D.

Faculty of Law, Chulalongkorn University

Corresponding author email: piyabutr.b@chula.ac.th



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Introduction

The world today is moving to embrace a fifth generation of wireless telecommunication technology, or 5G. While the first four generations focused on voice communication services and Internet via wireless phones, 5G focusses on collaboration, enabling connections between and among users, one or multiple wireless devices, wireless devices to machines and machine to machine. The technology has been continuously evolving to meet users' needs for speed, efficiency and access; 5G technology now offers wide geographic coverage, high speed, bandwidth and connection stability, a high level of service quality, while virtually eliminating transmission latency. These new capabilities have helped to change the market from a focus on servicing consumers to new stakeholders such as downstream businesses that serve both person-to-person and device-to-device or the Internet of Things (IoT). As a platform technology, the impact of 5G technology is multi-sectoral, covering manufacturing and services, generating efficiencies and new business models in field such as logistics, retailing, transportation services, medical services and public services.

Over the years, the government has set a clear policy to lead Thailand into the digital age, both economically and socially. 5G is not only a tool to support business operations. Rather, it has the potential to drive and transform economic structures including production, trade, services as well as impacting on social movements. 5G service policy and guidelines will therefore play a crucial role in addressing national policy goals. However, the success of 5G service development cannot be achieved solely by the action of either private or public sector actors, and will require coherence in order to maximize adoption and benefits to Thai society and quality of life. Therefore, the development of a national policy and framework for 5G implementation is an important imperative.

Conclusion

It is apparent that 5G technology is more appropriate to develop in a revolutionary direction than as an evolutionary technology in order to enable allocation of resources to support a wide variety of services efficiently. The focus is placed on market entry, industry verticals, and consumers.

The Role of Chulalongkorn University in Creating a 5G Technology Ecosystem

Photo by vecteezy.com

Arriya Wijitamornloet¹ and Alongkorn Pimpin^{2,*}

¹Biomedical Engineering, Faculty of Engineering, Chulalongkorn University

²Department of Mechanical Engineering, Faculty of Engineering, Chulalongkorn University

*Corresponding author email: Alongkorn.P@chula.ac.th



Introduction

Thailand faces a wide range of social challenges, including an ageing society, labour shortages, the global pandemic and depletion of natural resources. To tackle the challenges, modern technology has been continuously deployed, and telecommunications have perhaps had the greatest impact in integrating the digital and physical worlds to improve our quality of life. This integration led to a development of a modern engineering system called Cyber-Physical System (CPS). Trevino (2020) defined CPS as an engineering system that integrates the entire physical world, including sensor equipment, machinery and environment, with the cyber or the digital world, driven by a variety of networks and computers. The purpose of CPS is to communicate, exchange, analyse and manage data. The powerful interaction between the physical and digital worlds increases engineering system's efficiency and broadens its utilization.

Recognizing these fundamental shifts in both social and industrial sectors, Thailand's National Electronics and Computer Technology Center (NECTEC) has established the "Center of Cyber-Physical Systems" as a centre of knowledge, training and generation of human expertise to meet the emerging needs of the industrial sector. At the same time, Chulalongkorn University has launched a new course entitled "Cyber-physical Systems" at the Department of Mechanical Engineering, Faculty of Engineering. The program also established a collaborative network with Khon Kaen University and Kyushu University of Technology in Japan as well as relevant government agencies and private sector partners in the country to produce new graduates equipped with relevant ICT skills to meet a growing demand imposed by rapid growth in this sector.

One of the most frequent questions regarding CPS is "How does a Cyber-Physical System (CPS) differ from the Internet of Things (IoT)?" IoT is a system that focuses on connecting physical systems to the internet and exchanging an enormous amount of data, while CPS utilise data from physical sensors to control multiple devices or processes that work either independently or together. Thus, CPS uses more complex and diverse technologies than the IoT itself. The National Science Foundation (2020), USA, defines the CPS as "A Cyber Physical System is a mechanism that is controlled or monitored by computer-based algorithms, and tightly integrated with the Internet and its users. CPS systems tightly intertwine the physical and software components, each operating on different spatial and temporal scales, while exhibiting multiple and distinct behavioural modalities. This dynamic and complex interaction is agile, and changes based on the context". The development of this new and powerful system certainly requires all these existing machines and technologies work together seamlessly: wireless communication technology, precision sensors, autonomous machines, artificial intelligence, IoT technology, and precision manufacturing systems (Figure 1). Vital technologies such as wireless communication and 5G will play a pivotal role in driving this development.



Figure 1: Data transferring between the real world and the digital world connected via Cyber-Physical System
Source: Koonlachat Meesublak (2019)



5G Technology for Medical Development and a Better Quality of Life

Professor Viboon Sangveraphunsiri, Ph.D., Head of Regional Center of Robotics Technology, an expert in robot dynamic systems, robotic systems, and medical robotics shared his ideas and experiences on the development of medical robots incorporating 5G technology to boost efficiency in assessment, care, rehabilitation, and services for stroke patients and the elderly. The robots will enhance patient care and quality of life. Moreover, the robots are also being deployed to provide medical services for COVID-19 patients to ensure safety for both patients and healthcare professionals.

Integrating technologies for medical and public health services

“...Doctors need robots that can support medical care.

