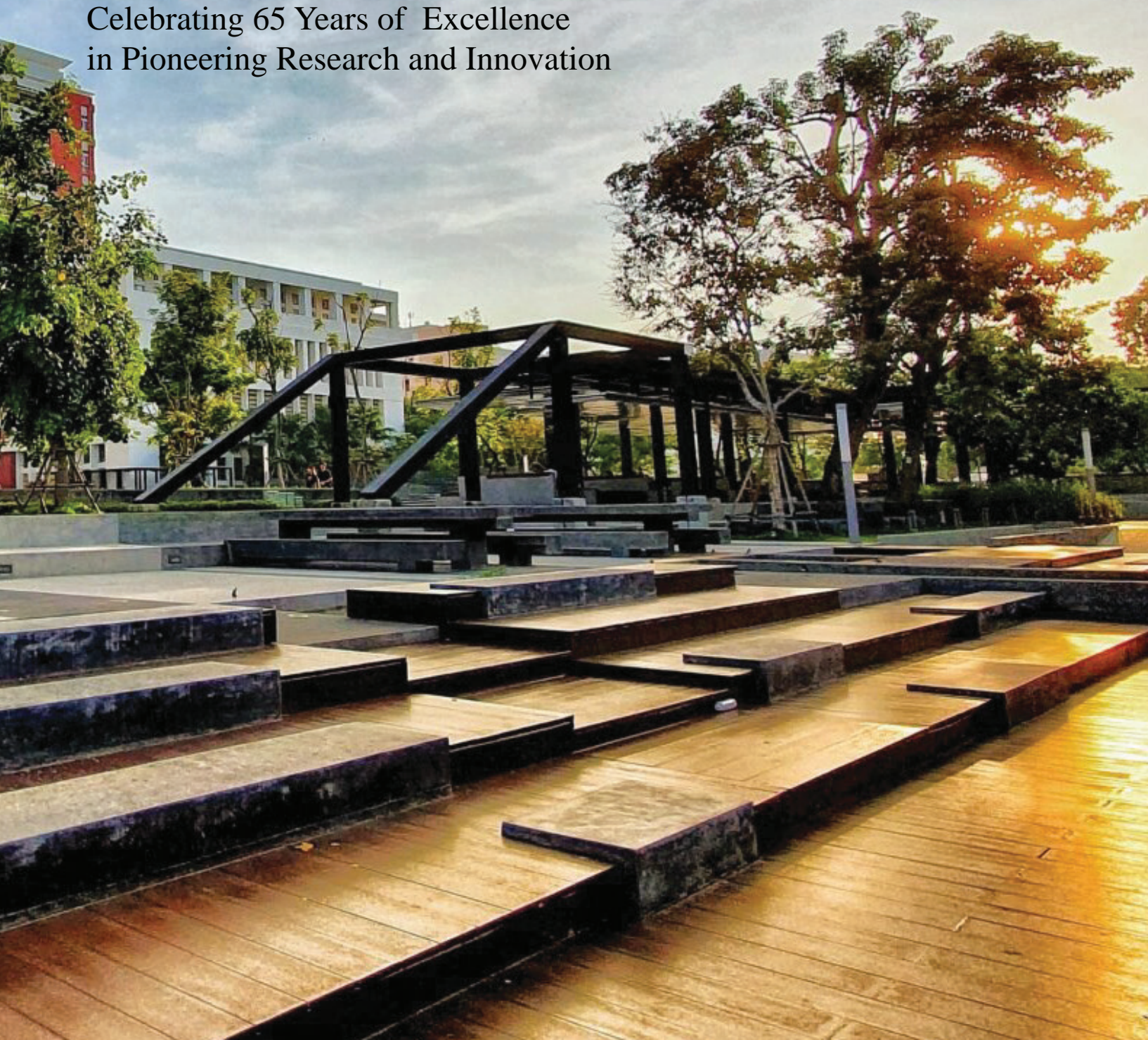




KMUTT RESEARCH AND INNOVATION

# IMPACT STORIES

Celebrating 65 Years of Excellence  
in Pioneering Research and Innovation



# CONTENT

	<b>Page</b>
<b>01</b> <b>Content</b>	2
<b>02</b> <b>Message from the President</b> Assoc. Prof. Dr. Suvit Saetia	3
<b>03</b> <b>OSSEOLABS: A Trailblazer in Jaw and Facial Surgery: From Local Excellence to Global Leadership</b> Assoc. Prof. Dr. Patcharapit Promoppatum Department of Mechanical Engineering, Faculty of Engineering	4 - 7
<b>04</b> <b>Khiri Wong Water Turbine: Affordable and Sustainable Clean Energy</b> Asst. Prof. Dr. Usa Boonbumrung Pilot Plant Development and Training Institute (PDTI)	8 - 13
<b>05</b> <b>Automated Transformer Welding Robot: A Bold Step by FIBO</b> Mr. Wuttichai Visarnkuna Institute of Field Robotics (FIBO)	14 - 19
<b>06</b> <b>I-ChEPS: Transforming Workforce Development in Thailand's Petrochemical Industry</b> Asst. Prof. Dr. Jindarat Pimsamarn Department of Chemical Engineering, Faculty of Engineering	20 - 25
<b>07</b> <b>“Mitr Phol Modern Farm” and Logistics Revolution: Shaping the Future of Thailand’s Sugarcane Industry</b> Asst. Prof. Dr. Pongchai Athikomrattanakul Logistics and Supply Chain Management, Graduate School of Management and Innovation (GMI)	26 - 30

Published by: King Mongkut’s University of Technology Thonburi

First Edition: A.D. 2025

This book is copyrighted by: King Mongkut’s University of Technology Thonburi

Protected under the Copyright Act 1994 with its Amendments.

# Message from the President

For over six decades, King Mongkut's University of Technology Thonburi (KMUTT) has been committed to driving the nation's progress through the cultivation of high-quality graduates, the generation of new knowledge, and the development of research excellence and impactful innovations. Our unwavering dedication is supported by robust research and development capabilities and strengthened by partnerships across various sectors, ensuring that research outcomes positively contribute to national development.

To align our research and innovation efforts to address both national and global challenges, KMUTT has established eight strategic research themes. These themes guide interdisciplinary research within the university and foster collaborations with external partners. We are devoted to cultivating an ecosystem that nurtures research and innovation by supporting centers of excellence, fostering international partnerships, and enhancing our research management systems, aimed at delivering transformative and sustainable outcomes.

As we celebrate KMUTT's 65<sup>th</sup> anniversary, we are proud to showcase stories of impactful work that reflect our dedication to advancing research and innovation tailored to the country's needs. These efforts highlight our role in serving society, driving knowledge creation, producing high-impact outcomes, all aimed at contributing to Thailand's sustainable development journey.

**Assoc. Prof. Dr. Suvit Saetia**

President





# A Trailblazer in Jaw and Facial Surgery: From Local Excellence to Global Leadership

Inventor	Assoc. Prof. Dr. Patcharapit Promoppatum
Affiliation	Department of Mechanical Engineering, Faculty of Engineering
Laboratory	OsseoLabs
Impact Value	125 million THB (2022-2024)
Collaborator(s)	Faculty of Dentistry, Chulalongkorn University; Phramongkutklao Hospital; and Rajavithi Hospital

Each year, approximately 5,000 patients undergo maxillofacial surgery in Thailand, primarily for oral cancer, cleft, or facial deformities.

Maxillofacial surgical procedures are intricate and time-intensive, resulting in high medical costs. Furthermore, commonly available medical devices are often limited in size and may not align well with the facial anatomy of Thai patients. Surgeons frequently need to adjust or modify these devices during surgery to fit the patient’s structure, which prolongs the operation and may impact recovery outcomes.

To address these challenges, an innovative solution has been introduced: **"porous structures for bone substitute"** for jaw and facial bone grafting, produced using 3D printing technology. This solution was developed by OsseoLabs, a spin-off company originating from the Department of Mechanical Engineering.

**Assoc. Prof. Dr. Patcharapit Promoppatum**, from the Department of Mechanical Engineering at KMUTT, highlighted the origins of this innovation. Leveraging his expertise in 3D printing, he began a collaborative research project in 2021 with the Faculty of Dentistry at Chulalongkorn University to address the specific needs of these patients

Initial research revealed that despite its significant economic and social potential, 3D printing technology was underutilized in the medical field. Beyond the clinical success for oral cancer treatments, this innovation has shown promise for a broader range of patient groups, leading to the production of these advanced devices in treating several other bone diseases.



CUTTING GUIDE DESIGN



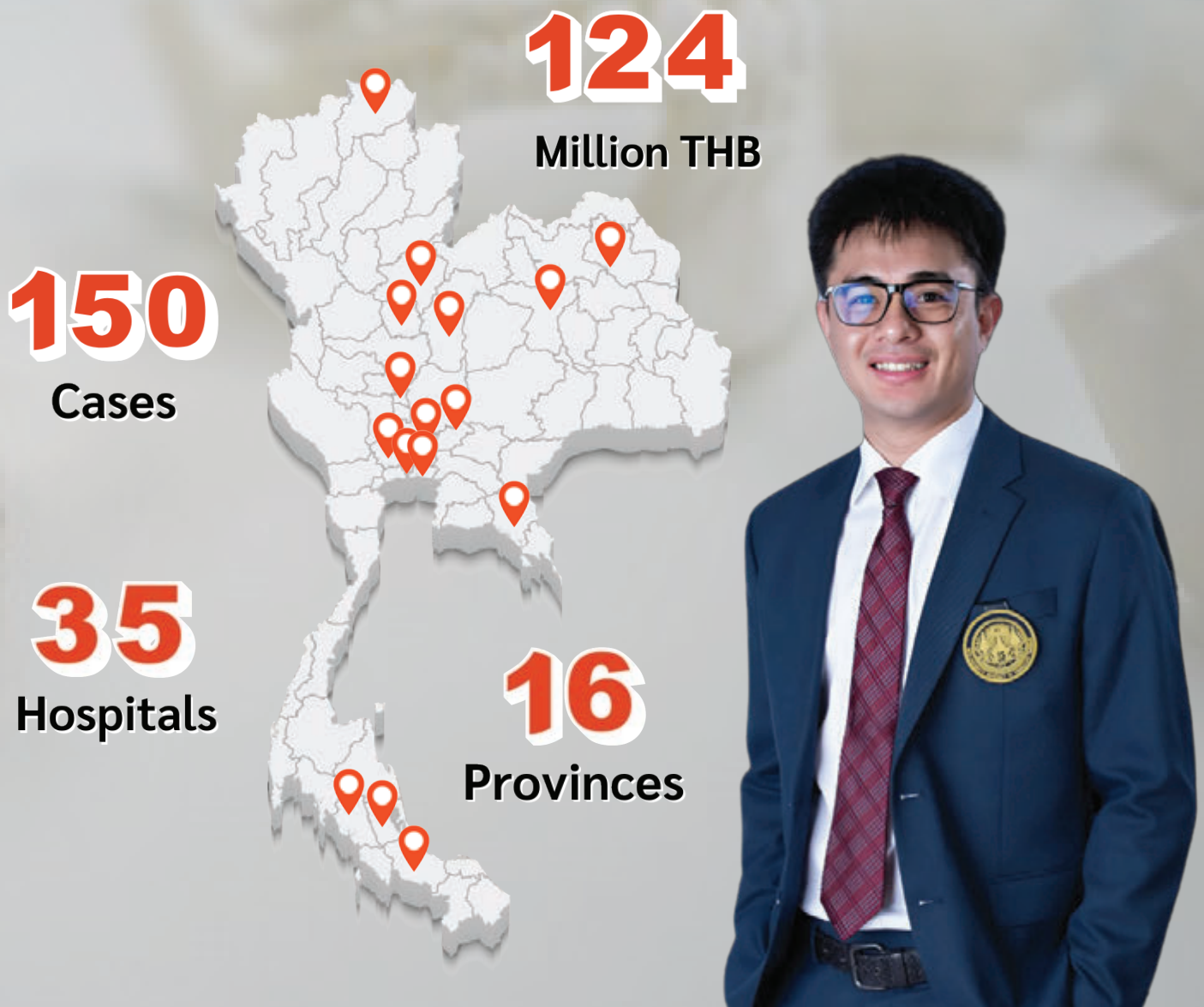
“

Our first case involved a patient with a jaw tumor. The outcome was highly successful—the patient made a full recovery, with no visible signs of surgery. Following this, we expanded our scope, transitioning from dental to orthopedic devices. In 2022, we established a company, grew our team, and secured additional funding.

”

Assoc. Prof. Dr. Patcharapit Promoppatum

# Impact Assessment



# Delivering Tailored Solutions

OsseoLabs integrates artificial intelligence (AI) for planning and data analysis to design medical devices tailored to individual patients. Using 3D printing technology, they create devices customized to each person's unique anatomy. By combining these technologies with the "porous structures for bone substitute" featuring a lattice-infilled structure, OsseoLabs enhances the efficiency, precision, and speed of maxillofacial surgeries.

"We create personalized devices so surgeons no longer need to make adjustments or modifications in the operating room. For cancer patients, whose treatment success rates are directly tied to the precision of bone removal, any insufficient cut increases the risk of recurrence. Our patient-specific surgical guides enable surgeons to execute their plans with high precision, making their work easier and faster. Patients retain more healthy bone, lowering recurrence rates—a win for both doctors and patients."

Although 3D printing technology is widely available today, OsseoLabs distinguishes itself through its proprietary porous material design. Their devices are not only precisely sized and shaped to fit bone contours but are also lightweight and strong, enabling tissue cells to grow and integrate seamlessly with existing bone. This unique feature gives OsseoLabs' products a competitive edge in both domestic and international markets.

## User Experience

In addition to developing "patient-specific devices" tailored to oral surgery needs, OsseoLabs' strengths lie in the expertise gained through extensive trial and error. For each surgery, the team conducts pre- and post-operative meetings to plan, collect user feedback, analyze outcomes, summarize lessons, and implement improvements in subsequent procedures.

"We now use OsseoLabs tools in all of our jaw reconstruction surgeries, as it is no longer practical to rely on commercial plates that require adjustments. With OsseoLabs, everything is printed with precision. OsseoLabs has transformed the standard of care in oral surgery."

Another notable impact on the medical field is OsseoLabs' innovative model that bridges dentistry and engineering.

"We dentists had the knowledge, while OsseoLabs brought in the technical know-how. When these two elements combine, a powerful innovation emerges—one that could well shape the future of education."