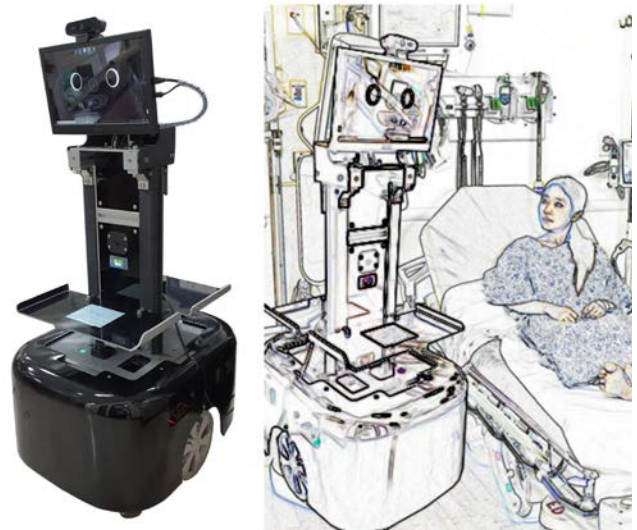
This robotics research aims to meet the specific challenges faced by stroke patients and elderly patients living alone. These patients need to take care of themselves independently...”

Public health care represents a major expenditure item, especially for ongoing and long-term care. Emerging diseases are appearing and treatment of existing diseases has become more complex and costly. Integration of new medical technologies is therefore vital to improve efficiency while maintaining standards of patient care. Examples include medical devices that incorporate telemedicine features allowing access to specialised medical services for patients in some remote health care centers including remote rural areas. Such internet-enabled devices can automatically monitor the patient’s condition and vital signs, even including equipment for physical therapy.

Given its vital role, research and development on robotics for medical and healthcare applications in Thailand date back to a Royal initiative by His Majesty the late King Bhumibol Adulyadej in 1987. In a shift from early applications in manufacturing, research has advanced over the past six years to develop medical robots, driven by emerging demand from within the medical profession and more capable technologies. The starting point for medical robotics was to address challenges faced by patients, particularly the elderly, and recovering stroke patients who live alone without carers. The primary goal is to design and develop technologies and systems to deliver efficient medical services at an affordable price and broaden access to all, regardless of location.

The early development of medical robots began with two prototypes. The first prototype—the ‘Care Robots’—provided assistance in assessing, care, rehabilitation, and provision of medical services for the elderly and stroke patients. The second prototype—the ‘Cure Robots’—provided rehabilitation services for stroke patients with paralysis at their own homes or nursing homes. Scaling of the two prototypes for industrial production was also successfully achieved through collaboration between the Faculties of Medicine and the Faculties of Engineering at Chulalongkorn University.

In late 2019, the COVID-19 pandemic struck, affecting the entire world. Caring for and treating infected patients requires measures and practices that protect healthcare professionals and patients alike. Robots that support telemedicine and telepresence features thus became critically important in such high-risk situations by minimizing the need for patient contact. Robots can undertake many routine tasks such as measuring body temperature and blood pressure, and can serve as a medium between patient and healthcare professional in quarantine areas. ‘Autonomous Mobile Robots with Teleoperation’ were deployed in operating theatres to communicate between the operating team and the medical team outside the theatre by broadcasting real-time video and audio consultation. Elsewhere, robots were used for non-medical support tasks such as delivering food and medical supplies to patients, and for cleaning and sanitising tasks in quarantined areas and cohort wards.



Telepresence and Telemedicine



5G Technology for Medical Development and a Better Quality of Life

“...Many types of medical robotic systems were developed to efficiently monitor vital signs through the network using cloud technology. The 5G network connects patients to doctors in real- time, regardless of distance...”

Many elderly people, including those who have suffered a stroke or other disease, or those requiring long-term care, live either alone or with an elderly spouse. This presents a risk when these patients are unable to effectively self-assess their condition or cannot access urgently needed medical care in an emergency. Delayed treatment increases the risk of death or disability as well as treatment cost. Some families may hire a carer to take care of them; however, hiring carers also carries risks and is sometimes resisted for cost or privacy reasons. Telemedicine and telepresence systems offer a ready alternative that allows monitoring of elderly and stroke patients in their homes as well as direct consultation with medical experts. It is also important to note that the algorithms powering these robotics systems were developed on an open platform that facilitates further development and innovation for future medical applications.

A wide range of general or specialist robotic systems are today available to monitor and record vital signs data in real-time through the 5G network on cloud-based servers. The 5G network serves as a crucial link, allowing Telepresence, Telemedicine & Teleoperation robots to function effectively in supporting patients needing special care and patients needing rehabilitation, such as stroke patients or the elderly/geriatric, and enables remote consultation and diagnosis. The sophistication of modern robots allows them to autonomously map the working area and navigate autonomously to conduct tasks, on flat or inclined surfaces, protected by an effective anti-collision and obstacle avoidance systems. Robots require an internet connection and due to the open software architecture can be readily customized or retooled to perform new tasks. The robots may readily be designed to be controllable via a smartphone app.

Regional Center of Robotics Technology, Chulalongkorn University Medical Robot Platforms



Robots for assessment, care, rehabilitation and providing services for elderly and stroke patients

Thailand's Readiness: 5G technology for medicine and quality of life

“...Testing of using 5G technology with the robots revealed no intrinsic problems; rollout is only held back by the lack of 5G network coverage...”

Technology advancement has led to massive increases in speed and data transfer capacity, allowing almost instantaneous sending of video and audio data with no lag. Despite the improved ease of use of modern smartphones, many older people are still unable to use them due to their physical limitations or fear of unfamiliar technologies. Intelligent robots can help fill this gap too as well as assist in the assessment, monitoring of vital signs including blood pressure, pulse, heartbeat, respiration, temperature, and other parameters. Other programmable capabilities include fall assessment, neurological assessment, strength assessment, and other related neurological assessments. Mobile robots can also be equipped with recreational programs such as instructional exercising or timed rehabilitation instruction programs. They are typically equipped with reminders to take medicine and a fall prevention program. Testing of 5G robots revealed no intrinsic problems; however, their operations were limited only by an incomplete or patchy 5G network infrastructure. This sometimes hampered the ability to connect mobile robots deployed in more than 12 hospitals nationwide or those at patients' homes. The incomplete 5G infrastructure resulted in a range of operational issues resulting from weak signal strength or intermittent connectivity. In some cases, hospitals were obliged to borrow some equipment from network providers as a stop-gap measure. Stability of use was impossible to achieve under such circumstances.