**Asst. Prof. Dr. Vorapat Trachoo, MD, DDS**

Oral and Maxillofacial Surgery Specialist

Department of Oral Surgery, Faculty of Dentistry, Chulalongkorn University

# Achievements Driving Impact

Since its establishment two years ago, OsseoLabs has provided surgical solutions for 50 oral cancer patients. In addition, the company has supported 81 other cases, including surgeries for oral cysts and tumors, dental implants, bone surgeries due to accidents, and various forms of bone cancer. These procedures, conducted in collaboration with medical schools and hospitals, have reported no complications.

A significant impact of OsseoLabs' innovation is the reduction in medical costs per case by up to 20%, achieved through shortened surgery times. This improvement saves approximately 40,000 THB per case in operating room charges.

Building on its success at the Faculty of Dentistry, Chulalongkorn University, OsseoLabs has expanded its services to 21 hospitals across Bangkok and other provinces. These include Rajavithi Hospital, Ramathibodi Hospital, Phramongkutklao Hospital, Sakon Nakhon Hospital, Khon Kaen University and Prince of Songkla University.

Currently, OsseoLabs' devices are undergoing FDA registration and certification to facilitate their integration into the local and international healthcare system. The company has also filed 16 patent applications across four jurisdictions—Thailand, the European Union, the United States, and Singapore—positioning itself for both domestic and international commercialization.

Recently, OsseoLabs invested in a production facility at the Institute of Field Robotics (FIBO) at KMUTT. Once operational, this facility is expected to boost production capacity to 2,000 units annually, enabling treatment for approximately 1,000 patients each year.

## User Experience

One of OsseoLabs' key strengths is its ability to design patient-specific tools and surgical plans using 3D imaging, which provides detailed visuals of the surgical area. This capability allows surgeons to anticipate and address potential complications before entering the operating room, thereby improving surgical efficiency.

"The product I used is 3D-printed bone fixation plates. Unlike commercial plates that require modifications in the operating room, these customized plates are ready to use, saving about 40 minutes to an hour per case. In surgeries, we typically need to mark cutting lines in the operating room. With surgical guides, this step is eliminated, making the procedure more precise and 50% faster."

In addition to jaw repositioning and repair, OsseoLabs' tools are utilized in orbital repair cases stemming from accidents. For these procedures, the orbital volume is carefully calculated, and tools are custom-made to the required volume and size, significantly enhancing repair outcomes.



## Dr. Teerawat Paipongna, DDS

Oral and Maxillofacial Surgery Specialist  
Sakon Nakhon Hospital



# Khiri Wong Water Turbine

## Affordable and Sustainable Clean Energy

Project Leader	Asst. Prof. Dr. Usa Boonbumrung
Affiliation	Pilot Plant Development and Training Institute (PDTI)
Laboratory	Clean Energy Systems Integration Laboratory (CESi)
Impact Value	32 million THB (2007-2024)
Collaborator(s)	Khiri Wong Water Turbine Community Enterprise

Khiri Wong, a small village nestled among the mountains in the Kamlon subdistrict of Lan Saka district, Nakhon Si Thammarat province, is renowned for its pristine air. Visitors are drawn to this serene destination to enjoy its refreshing atmosphere and embrace a tranquil, nature-inspired lifestyle high up on the mountain. The villagers’ way of life revolves around mixed fruit orchard farming, locally known as “Suan Som Rom,” where an abundance of fruits—such as durian, mangosteen, longkong, and stink beans—are cultivated on high mountain slopes.

Nearly 30 years ago, the villagers of Khiri Wong faced the challenge of living without electricity. At night, their sole source of light came from kerosene lamps, a limitation that was particularly burdensome during the fruit harvest season when they often had to prepare durian paste on the mountains, relying on dim kerosene lamps. This inadequate lighting frequently led to burnt batches of durian paste, resulting in substantial losses. In 1998, **Uncle Song Boonchaloei**, inspired by a large water turbine he had seen elsewhere, became the first to envision harnessing hydropower to generate electricity.

Uncle Song’s first water turbine was made from cans of pickled mustard greens and canned fish attached to an old bicycle wheel. Despite numerous trials and errors, the turbine produced just enough electricity to power a single light bulb. A few other villagers joined the effort to improve the system, but it still fell short of meeting the community’s energy needs.

In 2003, **Dr. Krissanapong Kirtikara**, then President of King Mongkut's University of Technology Thonburi (KMUTT), visited Khiri Wong and learned of the villagers’ struggles during a meeting with Uncle Song. Recognizing the potential of their initiative, Dr. Krissanapong tasked **Asst. Prof. Dr. Usa Boonbumrung**, Head of the Clean Energy Systems Integration Laboratory (CESi) at the Pilot Plant Development and Training Institute (PDTI), KMUTT, with gathering data and collaborating with the local community. The problem statement was: the fruit orchard sheds on the mountain had access to water but lacked electricity. Despite continuous efforts to improve the water turbine’s efficiency, the electricity produced remained insufficient to meet the villagers’ needs.

## Water Turbines: The Solution

Asst. Prof. Dr. Usa Boonbumrung explained that two decades ago, the concept of clean energy was still far-fetched to many villagers. At the time, solar energy was prohibitively expensive, costing around 200 THB per watt, and was therefore out of reach for most households. However, Khiri Wong is blessed with abundant hydropower resources. The villagers already had a piping system in place to transport water from the mountain tops, used exclusively for cultivating fruits and other crops. Asst. Prof. Dr. Usa proposed that if this water were first passed through small-scale hydropower turbines before being released for agricultural use, it could generate electricity for various purposes. Moreover, hydropower turbines offered the most economical clean energy option when measured by cost per kilowatt-hour.

Despite its cost advantages—ranging from approximately 1.5 to 12 THB per kilowatt-hour—small-scale hydropower technology faced a major hurdle: expensive imported equipment.



In 2004, the KMUTT research team began collaborating with the Khiri Wong community to address this challenge. Together, they set out to develop “pico-hydropower turbines” designed to fit the existing piping system. By combining the university’s technological expertise with the villagers’ local knowledge, the team aimed to create an affordable and efficient solution. By 2007, a prototype was successfully developed, and five turbines were installed, each with a capacity of 1 kilowatt, totaling 5 kilowatts. The production cost of these turbines was approximately 0.72 THB per kilowatt-hour.

“

The villagers already had their water pipes. If they wanted to generate 1 kilowatt of electricity while maintaining their existing pipe size, they would have had to purchase turbines from Europe—equipment that was not only difficult to procure but also prohibitively expensive. We addressed this by designing turbines specifically tailored to their current pipe sizes, enabling them to achieve the desired electricity output without having to modify their infrastructure. Since the early days of this project, KMUTT research team has remained focused on two key goals: improving efficiency and reducing costs.

”

**Asst. Prof. Dr. Usa Boonbumrung**



## From Water Turbines to a Community Enterprise

Following the successful demonstration of KMUTT's water turbines, the villagers of Khiri Wong grew increasingly engaged in the initiative. In 2007, the Khiri Wong Water Turbine Group was formed, allowing members to place orders for turbines tailored to fit their existing pipe sizes for installation in their orchards. The initial production costs were partially subsidized by research grants from KMUTT and other sources, with villagers contributing 20–30% of the total cost.