Telemedicine/Telepresence/Autonomous Robot (5G Network)



Adopting 5G technology during the global pandemic: guidelines for treatment, restoration, control/prevention of emerging diseases

“...5G networks are playing an increasingly central role as a data management backbone, connecting patients seamlessly in real-time to paramedic and medical personnel...”

Adopting 5G technology for use in medical robotics initially focused on the 5G Integration to Stroke Rehabilitation Robotics System. Stroke patients are required to carry out rehabilitation activities with the robots for a suggested period of time as scheduled by a health care personal; the resulting data are stored in a cloud-based database with analysis application or cloud-based computing application throughout the rehabilitation program. A cloud computing system monitors performance and patient progress, regardless of location, allowing the doctors to assess and monitor their patients at any time. In the past, rehabilitation was led by a physical therapist, and doctors would receive the results only at the end of the program or session. The 5G robotic system

enables doctors to easily monitor rehabilitation activities and adjust the program as it progresses. Moreover, the data also show the level of patient effort by analysing patient-robot interactions, again allowing doctors to fine-tune strategies to encourage patients to independently continue with rehabilitation exercises even without support from the robot.

Robots can not only assist stroke patients suffering from various degrees of impairment or paralysis. They can also deliver remote patient care, closely assessing, caring for, and rehabilitating stroke survivors, while sending real-time data directly to doctors. These robots can even help assess the likelihood of a stroke in new or elderly patients, as well as predict a recurrence of strokes in patients with a history. The versatility and multiple uses of robots in medicine need to be further explored through research in order to unlock the potential value offered by 5G connectivity- not only for stroke victims and the elderly but also for other patient categories and conditions, leveraging the capability to deliver medical services and rehabilitation customised to the individual patient's needs. Moreover, the ability of robots to offer entertainment and companionship is continually enhanced by advances in artificial intelligence, improving the quality of life for patients living alone. Most importantly, treatment and rehabilitation regimens can be quickly adjusted to evolving patient needs through the 5G network.

While medical robots were designed to run on the 4G network, data transfer requirements have increased dramatically, particularly for imaging. The technical limitations of 4G, particularly latency, also prevent data transfer in real-time. The launch of 5G technology overcame these limitations on bandwidth, speed, and latency, opening the door to vastly increased capability and flexibility in data management, allowing hospitals to use cloud-based computing to connect seamlessly with patients, rehabilitation practitioners, and doctors. Other advances in robotics also expanded the utility of robots, such as autonomous intelligent operations in remote locations. Robots can now work safely in high-traffic areas, avoid collisions with people or obstacles, and through the 5G network, enable communication among medical personnel and their patients who may be in different locations. All these technologies have been the subject of research and development by our researchers at Chulalongkorn University, facilitating further development and support for enhanced approaches to treatment, recovery, prevention, and control of existing and emerging diseases and long-term patient care.



Rehabilitation robots for stroke patients

Limitations on use of 5G technology in medicine and patient care

“...5G still faces problems with coverage and the limited number of access points. It is therefore crucial for service providers to step up and expedite completion of a fully and complete nationwide network as quickly as possible...”

Following the launch of 5G in Thailand, providers are in the process of expanding coverage and testing the specific services. A trial is currently underway to test the use of 5G to connect medical devices with a cloud-based medical database that also carries out medical data analysis. This service is marketable and is destined to become a valuable service in the future. Robots are pre-installed with medical data transfer capabilities as well as telepresence and telemedicine services operating via the 4G / 5G networks. During the first phase of research when the 5G network was not widely available, the research team was supported by AIS, a 5G network provider, who provided key equipment for testing services under the 5G network. In July 2020, the 5G network coverage area was further developed, and data-intensive tasks such as controlling robots and robotics services have as a result vastly improved. Nevertheless, 5G network coverage is still not fully developed; additional equipment is required; access points are still limited, and the cost remains high. 5G service providers are working to address these issues and aim to deliver full nationwide 5G network coverage as soon as possible.

Research and development in the field of medical robotics require a high level of investment. Though funding levels and management of the government's research budget have both improved considerably in recent years, additional investment is needed to achieve cutting-edge advances in a fast-evolving technological environment. Management of public funding will thus require improvement and greater flexibility to enable the country to remain at the forefront of this critically important field. Adequate levels of public funding will allow the design of new-generation medical robots that meet medical industry standards and are equipped with more practical functions and higher levels of AI implementation. Significant growth in demand for medical robots is forecast, so cost-effective production capacity will be needed to achieve significant uptake and benefits across Thailand's health sector.



What is the role of educational institutes in developing and applying future technologies for medical development and quality of life in Thailand?

“...In the past, Chulalongkorn University was able to produce robots to support medical work, including robots to support medical activities for patients with COVID-19 which were donated to more than 12 hospitals and sanatoriums nationwide...”

Chulalongkorn's research team has more than 30 years of experience in robotics and provides the University and the country with sustainable robotics research expertise. This integrated expertise paves the way for the University to produce its own medical robots in-house based 100% on Chula's own designs and technologies. In addition, the university has also established a small advanced production facility with an efficient and modern robotic production system. Production control follows international standards and is equipped with computer-controlled machining to ensure high precision and reliability.