As demand for water turbines grew, the Khiri Wong Water Turbine Community Enterprise was established in 2014 for effective budget management. Under the "Inclusive Innovation" concept, subsequent turbine models became more efficient and affordable. These small-scale hydropower turbines, with capacities ranging from 300 watts to 1 kilowatt, now have a production cost of just 15 THB per watt.

In 2017, as external funding declined, the KMUTT research team worked closely with the community to address financial challenges. Recognizing the turbines' value and efficiency, some members opted to pay the full production cost. The research team continued manufacturing turbines at cost, while the community enterprise handled distribution to members. Over time, the initiative expanded to neighboring communities along the Nakhon Si Thammarat mountain range.



### Impact Assessment

Generated  
**3,400 MW**  
of electricity

saving  
**32**  
million THB

Reduced fuel consumption by  
**857,000** liters

Reduced CO<sub>2</sub> emissions by  
**2,300** tons



The key advantages of Khiri Wong turbines include compact size, durability, low maintenance, and high energy conversion efficiency. Economic analysis revealed that a 1-kilowatt Khiri Wong turbine, with a 20-year installation and maintenance cost of under 40,000 THB, has a payback period of less than two years. In comparison, a generator operating over the same period would incur fuel costs amounting to hundreds of thousands of THB.

The Khiri Wong Water Turbine Community Enterprise has garnered multiple accolades, including the Thailand Energy Awards 2020 and the winner of the ASEAN Renewable Energy Project Awards 2020 in the Off-Grid (Power) category. The ASEAN Renewable Energy Project Awards are part of the prestigious ASEAN Energy Awards presented by the ASEAN Center for Energy in Jakarta, Indonesia.

Based on the knowledge and success, the National Research Council of Thailand (NRCT) supported the development of a master plan to promote small-scale hydropower turbines in communities across the Nakhon Si Thammarat mountain range. This initiative aligns with the Alternative Energy Development Plan (2018–2037) and aims to expand the adoption of Khiri Wong turbines to 40 districts spanning six provinces: Surat Thani, Trang, Satun, Nakhon Si Thammarat, Phatthalung and Songkhla.

Since the start of this project in 2004, 160 turbines have been installed in Khiri Wong and nearby communities, providing a combined capacity exceeding 110 kilowatts—comparable to a small power plant. This capacity meets daily needs, providing 24-hour electricity for agricultural activities, reducing generator fuel costs, and mitigating greenhouse gas emissions by 350 tons annually. Villagers have fully embraced renewable energy, taking responsibility for turbine maintenance and repairs, in line with Sustainable Development Goal (SDG) 7: ensuring access to affordable, reliable, and sustainable modern energy for all.



Looking ahead, the research team is exploring hybrid power systems. During dry seasons, when water resources are insufficient for turbine operation, solar power—now more affordable—can supplement hydropower. Electricity from water turbines (alternating current or AC) and solar panels (direct current or DC) is stored in batteries. With inverters converting DC to AC, the electricity can be used for various activities, including food processing, refrigeration, and durian freezing.

# Feedback from Khiri wong Villagers

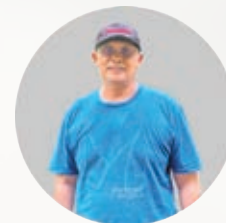
“Before this, we relied on kerosene lamps after dark and could not use any electrical appliances. Now, as we stay in the shed to tend to the orchard, having amenities like a refrigerator, washing machine, and rice cooker is essential. The water turbine provides that.”

Mr. Winai’s turbine, installed in 2017, has proven highly durable, operating effectively even after years of use. Maintenance is simple, requiring only occasional replacement of faulty components. Despite the initial investment and upkeep costs, which amounted to tens of thousands of THB, Mr. Winnai considers the expense worthwhile.

“People often ask if the investment was worth it. Initially, it may not seem justified because the costs were significant: over 10,000 THB for the turbine itself, more than 20,000 THB for a battery, and another 20,000 THB for an inverter—totaling over 50,000 THB. But in my view, I now have light, can charge batteries, and cook rice. If I have achieved what I need, then it is worth every penny.”

**Mr. Winai Kongtham**

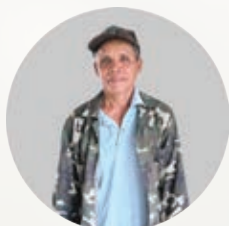
Khiri Wong Water turbine Users



“Technology is essential these days. Electricity in the orchard sheds significantly influences workers' decisions. When they come to work, their first question is whether there is electricity and internet access because they need to stay connected with their families. If these amenities are available, they are more likely to agree to work here.”

In Khiri Wong, water turbines primarily power essential amenities in agricultural areas, such as rice cookers, fans, televisions, and refrigerators. However, their direct applications in farming remain limited. To address this, the community is exploring ways to leverage hydroelectricity to advance smart farming practices.

“We’re planning to use electricity to control pests in orchards and to power equipment like lawnmowers and pesticide sprayers. Currently, these rely on fuel-powered engines. If we succeed in replacing them with hydroelectric-powered systems, it will reduce costs and carbon emissions, supporting the environment and aligning with clean energy goals.”



**Mr. Wirat Treechot**

Secretary of the Khiri Wong Water Turbine  
Community Enterprise



# Automated Transformer Welding Robot: A Bold Step by FIBO

Inventor	Mr. Wuttichai Visarnkuna
Affiliation	Institute of Field Robotics (FIBO)
Impact Value	2 million THB (2022–2024)
Collaborator(s)	Precise Electric Manufacturing Co., Ltd.

Precise Electric Manufacturing Company Limited, a subsidiary of Precise Corporation Public Company Limited, has been a leading provider in the electrical and energy sectors for over 40 years. Among its core operations is delivering comprehensive electrical engineering solutions, including the production of transformer tanks commonly seen on utility poles throughout Thailand. The primary function of transformer tanks is to convert voltage between two different levels, either stepping up or stepping down the voltage as required. This process ensures the efficient and safe transmission of electricity.

Traditionally, the manufacturing of Precise's transformer tanks relied entirely on skilled Thai welders. These workers operated under challenging conditions, working against the clock amidst intense sparks and heat to produce high-quality products. However, as market demand grew and orders surged, the company faced significant challenges. Employee fatigue from overtime work and associated health risks became critical concerns for the management. To address these issues, Precise initiated a collaboration with the Institute of Field Robotics (FIBO) at King Mongkut's University of Technology Thonburi. Together, they embarked on developing an Automated Welding System to replace manual labor.



## Impact Assessment

Labor costs reduced by  
**2** million THB

Production time shortened by  
**25%** per model.

**2**  
employees successfully  
upskilled.

## Embracing Automation: A Shift from Human Labor

Mr. Perapon Pechampai, Project Management Officer at Precise Electric Manufacturing, reflected on the traditional transformer tank production process, which required four welders per production line, each working an 8-hour shift (from 8:00 AM to 5:00 PM).

"The main issue we faced was during periods of high order volume. Employees had to work overtime. Late-night shifts and insufficient rest negatively impacted their health, which in turn reduced their efficiency. Additionally, holding the heavy welding equipment for extended periods caused fatigue, leading to intermittent pauses. These pauses resulted in gaps in the welds, causing leaks and defects in the final product."

Another challenge was the rising labor costs, as the company had to pay overtime wages in compliance with labor laws. These factors motivated the company to explore automation systems to alleviate employee workloads. Coincidentally, the Thai government was actively promoting the Factory 4.0 initiative. Recognizing this as an opportunity to leverage technology for business transformation, Precise's management decided to collaborate with FIBO.

"At the time, we realized that hiring a private company to build an automated welding station might fulfill our immediate goal, but it would not enhance the company's expertise in the long term. This led us to establish a new unit dedicated to automated systems, using our in-house staff who had relevant experience. We then began searching for a consultant or institution capable of meeting our needs. Eventually, we were advised to approach FIBO," Mr. Peeraphon recounted, explaining the origins of the partnership.

### Mr. Perapon Pechampai

Project Management Officer  
Precise Electric Manufacturing Co., Ltd.



## FIBO: A Trusted Partner in Automation Innovation

FIBO’s reputation and extensive experience in robotics and automation made it an obvious choice for Precise Electric Manufacturing, but one factor set it apart: its dedicated academic services division, which works full-time with the private sector.

“We saw this as a key advantage, ensuring project continuity and a higher likelihood of achieving 100% success.”

Discussions between Precise Electric Manufacturing and FIBO began in 2019, focusing on defining the project scope and system design. The project officially launched in 2020 with the signing of an agreement.

The automated welding system project required collaboration from multiple stakeholders: Precise’s design expertise, ABB’s guidance as the robot distributor on capabilities such as movement range, load capacity, and accessibility, and FIBO’s specialization in system integration.

Precise tasked FIBO with developing a robotic system capable of autonomously assembling components and performing continuous welding, aiming to increase production capacity by 1.5 to 2 times over the existing system.

The project’s desired outcomes included: 1) Reducing the number of workers per station from four to one, 2) Providing staff training on smart factory development, including hardware and software, 3) Improving weld quality by minimizing defects, and 4) Enhancing worker well-being by reducing physical fatigue, improving health, and lowering risks of injuries caused by welding sparks or heavy equipment.

FIBO did not just build a welding robot, but created a complete automation system. This involved designing robot placements, calculating production capacity, selecting suitable technologies, developing control software for individual robots, and integrating them into a centralized system to achieve the project’s objectives.

Work began in 2020, and by 2022, prototype robots were operational, effectively reducing human workloads on production lines.



Drawn to the challenge, the team agreed to work with the company immediately, according to **Mr. Wuttichai Visarnkuna**, Deputy Director for Academic Services at FIBO.

“What distinguishes FIBO from other service providers is its ability to deliver functional prototypes alongside comprehensive knowledge transfer.”

“When we take on a project, we provide clients with prototypes that meet industrial standards and are ready to be integrated into production lines. Alongside this, we hand over blueprints, supplier lists, and even the software source code. Additionally, we conduct training sessions and transfer knowledge to the client. We then move on to create new innovations.”



## Automation: Maximizing Efficiency and Reducing Costs

The fully operational automated welding system comprises three types of robots: 1) Welding robot – performs the welding tasks, 2) Jig and fixture robot – positions workpieces for welding, and 3) Pick-and-place robot – handles the picking and placing of workpieces. This system was specifically designed to weld two transformer tank models: the Trio-Core 3D Transformer Tank and the VT for LBS Tank.

Mr. Perapon highlighted that the robotic system not only doubles production capacity but also reduces the number of workers per station from four to two. Additionally, it minimizes workplace accidents caused by handling heavy steel or exposure to welding sparks. The system has enabled the company to save 760,000 THB annually in production costs. Another key advantage is the reduction of defects. While human welders require pauses that can lead to gaps in welding, robots operate continuously, ensuring seamless welds. This reduces the risk of leaks and the cost associated with defect inspections and repairs.

**Ms. Kanokwan Pandueng**, Senior Division Manager at Precise Electric Manufacturing, added that the automated system developed by FIBO has helped the company save over 760,000 THB annually in labor costs. It has also significantly boosted production efficiency. The production of VT transformers has increased from 25 units to 50 units per 24 hours. The daily production of 1-phase transformers has increased from 30 to 60 units, while 3-phase transformer output has grown from 12 to 24 units per day. This is because robots can operate 24 hours, whereas human labor is limited to a maximum of 12 hours.

Furthermore, Precise’s employees have received training to enhance their software and hardware skills, enabling them to transition from traditional welding roles to operators of automated systems.



## Shaping the Future of Work: Transitioning from Welders to System Operators

Mr. Boonyarit Thonapan, Level-2 Welder Technician at Precise Electric Manufacturing, is one of the employees who has advanced his skills and responsibilities to become an automated system operator. Mr. Boonyarit shared that he trained as a welder in vocational school and had worked at Precise for three years. He undertook training to develop skills in robotic control. It took him approximately six months to learn the basics and apply them effectively on the production floor.

"Previously, as a welder, the work was quite repetitive. But as a robot operator, I need to continuously adjust the program based on the conditions on-site. It requires constant thinking."

He also emphasized the significant reduction in physical strain since transitioning to his new role.

"When I was a welder, the job involved enduring heat and sparks. Over time, my vision also suffered from the constant welding work. Now, as a robot operator, the work is much more comfortable and less physically demanding."

The story of FIBO's robots extends beyond their role in the production line. It symbolizes how technology can foster a better future, enhancing organizational capabilities, reducing production defects, and improving workers' quality of life. This project represents a dual transformation: advancing industrial systems while simultaneously reshaping the lives and roles of the workforce.

**Mr. Boonyarit Thonapan**

Level-2 Welder Technician  
Precise Electric Manufacturing Co., Ltd.



## FIBO: Vision and Academic Services

The Institute of Field Robotics (FIBO), King Mongkut's University of Technology Thonburi (KMUTT), was established in 1995 by **Assoc. Prof. Dr. Djitt Laowattana**, driven by his vision of robotics and automation as transformative forces for industrial growth and national development.

FIBO's mission rests on three pillars: education, research, and academic services. These pillars collectively aim to advance knowledge and develop skilled professionals in robotics and automation.

The Academic Services Division, a vital part of FIBO, comprises a team of 15 full-time engineers with expertise spanning computer science, mechanical engineering, electrical engineering, and mechatronics—disciplines essential for robotics and automation.

Mr. Wuttichai Visarnkuna, Deputy Director of the Academic Services Division, highlighted the division's unique approach: instead of competing with private companies, it focuses on crafting tailored solutions for clients, particularly in large-scale projects involving advanced technologies with high impact.

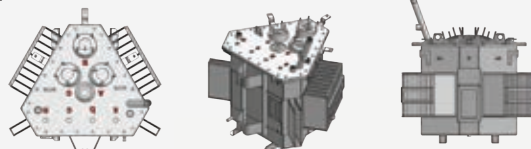
"In every project, FIBO delivers prototypes, software, and comprehensive knowledge transfer, enabling clients to scale and apply the technology further. This aligns with our philosophy of fostering innovation by pushing the boundaries of development rather than revisiting past technologies."

Dr. Djitt, now an advisor to FIBO, underscored the institute's commitment to pioneering new technologies and creating prototypes rather than duplicating existing solutions. Project service charges include intellectual property, and final deliverables encompass prototypes, databases, and all relevant knowledge. This enables clients to mass-produce or replicate the technology independently.

"Some may perceive FIBO's approach as a disadvantage. However, when the organizations we collaborate with successfully produce and commercialize these technologies, it strengthens domestic industries and benefits the country as a whole."

Looking ahead, Dr. Djitt emphasized the importance of learning from the past, staying grounded in the present, and striving for the future.