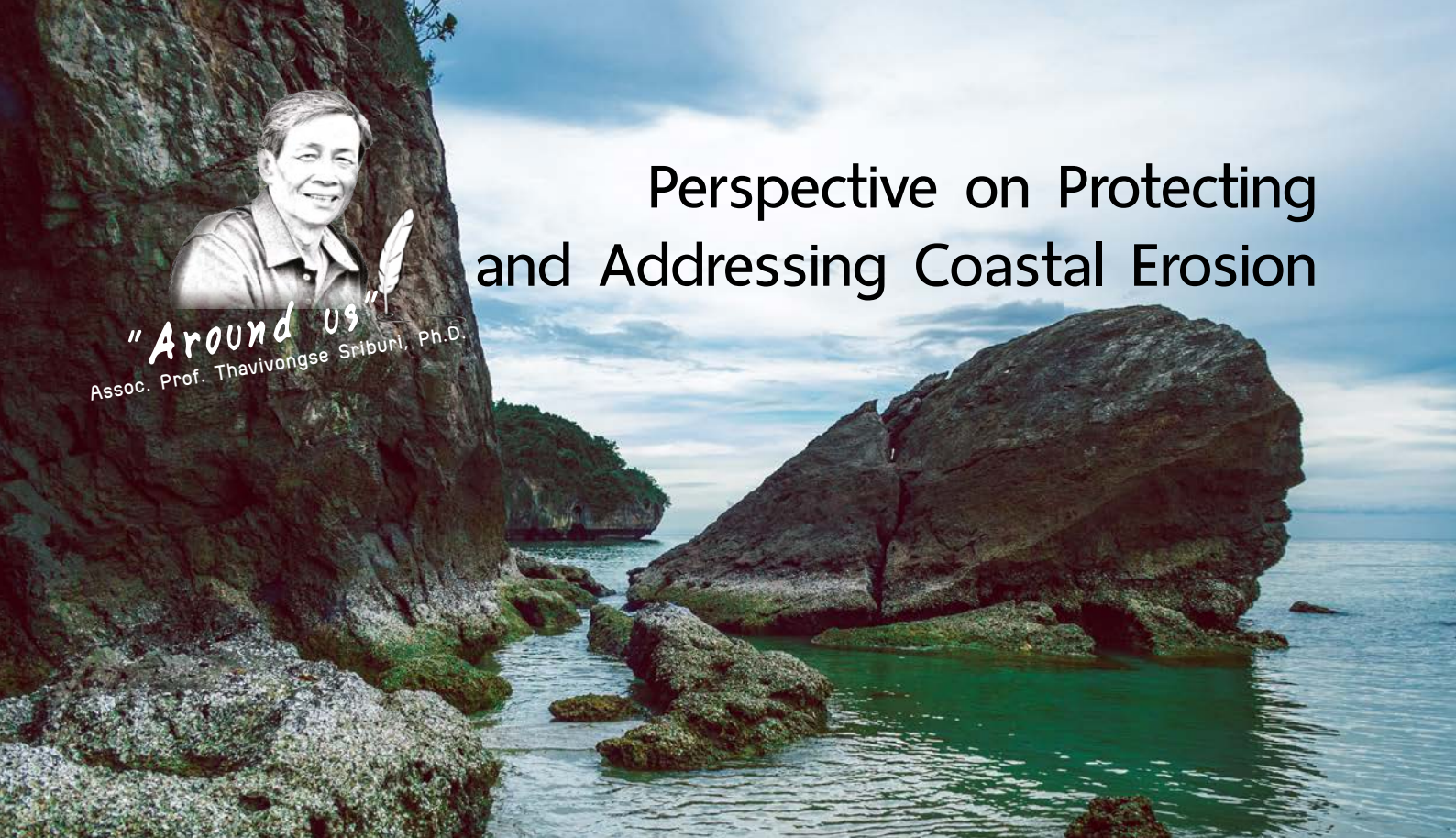
The production system also includes a maintenance routine that allows remote maintenance via the 5G network. All robotics systems are also developed by Chulalongkorn University and are considered as a valuable core technology, enabling the University to produce various types of customised medical robots. These robots are currently deployed in more than 12 hospitals nationwide and are today used to assist doctors in taking care of patients with Covid symptoms in quarantine areas. The robotics research is partly supported by the Research Fund of Chulalongkorn University, King Chulalongkorn Memorial Hospital, Thai Red Cross Society, and partially with research funding from the Robotic and Automation Systems Laboratory, Faculty of Engineering, Chulalongkorn University. However, due to lack of space, mass production of robots cannot yet be implemented at a satisfactory level, although the Faculty of Engineering has recently allocated space and facilities to support future expansion.



Since the deployment of medical robots carries ethical implications, the University's research must adhere to ethical standards. The next step will be to register with the Food and Drug Administration (FDA) to ensure compliance with the FDA standard. The robots must also comply with the ISO 13485 Standard- a global quality management standard for medical devices; this is an essential prerequisite to building user confidence. However, compliance certification should be readily achievable, given that the robotics research and development is grounded as a collaboration between doctors and engineers, with clear goals set for the development outcome, in line with the needs of hospitals and patients. The robots are also marketable and highly likely to be commercialised. Currently, the private sector is interested in commercialising robotics research carried out by Chulalongkorn University; this will generate tangible benefits to Thailand's health sector and society.



Professor Viboon Sangveraphunsiri, Ph.D. holds a Bachelor of Engineering in Mechanical Engineering from Chulalongkorn University, a Master of Engineering, and a Doctor of Engineering in Mechanical Engineering from Georgia Institute of Technology, USA. He has received the National Outstanding Researcher Award National Research Council Engineering and Industrial Research 2016, Outstanding Technologist Award Foundation for the Promotion of Science and Technology Under Royal Patronage of the year 2017.