"In the past, FIBO led the charge as Thailand's cornerstone for robotics and automation, a role we continue to uphold today. However, our focus has evolved. We no longer build individual robots as we once did. Today, we aim to develop platforms and connectivity. By excelling in these areas, we can deliver even greater support to industry and contribute to the nation's advancement."



# I-ChEPS :

## Transforming Workforce Development in Thailand's Petrochemical Industry

Project Leader	Asst. Prof. Dr. Jindarat Pimsamarn
Affiliation	Department of Chemical Engineering, Faculty of Engineering
Impact Value	Achieved 638 million THB in annual cost savings from implemented projects (2012-2024)
Collaborator(s)	IRPC Public Company Limited

In a world where learning transcends the confines of classrooms and traditional educational institutions, King Mongkut's University of Technology Thonburi (KMUTT) has broadened its mission. Moving beyond merely producing graduates for the general labor market, KMUTT now emphasizes promoting lifelong learning to unlock the potential of individuals across all groups and ages.

A pivotal initiative in this endeavor is the university's effort to transfer its knowledge to enhance workforce skills, particularly in complex industries that demand specialized expertise. This commitment materialized in a project aimed at developing an integrated chemical engineering learning process for production staff at IRPC Public Company Limited, known as the IRPC Chemical Engineering Practice School (I-ChEPS). The objective is to elevate the knowledge and skills of factory operations staff, enabling them to perform professionally, boost productivity, and drive the petrochemical industry and Thailand's economy toward sustainable growth.



### Impact Assessment

Achieved  
**638** million THB  
 in annual cost savings from implemented projects  
 (Cohorts 1-12)

Implemented  
**117** projects  
 out of 546 projects

Engaged a total of  
**238** learners  
 Cohorts 1-12

## The Inception of a Groundbreaking Educational Journey

The I-ChEPS project is an evolution of the established **Chemical Engineering Practice School (ChEPS)** at KMUTT, initially designed for master's degree students. ChEPS was inspired by the Practice School concept from the Massachusetts Institute of Technology (MIT), which emphasizes learning through hands-on experience ( constructionism-based learning). This approach allows learners to build their knowledge by solving real-world problems.

The project received strong backing from **Assoc. Prof. Dr. Harit Sutabutr**, then president of KMUTT, and **Mr. Paron Israsena Na Ayuthaya**, an advisor and former KMUTT Council president. Both MIT alumni, they recognized the value of constructionism in cultivating a learning organization that develops personnel and promotes sustainable organizational growth.

Launched in 1997, ChEPS is a two-year master's program in chemical engineering. A distinguishing feature of the program was its final semester, during which students gained practical experience by addressing real-world challenges at factories, guided by professors on-site. The success of ChEPS was soon apparent, as its graduates, equipped with practical skills and job readiness, became highly sought after by the industry. This success validated the effectiveness of the practice school model and Constructionism-based learning as a beneficial educational approach. Consequently, the project expanded its focus from graduate students to industrial workers, underpinned by the belief that learning can occur anywhere and that empowering human resources is key to elevating Thailand's global competitiveness.

With steadfast support from its leadership, KMUTT embraced a new role in developing learning innovations for the industrial workforce. The university's collaboration with the **Siam Cement Group (SCG)** led to the establishment of the **Constructionism Chemical Engineering Practice School (C-ChEPS)** in 2000. This initiative, which operated until 2020, promoted lifelong learning for employees with vocational qualifications in the petrochemical sector at the Map Ta Phut Industrial Estate in Rayong and SCG's paper and packaging business in Ratchaburi. Following this, in 2007, KMUTT partnered with **PTT Global Chemical Public Company Limited**, Petroleum Institute of Thailand (PTIT) and Suksapattana Foundation to launch the **Productivity Improvement and Innovative Creation Training by Learning Concept of Chemical Engineering Practice School (PI-ChEPS)** Program.

## Bridging Industry and Academia for Workforce Excellence

The success of the ChEPS and PI-ChEPS projects caught the attention of the management at IRPC Public Company Limited, leading to a partnership with KMUTT in 2011 to develop the **IRPC Chemical Engineering Practice School (I-ChEPS)** for IRPC’s production line operators. The first cohort commenced in 2012.

Mr. Lersak Thongruang, Senior Executive Vice President of Operations at IRPC, explained that the company’s focus on workforce development arose from a desire to enhance the potential of factory employees, most of whom held vocational qualifications, in preparation for career advancement.

At IRPC, factory workers operate in shifts under the supervision of a shift supervisor, a role originally intended for those with a bachelor’s degree. However, as the company expanded, hiring bachelor’s degree holders became costly. Additionally, experienced factory workers began seeking opportunities for advancement. This prompted the company to explore solutions that addressed both the need for cost reduction and career progression.

“Our assignment was to reduce company costs while simultaneously facilitating employee career advancement. The company decided to allow vocationally qualified employees with potential, sufficient experience, and strong performance to be promoted to shift supervisors,” Mr. Lersak noted.

“However, this new policy revealed a challenge: vocationally qualified employees often lacked formal academic knowledge, relying instead on skills passed down from senior colleagues. While they could perform tasks, their limited academic foundation created a knowledge gap the company sought to bridge.”

To address this, IRPC aimed to enable production employees to advance to shift supervisor roles with the necessary knowledge. Mr. Lersak highlighted that KMUTT was chosen as a partner due to its well-prepared personnel and systematic management, which perfectly aligned with IRPC’s needs.

**Mr. Lersak Thongruang,**  
Senior Executive Vice President  
of Operations at IRPC



## A Unique Learning Model

Asst. Prof. Dr. Jindarat Pimsamarn, Project Leader of I-ChEPS, described the program's 10 month curriculum, which integrates classroom learning with practical work experience. The curriculum is structured into six phases, beginning with **Fundamental Science and Engineering**, and progressing to more complex subjects. The second phase covers **Mass and Energy Balances**, followed by **Fluid Transfer** in the third phase, **Heat Transfer** in the fourth, and **Unit Operation**, including safety in chemical plant, in the fifth phase. Each phase combines lectures with group projects, where learners address real workplace challenges in consultation with their supervisors, ensuring the immediate application of solutions. The fifth phase culminates in a group presentation to develop communication skills, while the sixth phase involves an **Individual Project**, concluding with an individual presentation as a graduation requirement.

"Presentation and communication are skills we emphasize greatly. Even if someone is highly skilled or knowledgeable, the inability to communicate their ideas can cause issues. Communication also serves as a tool to validate their actions. Therefore, our program highlights presentation days as major events, attended by factory employees, shift supervisors, and executives, which has always received strong support."

"Our approach, which has proven successful, is learn-do-solve-present cycle. This iterative process reinforces learning, as single experience can be easily forgotten. Upon graduation, the company must continue to challenge employees with new tasks to sustain their growth."

Another key element of the program is the facilitator, a KMUTT master's graduate in chemical engineering, who supports learners throughout the course. Each facilitator mentors no more than five learners and is stationed at the factory, coordinating with the teaching staff to ensure alignment with the curriculum and industry goals.

Professors also visit the factory periodically to monitor progress, ensuring that learner projects are on track and that learning outcomes meet industry objectives.

"The facilitator's role is to assist when learners need guidance, helping them understand not only what to do but why it should be done. This mentorship is, therefore, vital to the project's success," Asst. Prof. Dr. Jindarat noted.