Perspective on Protecting and Addressing Coastal Erosion

"Around us"
Assoc. Prof. Thavivongse Sriburi, Ph.D.

In the past, erosion problems on the coast of Thailand did not seem to raise cause for concern. However, this has changed with intensive development of our coastal areas for multiple purposes such as tourism and recreation, fisheries and aquaculture, residential areas for local communities, industry, ports, water transport, etc. The Department of Marine and Coastal Resources was given spatial responsibility in line with the Marine and Coastal Resource Management Promotion Act 2015, which divided the coastal areas into two types:

1) Land area, of approximately 17.24 million rai, covers 549 sub-districts. The land area includes marine and coastal resources located in four types of sub-districts: sub-districts that are adjacent to the sea, adjacent to the lakes, on islands and sub-districts with mangrove forests, coastal swamps and beach forests.

2) Sea area, covering all marine and coastal resources and ecosystems in the territory of Thailand within 200 nautical miles of the coast. This complies with the United Nations Convention on International Law of the Sea (UNCLOS). The area is approximately 202.67 million rai.

Thailand has approximately 3,151 kilometres of coastline, covering 23 coastal provinces, of which, 2,040 kilometres are located along the Gulf of Thailand, which covers 17 provinces. The other 1,111 kilometres are on the Andaman coastline, covering 6 coastal provinces. In all, there are over 21 million inhabitants in these coastal areas.

Coastal erosion on the coast of the Gulf of Thailand is evident in every province. Spreading from the eastern coastline to the west, some areas have suffered severe loss; provinces with an average erosion rate of more than 5 metres per year are classified as critical areas. Eleven provinces fall into this category: Chanthaburi, Rayong, Chachoengsao, Samut Prakan, Bangkok, Phetchaburi, Prachuap Khiri Khan, Surat Thani, Nakhon Si Thammarat, Songkhla and Pattani. Many other areas are experiencing erosion problems at the rate of 1-5 meters per year, especially within the inner Gulf of Thailand from the Bang Pakong estuary to the Tha Chin River which suffers the most.

On the Andaman coastline, coastal erosion also affects every province but is less severe than on the Gulf coastlines. The provinces suffering from severe erosion at an average rate of more than 5 meters per year are Ranong, Phuket, Krabi, Trang and Satun. The remaining provinces are losing coastline at a rate of 1-5 meters per year.



 Moderate erosion 1 - 5 meters/year
 Severe erosion >5 meters/year

Coastal erosion along the coastline

Source: Marine and Coastal Resource Database,
 Department of Marine and Coastal Resources

Coastal erosion occurs continuously from winds and waves, causing sediment from one location to be transported and deposited in another area, causing natural changes to the original coastline. Areas where sediment deposited is less than the amount transported are considered as erosion areas. There are two major causes of shoreline changes:

1) *Natural causes of coastal change:* the main natural causes of erosion are winds, sea-level rise, flooding or activities of marine organisms. Coastal hydrodynamics and transport processes play a key role in changing the characteristics of coastal sediment loss and deposition.

2) *Human causes of coastal changes:* human activity is a key factor in shoreline changes. Humans place a heavy focus on economic and social development by utilizing marine resources but fail to emphasize the importance of resource conservation and restoration. Human activity destroys vital natural protection for coastlines. Activities that accelerate and intensify the erosion process include:

2.1) Large-scale developments in coastal areas such as construction of deep-water ports, coastal roads and land reclamation to construct infrastructure in industrial estates.

2.2) Development of marine and coastal attractions for tourism activities, e.g., hotels, roads and commercial development. These activities encourage encroachment into coastal dunes which act as a barrier against natural erosion.

2.3) Dam building including weirs or upstream reservoirs which decrease the amount of sediment, flowing along the river, accumulating in estuarine areas. This results in a net loss of sediment, causing continuous coastal erosion as seen along the Bang Khun Thian coastline.

2.4) Encroachment of mangrove forests for aquaculture and shrimp farming. Mangrove forests perform a critically important role in protection against coastal erosion. They act as mud sediment traps, allowing soil to develop along the coast, and also act as physical barriers against currents, waves and wind, preventing coastline destruction.

2.5) Groundwater pumping results in land subsidence, contributing to the severity of coastal erosion. Overexploitation of groundwater pumping can be seen in the upper Gulf of Thailand in areas such as Bangkok, Samut Prakan, Samut Sakhon and Samut Songkhram.

2.6) Climate change affects coastal and coral ecosystems. Inclement weather and rising sea levels affect the coastline and contribute to erosion.

Impacts of coastal erosion

The impacts of coastal erosion may be classified into four areas:

1) *Economic*: the tourism industry is directly affected by deterioration of the country's beautiful coastal areas, especially along famous beaches and world-famous destinations, which suffer huge losses in revenue and fewer future investments. Prevention and restoration are highly capital intensive and require long-term commitment and collaboration.

2) *Social*: coastal communities suffering from coastal erosion may be forced to migrate to other areas causing loss of way of life and local traditions. People struggle to find new land to build their homes and work but are nevertheless often unable to work on the land as before, creating additional economic impact.

3) *Quality of life*: communities affected by erosion lose their land and assets and are forced to change their way of life, resulting e.g. in breakup in family structures and loss of quality of life.

4) *Environment and coastal ecosystems*: ecosystems and the environment directly impacted by coastal erosion include beach ecosystems, mangrove forests, seagrasses and corals. Changes in sediment flows cause sediment build-up on seagrass and coral reefs, leading to degradation of these fragile environments. This is exacerbated by loss of coastal mangrove forests which perform critical ecosystem services as spawning grounds and habitats for coastal biodiversity.