Additionally, a team-building activity held at a temple during the program's initial stage helps break down barriers among learners from different departments, fostering a collaborative learning environment and setting the stage for their shared journey as peers.



## Transformative Impact

"From 2012 to 2024, the I-ChEPS program has successfully run 12 cohorts with a total of 238 participants, delivering profound and far-reaching impacts.

Mr. Lersak Thongruang, Senior Executive Vice President of Operations at IRPC Public Company Limited, highlighted the program's success in equipping employees with the knowledge and skills necessary for promotion to shift supervisors without significantly raising costs. Additionally, the program has yielded economic and financial benefits, as employees' newly acquired knowledge and projects implemented during the course have led to energy savings, reduced production costs, and more efficient factory operations.

Program participation serves as a criterion for shift supervisor promotion, providing employees with a clear career path.

"Over 12 years, it's clear that program graduates possess the knowledge and ability to manage operations smoothly and safely. The projects they work on address real workplace issues, and the solutions can be immediately implemented, yielding substantial cost savings for the company."

Asst. Prof. Dr. Jindarat noted that I-ChEPS has saved the company more than 2 billion THB over its 12-year span, with annual savings of approximately 600 million THB.

Beyond cost reduction, the program has significantly transformed the lives, mindsets, potential, and value of its participants.

"We elevate the capabilities of production employees who, while experienced, often lack a deep understanding of the underlying theories. Helping them grasp these principles unlocks their potential, enabling better communication with engineers and easing their work. Several managers have shared with us that they feel like they've gained new team members who are eager to experiment and learn when facing new challenges. This shift in mindset is key, unlocking not just knowledge and skills, but a whole new approach to their work."

## Voices of Transformation: Stakeholder Perspectives

Testimonials from participants and stakeholders underscore the transformative impact of the I-ChEPS program:

"This program has broadened my perspective. I used to think in one direction, but now I approach problems more systematically. The theoretical knowledge provided by the instructors is excellent and directly applicable to my work in the factory."

**Mr. Teerawee Watanasit**  
Participant, Cohort 12

"With 25 years of frontline operations experience, I felt a need for fundamental knowledge in engineering and chemistry to enhance my work. After completing this program, I feel transformed in nearly every aspect. The program not only taught me engineering but also helped me improve in various areas - more confidence in presentations and better English skills. I also developed essential skills such as teamwork and effective communication with colleagues."

**Mr. Phutarase Netanong**  
Lead Team Operator, Oil Refinery 2,  
Participant, Cohort 12



"Several of my subordinates have attended I-ChEPS, and I have observed significant improvements in their approach and thought processes. Their communication has become clearer, more concise, and well-organized, allowing them to train others effectively. The additional knowledge in petrochemicals, combined with their expertise in engines, mechanics, and electronics, has greatly enhanced their performance."

**Mr. Chakarin Chana**  
Senior Manager, IRPC

"I feel that I have become a better instructor. Although I hold a PhD, my knowledge was largely theoretical, derived from textbooks, and I had never worked in a factory. I realized that about 80% of what I encountered in the factory through I-ChEPS was new to me. I always encourage learners not to be afraid and to learn alongside me. Sometimes, I even learn from them and use their cases in my classes. Working with the industry has helped me truly understand concepts I previously thought I had mastered. Now, when I teach, I can visualize the practical applications clearly, and I feel that this has significantly improved my teaching."

**Asst. Prof. Dr. Jindarat Pimsamarn**  
Project Leader, I-ChEPS

"As a facilitator in the I-ChEPS program for seven and a half years, I have gained extensive knowledge in chemical engineering by teaching daily and learning alongside the learners about factory processes that extend beyond theory. This experience has also helped me develop my teaching skills. After the instructor concludes their lectures, I step in as a teaching assistant, guiding the learners through the material. Another benefit of this role is learning to manage diverse types of learners, which has significantly enhanced my problem-solving abilities. I have developed both interpersonal and technical skills. Initially, I was not a strong communicator, but since joining the program, I feel my thinking is more organized, and I now speak with greater clarity."

**Mr. Arthit Dubey**  
Facilitator, I-ChEPS Program

## A Blueprint for Future Workforce Development

The I-ChEPS program exemplifies how academia-industry collaboration can drive sustainable growth and innovation through strategic workforce development.

Assoc. Prof. Dr. Sakarindr Bhumiratana, Advisor and former President of KMUTT, highlighted the program's success as stemming from its constructionism-based learning approach and the robust partnership between academia and industry. Both parties actively engage in consultation, planning, and resource sharing, fostering a synergistic relationship.

"KMUTT values this initiative, extending beyond the university to engage with the industrial sector. The industry partner also recognizes the benefits of this learning approach. With mutual faith in constructionism learning, both parties collaborated, resulting in continuous development and improvement—key to the program's success."

As Thailand transitions to a knowledge-based economy, I-ChEPS represents more than a training course—it is a pivotal development in industrial workforce enhancement. The program has significantly impacted participating organizations and elevated the potential of the Thai workforce. The constructionism concept underscores the value of learning through hands-on experience and showcases the vital role universities can play in driving economic and societal advancement.

# “Mitr Phol Modern Farm” and Logistics Revolution: Shaping the Future of Thailand’s Sugarcane Industry

Project Leader	Asst. Prof. Dr. Pongchai Athikomrattanakul
Affiliation	Logistics and Supply Chain Management, Graduate School of Management and Innovation (GMI)
Laboratory	Center for Logistics Excellence (LOGEX)
Impact Value	1.3 billion THB (2024)
Collaborator(s)	Mitr Phol Sugar Corporation Limited, Sugarcane farmers

When people hear "Mitr Phol," they often think of the sugar brand that has been a staple in Thailand for decades. Since its first sugar mill opened in 1956, Mitr Phol Group has grown to become a leader in the sugarcane and sugar industry. Today, it ranks as the largest sugar producer in Thailand and the fourth largest in the world. Beyond being a major revenue contributor to the economy, the company plays a crucial role in supporting the livelihoods of sugarcane farmers in Thailand.

The path to this success was not without challenges. Mitr Phol faced significant hurdles, particularly in the costly and time-intensive processes of harvesting and transporting sugarcane to factories, which frequently led to losses. These challenges highlighted the need for a more efficient logistics system.

To address these issues, Mitr Phol Group partnered with King Mongkut's University of Technology Thonburi (KMUTT) to enhance the efficiency of the logistics system for transporting sugarcane to factories, ensuring production balance, minimizing losses, and preserving the quality of sugarcane.

**Mr. Paitoon Praphatharo**, Senior Executive Vice President, Sugarcane Management at Mitr Phol Sugar Corp., Ltd., cited two primary reasons for selecting KMUTT. First, the longstanding strategic partnership between the two entities, marked by numerous joint projects, provided a solid foundation for collaboration. Second, KMUTT is renowned for its expertise in engineering, particularly industrial engineering, which applies machinery management, technology management, and data processing to enhance operational efficiency and minimize loss time.

"KMUTT's exceptional knowledge in this field aligns perfectly with Mitr Phol's vision to develop a Just-In-Time logistics process for sugarcane, ensuring swift and timely transportation and delivery."

After reaching an agreement, a research team from KMUTT commenced field studies and data collection in Phu Khiao district, Chaiyaphum province, in 2014.