It is apparent that the effects of erosion occur as a chain reaction; it is continuous and interrelated in all aspects of society: economy, society, resources and quality of life. The adverse effects can be prevented and mitigated only through cooperation among all stakeholders, including central and local government agencies, coastal communities and the private sector.

Prevention and control measures

Prevention and control measures currently deployed in Thailand include the following:

1) *Natural measures* such as mangrove forest restoration and conservation including beach forests, seagrasses and coral reefs to reduce the intensity of waves hitting the shore. Such measures take a long time to achieve a secure and stable coastline.

2) *Engineering measures*: use of groynes stone sea walls and other engineering structures to trap sand sludge, dissipate wave energy or build more sandy beaches to protect and conserve the shoreline.

3) *Integrated measures* mean using a combination of natural and engineering measures such as woven bamboo walls to reduce wave intensity. As more sediment accumulates, mangrove seedlings are planted behind the bamboo walls to restore mangrove forests. Results indicated that mangroves have thrived under these conditions.

Even though various organizations have implemented projects to mitigate local coastal erosion problems, only a few have focused on their impacts on the ocean itself, with most initiatives focused on onshore impacts. Many major development projects have passed or undergoing the Environmental Impact Assessment (EIA), but the emphasis of coastal and marine morphology is limited.

As a result, planned mitigation of coastal erosion have often failed completely or did not fully achieve their objectives. Construction of such mitigation projects also introduced their own problems, whether onsite or in adjacent areas, resulting in continuing knock-on effects.

Countries with coastal areas such as the Netherlands and the United States have established clear measures to prevent and address coastal erosion. A shoreline impact assessment (SIA) with clear mitigation measures for each type of coastal area has been established. The SIA incorporates two key parts: morphological impact assessment (MIA) and environmental impact assessment (EIA).

The SIA uses MIA to assess likely changes in coastal systems, applying new technologies such as geographic information system (GIS) or remote sensing or others to make a pre-development risk assessment. This provides preliminary baseline data for further analysis in case of future development projects or activities in that area.

The MIA process is crucial since it evaluates impacts of project construction on ocean morphology during the construction phase. It also evaluates how construction and operation will affect the area and what would be the severity of the impact of construction on morphology. MIA may use one of several methodologies including mathematical modelling to evaluate and recommend preventative or remedial measures to mitigate anticipated impacts such as changes in sediment distribution, considering adjacent ecosystems as well as the project area itself.

The assessment must be carried out during or after the construction period to evaluate possible impacts on ocean morphology. This covers projected impacts and whether the impacts would be short term or long term. The area of assessment should include the full area of shoreline impacted by construction as well as adjacent areas and the ocean. The assessment must consider serious incidents such as storms and accidents in or near the area and must clearly identify the severity and likelihood of possible incidents in order to prepare monitoring and auditing measures.

The most important part of conducting a morphological impact assessment (MIA) is that monitoring and auditing measures need to be established for each project or activity. Changes to site morphology must be clearly defined and monitored to establish preventive and corrective mitigation measures. Stakeholders must establish a clear action plan to mitigate coastal erosion or establish a full environmental management program (EMP).

Once the morphological impact assessment (MIA) has been completed, the data obtained will contribute to the environmental impact assessment (EIA). In the past, although there was a section on area morphology, it was very generic and could not be practically assessed.

Effective prevention and mitigation of coastal erosion requires development of an effective system. It is apparent that previous efforts have failed due to lack of morphological data and absence of an EIA on morphology. Most assessments were based on speculation around what might happen and the severity of expected impacts. Therefore, an effective assessment of morphology would make EIA a more powerful and effective tool for decision-making. Otherwise, the government may need to increase its budget to tackle endless and worsening problems of coastal erosion and associated economic, environmental and social impacts.

References

- Department of Marine and Coastal Resources. (2020). Marine and Coastal Resource Database. *Coastal Erosion*. Retrieved on October 1, 2020 from <http://www.dmcr.go.th/marinecenter/erosion.php>
- Department of Marine and Coastal Resources. (2008). *Coastal Erosion Prevention of Thailand*. Journal of Marine and Coastal Resources, (Issue 1 March 2011), 70–78. Strategic Management on Prevention and Solutions for Coastal Erosion.
- Office of Natural Resources and Environmental Policy and Planning. (2007). Critical erosion situations on the Gulf of Thailand.

The Effect of Agricultural Insurance on Increasing the Efficiency of Risk Management in Agriculture, Livestock and Fisheries

Prof. Samrieng Mekkiengkrai
Faculty of Law, Chulalongkorn University



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Climate change is leading to more severe and frequent natural disasters which adversely affect Thailand and its economy. As an agricultural country, this affects millions of Thai people who are directly impacted by extreme weather events and natural disasters caused by climate change. Insurance has therefore assumed increasing importance in disaster risk management, especially for events that may affect agricultural crops. The government recognises that agricultural insurance could be used to drive the economy forwards and reduce the burden on the public purse of emergency aid to farmers. However, agricultural insurance is a high-risk business that consequently attracts relatively few insurance firms. The high premiums are generally not affordable to Thai farmers, whose incomes are typically extremely low. Therefore, the government must step in to offer subsidies to reduce the cost of premiums in order to broaden farmer participation in such insurance schemes. Such measure would reduce total public budget requirement for disaster compensation for farmers. Moreover, the farmers would also be able to use the insurance as collateral to apply for loans from financial institutions as well as using the compensation that has been reimbursed for restarting or resuming their farming activities.

However, the country's existing laws and regulations are cumbersome and not conducive towards a thriving agricultural insurance sector. Given the involvement of multiple agencies, the government must take the lead in order to drive reform and facilitate development of new agricultural insurance policies. Upon reviewing its policy, the government must consider the appropriate compensation levels, criteria and process, transfer of knowledge and building understanding among farmers, mechanisms which aim to reduce and relief government

from subsidies-related expenditures whilst shifting and relying more upon the insurance system, which would reduce the risk currently underwritten by the taxpayer. Moreover, the government must ensure that effective farm loan support is provided by the Bank for Agriculture and Agricultural Cooperatives, and must also ensure extensive cooperations among relevant agencies and the private sector. Finally, the government will require a data and statistic database regarding business responses and feedbacks from the insurance industry regarding appropriate insurance policies.

At present, there are several research studies on the topic of agricultural insurance services for both crops and livestock. Nevertheless, additional studies are needed to ensure a sustainable business sector and benefits to farmers. Examples include appropriate insurance solutions such as services, premiums that follow established legal and actuarial principles, appropriate indemnity assessment consistent with the digital age. Studies should also be further conducted into IT system development, integration of agricultural insurance databases from all relevant agencies, development of an indemnity assessment method for compensation that should encompass crops, livestock and fisheries. Moreover, it is recommended to conduct feasibility studies on drafting new laws which are specific to agricultural insurance and are similar to those enforced in South Korea, Japan and the Philippines. The Office of Insurance Commission (OIC) has assigned **Chula Unisearch** to conduct a research study entitled *“the effects of agricultural insurance on increasing the efficiency of risk management in agriculture, livestock and fisheries,”* to develop an insurance system to accommodate farmers’ risks more appropriately and efficiently. Moreover, the insurance system would also act as a mechanism to drive the agricultural economy forward, in line with the country’s overall economic development plan.

In this study, the research framework, process/tools and detailed implementation are set prior to a kick-off meeting with executives and OIC officials. The study is carried out through data collection, data compilation, and presentation of research findings to support policy reform. Relevant insurance data and laws regarding agriculture (crops, livestock and fisheries), insurance laws relating to agriculture and other related laws, both national and international, are also collected to create a knowledge-base analysis. The data also includes policies that allow integration of insurance to help with agricultural risk management both in Thailand and in other countries, different types of insurance (crops, livestock and fisheries) which covers agricultural risks, agricultural insurance products, risk management, criteria for insurance compensation, factors used in calculating insurance premiums, reinsurance and other data that benefit insurance. The study also analyses current and ongoing problems and obstacles. The study aims to cover at least five countries including South Korea, Japan, India, the United States and Australia, or any countries with an environment and context similar to Thailand which can offer relevant guidelines upon drafting Thailand’s agricultural insurance law.

The accumulated data is analysed by comparing Thailand with other countries and a draft Agricultural Insurance Act prepare, covering crops, livestock and fisheries. A public hearing regarding the draft has been organised. A framework on how to increase the ability to manage agricultural risks using agricultural laws are also discussed and heard from relevant agencies. After that, a recommendation has been made regarding each type of insurance (crops, livestock and fisheries) covering topics of agricultural risks, agricultural risk management, insurance products, criteria to obtain insurance compensation, criteria used in calculating insurance premiums, reinsurance and other relevant ideas that benefit the insurance itself. The discussion also includes problems and obstacles, pros and cons of each insurance type as well as drafting strategic recommendations on the roles of government and related agencies. A recommendation to ensure the success of the policy, both in short term and long term, has been established accordingly.

The research team purports this research to serve as a foundation for future implementation of a successful and sustainable agricultural insurance policy. The agricultural insurance should be put in place for farmers to reduce the government budget on financial aid for farmers. This will benefit the overall national economy.



Receiving a Smart City Certificate for Rama IV Smart City

Prof. Chakkaphan Sutthirat, Ph.D., Vice President for Research Affairs, Chulalongkorn University, together with Assoc. Prof. Pinraj Khanjanusthiti, Ph.D., Dean of Faculty of Architecture, Chulalongkorn University and Mr. Prasopsuk Pimkowit, Deputy Director of the Strategy and Evaluation Department, Bangkok Metropolitan Administration acted as representatives for the project entitled **“Rama IV Smart City”** representing four districts in Bangkok: Pathumwan District, Bang Rak District, Sathorn District and Klong Toey District. The representatives from Chulalongkorn University together with Rama IV Smart City development partners attended the event **“Thailand Smart City Week 2020,”** on Friday 16 October, 2020 at Mitrtown Hall 1, 5th Floor, Samyan Mitrtown Hall. They were awarded a certificate recognising its potential and preparations to transform into a Smart City. The certificate was awarded by Mr. Teeranan Srihong, Chairman of the Board Digital Economy Promotion Agency Supervisory Board (NESDB), Ministry of Digital Economy and Society and Assist. Prof. Natthaphon Nimmanpacharin, Ph.D., Director-General, Digital Economy Promotion Agency. Assist. Prof. Saowanee Wijitkosum, Ph.D., Deputy Director of Chula Unisearch attended the opening ceremony and congratulated the awardees on the award to **“Rama IV Smart City,”** as one of the 13 selected recipients.

Diplomats, executives and business partners also attended and participated in a concurrent event entitled *‘Joining Forces: Smart City Global Partnership in Action’* organised- by international partners. The Rama IV Smart City Project is a research project led by the Sustainable Urban Development Research Super-Cluster and **Chula Unisearch**.

Rama IV Smart City is a project under the concept of **“Co-creating Rama IV: Urban Vibe”** focusing on utilising knowledge and innovation from educational institutions to address challenges in urban development. This project is in line with the 20-year National Strategy (2018-2037) and aims to forge cooperation among urban development partners to develop the area as a best-practice demonstration of systematic urban development with broad stakeholder participation. Such an approach will contribute to long-term sustainable urban development in the future.

Developing the Rama IV area into a Smart City is being undertaken through collaboration partnership between Chulalongkorn University and partners from both public and private sectors. Public partners include the Mass Rapid Transit Authority of Thailand (MRTA) and Metropolitan Electricity Authority (MEA), among others. The private sector is represented by TCC Assets (Thailand) Company Limited and Central Pattana Public Company Limited. Local communities were also closely involved. Chulalongkorn University, as a prestigious educational institution in the Rama IV area, will act as an intermediary to facilitate cooperation among the partners and local communities. The University will also bring out the knowledge, innovation and expertise of its faculty, researchers and staff to foster interdisciplinary integration leading up to area development appropriate to the context and needs of local communities and the capacity of the areas.

ITAP Program is Open for Applications

The National Science and Technology Development Agency (NSTDA) in collaboration with **Chula Unisearch**, Chulalongkorn University invites faculty members, researchers and experts conducting research projects, providing academic services or advising SMEs and larger businesses to apply for funding under the Innovation and Technology Assistance Program (ITAP). The application form can be downloaded from <https://docs.google.com/forms/d/1XVgN4TgEyiW0XTHVTlkXwPFT4A-ObNcO0BEmWEuCITA/edit?ts=5f0430e5> For additional information contact:

- Ms. Siriya Anagnanon, ITAP: Tel: 082-498-8295
- Ms. Supansa Komin, Head of Science, Medicine and Public Health, Chula Unisearch: Tel: 095-165-3452 Email: Itapchula@gmail.com
Facebook: <https://www.facebook.com/ITAPCHULA>



Academic Conference on Waste-to-Energy Technology

On 24 July 2020, the Provincial Electricity Authority (PEA) and **Chula Unisearch**, Chulalongkorn University held an academic conference on *“The Study and Development of Waste-to-Energy Technology”* at the Mandarin Hotel, Bangkok. Mr. Kitti Liang Kruai, Deputy Director, Power System Research and Development, Provincial Electricity Authority (PEA) presided over the opening ceremony, while Prof. Tharapong Vitidsant, Ph.D., lecturer at the Department of Chemical Technology, Faculty of Science, Chulalongkorn University and head of the research project, together with researchers Assoc. Prof. Kanit Wattanavichien, Ph.D., and Mr. Jaru Nartkornkul, delivered keynote lectures on *“Operating the Waste-to-Energy System.”*

OBEC and Chulalongkorn University Held a Press Conference on their Collaboration for the Development of Innovation to Elevate the Quality of Education

On Monday 10 August 2020, the Office of the Basic Education Commission (OBEC), Ministry of Education and Chulalongkorn University issued a joint press conference on the topic: *“Active Learning: an Innovation to Improve the Quality of Education for Teachers and Educational Staff – a Collaboration between OBEC, Ministry of Education, and Chulalongkorn University”*. Deputy Prime Minister Special Emeritas Prof. Wissanu Krea-Ngam, Ph.D., chaired the press conference, held at Government House, together with Mr. Amnat Wichayanuwat, Secretary General of OBEC, and Prof. Bundhit Eua-arporn, Ph.D., President of Chulalongkorn University. **Chula Unisearch** was assigned to coordinate a new project entitled: *“Transforming the Quality of Thai education – Providing Access to Innovation for All Learners Within 2 Years,”* to achieve goals set within the timeframe.

On this occasion, Assist. Prof. Sornnate Areesophonpichet, Ph.D., Assistant to the President for Strategy, Organizational Quality Assurance and World University Rankings, Assoc. Prof. Siridej Sucheewa, Ph.D., Dean of the Faculty of Education, Chulalongkorn University, and Supichai Tangjaitrong, Ph.D., Managing Director of Chula Unisearch also attended the press conference.



Study Visit

The management team at **Chula Unisearch** recently welcomed administrators, Faculty members, researchers, research assistants and support staff from Dhurakij Pundit University and the Chulalongkorn University Social Research Institute (CUSRI). The visitors aimed to learn about **Chula Unisearch**'s approaches to funding management and effective research project management as well as to exchange views on the approaches to operate academic services and facilitate collaborative research. The visit provided an important opportunity for the three organisations to exchange knowledge and it was agreed to strengthen future academic collaboration among the three institutions.



Fire Drill

On Wednesday 2 September 2020, **Chula Unisearch** staff participated in the 2020 Fire Drill at Chulalongkorn University Research Building. The fire drill was held to remind all staff on evacuation procedures and fire safety measures. The drill covered basic knowledge on fire emergencies, safety measures and fire exit routes so that all staff would be able to evacuate the building quickly, safely and without panic. Staff were also instructed on how to use fire extinguishers and how to seek help in case of fire.

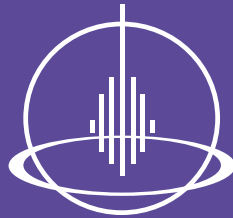


Campaign "Less Smoking, Less Illness, Live Longer"

Chula Unisearch has adopted Chulalongkorn University's policy to protect the health of non-smokers and delegate smoking areas. From 27 October 2020, all departments within the university buildings and shared public spaces are designated as smoke-free areas, while designating separate smoking areas. At **Chula Unisearch**, "**No smoking**" signs are clearly displayed in smoke-free areas and "**Smoking area**" signs are displayed in permitted areas. In addition, **Chula Unisearch** is campaigning against smoking under the slogan "**Unisearch- Less Smoking, Less Illness, Live Longer**" for the health of its staff and society.







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