## Transforming Sugarcane Harvesting: The Shift from Manual to Mechanical

Before the collaboration with KMUTT, Mitr Phol Group relied on traditional methods for harvesting and transporting sugarcane. Workers manually cut the cane into long stalks, which were then stacked on the ground before being loaded by grabber trucks for transport to the sugar mill.

Mr. Paitoon explained that sugarcane is a seasonal crop. After each harvest, new shoots sprout from the stumps and can be re-harvested for the next two to three years. It takes approximately 12 months for sugarcane to reach its peak sweetness, making December to March or April the prime harvesting window.

A critical challenge during this period is the race against time. Farmers often rush to harvest their cane, anxious they will not complete the process before the season ends. This urgency results in a surge of cane deliveries to mills, which have limited crushing capacity. Consequently, excess cane piles up outside the mills, leading to losses due to microbial reactions that diminish sugar content.

"If we can streamline the logistics process from harvesting to milling, minimizing the time delivering sugarcane to the mills, matching the volume to the mill's capacity, it benefits everyone. Farmers won't face weight losses from cane left outside, cane quality remains high, and mills can maintain consistent cane supply, yielding more sugar per ton," Mr. Paitoon noted.

Around the same time, Mitr Phol began its shift towards mechanization under the "Mitr Phol Modern Farm" initiative. They introduced sugarcane harvesters to replace manual labor and installed a new sugarcane crusher tailored for mechanically harvested cane, starting at the Mitr Phu Khiao mill.

The adoption of mechanical harvesters marked a significant turning point. Unlike manual harvesting, which yields long stalks, mechanical harvesters run through the plantation and cut the cane into shorter pieces, around 12-15 centimeters long. These shorter stalks are immediately transported to the mill, eliminating the need for piling cane on the ground and reducing the risk of soil contamination.

"In the early days, we had only a few harvesters. To synchronize the cane intake with the mill's capacity for mechanically harvested cane, we needed a logistics system to track harvesters and delivery trucks in real-time. This system allowed us to manage the workflow efficiently. For instance, if fewer trucks were at the mill but more were expected shortly, we knew we had enough cane for processing. If a harvester broke down, we could quickly arrange repairs, or if a driver took an extended break, we could prompt them back to work. This approach ensured the smooth operation of machinery, consistent cane supply, and overall system efficiency," Mr. Paitoon elaborated.

**Mr. Paitoon Praphatharo**  
Senior Executive Vice President, Sugarcane Management  
Mitr Phol Sugar Corp., Ltd.



## Innovating Logistics: Transforming Sugarcane Harvesting and Transport

Asst. Prof. Dr. Pongchai Athikomrattanakul, Director of the Center for Logistics Excellence at KMUTT and project leader, highlighted that the KMUTT research team embarked on their work with Mitr Phol's vision to transform modern agriculture into a smart farming system. This system aimed to integrate mechanization across the entire process, from cultivation to production. Central to the transformation in harvesting was the sugarcane harvester, which Mitr Phol plans to adopt in place of manual labor over the long term. The use of harvesters facilitates systematic management of harvesting and transportation while addressing labor shortages. Manual cutting presents numerous challenges, including exposure to dust, sunlight, and the risk of injuries from sharp sugarcane leaves.

"During our field visits, we observed that Mitr Phol had invested in factory upgrades, including a new sugarcane crusher designed specifically for mechanically harvested cane. This demonstrates their comprehensive approach within the factory. However, they are concerned that without an efficient logistics system, operational issues could arise. Once the sugarcane is cut, without a proper system or technology in place for management, problems are inevitable."

With a clear directive from Mitr Phol, the research team conducted an in-depth analysis of data and the transportation process to design an optimized logistics system. This system focuses on the efficient movement, storage, collection, and distribution of harvested sugarcane from the fields to the mills. The process includes transporting sugarcane to the mills, managing the queue at the mills, loading the sugarcane into the sugarcane crusher, and optimizing truck utilization.

The research team spent a year designing and testing the logistics system, starting at the Mitr Phu Khiao sugar mill in Chaiyaphum. They then expanded the system to other mills, including Mitr Phu Luang in Loei, Mitr Phu Wiang in Khon Kaen, Mitr Kalasin in Kalasin, and Mitr Phol Dan Chang in Suphan Buri.

Launched in 2014, the project's key achievement is the development of a modern farm system, alongside the introduction of agricultural logistics. This marks one of Thailand's pioneering initiatives, with the university partnering with a major industry group like Mitr Phol.

KMUTT integrated supply chain and logistics management technology with modern farming principles to enhance Mitr Phol's operations, overseeing the entire process from cutting to crushing. The project includes the design and development of four key components: (1) **Technology Equipment:** GPS technology is installed on sugarcane harvesters and transport vehicles, enabling real-time tracking of their locations and operational status; (2) **Network:** This

component links the data from the harvesters and transport vehicles to the application software; (3) **Application Software:** The core of the project, designed with modern logistics information system principles, facilitates efficient management of logistics processes from plantations to factories; and (4) **Monitoring:** A control room was developed for monitoring, allowing staff to quickly and easily track the status of cutting, transportation, and sugarcane quantities.

"This project is interdisciplinary, requiring expertise in three key areas: engineering, technology, and supply chain and logistics management," Asst. Prof. Dr. Pongchai noted.



## From Logistics Innovation to Integrated Transformation

The developed system has significantly improved Mitr Phol's logistics management, reducing operational time, enhancing the freshness and cleanliness of the sugarcane, and increasing farmers' earnings by 15-20 THB per ton due to higher sugar content. Drivers have benefited from higher income as they can complete more transport rounds, while harvester owners are maximizing the utilization of their machines, which has led to a steady increase in the number of harvesters in operation. As a result, Mitr Phol has seen an average increase of 10 kilograms of sugar per ton of sugarcane. The collective benefits for all stakeholders have created strong momentum, driving substantial improvements in the overall management of mechanical sugarcane harvesting.

Discussing the impact on Mitr Phol, Mr. Paitoon highlighted the sugarcane logistics system as a key driver of tangible and integrated transformation.

"We can efficiently monitor and track the entire process, from cane harvesting in the fields to transportation, all the way to the factory. By analyzing the time taken at each stage, we manage to reduce the 'cut to crush' time—the interval between cutting and milling. Previously, manually cut sugarcane took over 30 hours, but with mechanized harvesting and a dedicated crushing machine, we've reduced this time to just 6-8 hours. Time is critical in the sugarcane industry, as maintaining the sucrose content in the cane is essential. The faster we get the cane to the factory, the more sugar we can extract. A logistics system that ensures a consistent sugarcane supply to the mill can significantly boost sugar production."

The freshness and cleanliness of the sugarcane have led to higher sugar yields from the new cane crusher designed specifically for mechanically harvested cane, outperforming the traditional crusher by more than 10 kilograms of sugar per ton of sugarcane. This means that Mitr Phol has increased sugar production while maintaining the same volume of sugarcane. Under the 70/30 revenue-sharing model, the additional income from the higher sugar yield is distributed, with 70 percent going to the farmers and 30 percent to the factory.

Moreover, the logistics system enables the tracking of sugarcane harvested from each plot, revealing yield per unit area. Low-yield plot can be quickly identified, allowing for targeted interventions to improve outcomes.

"Improving yield boosts the income of sugarcane farmers. When farmers achieve higher yields and better earnings, they are less likely to switch to other occupations. This, in turn, contributes to the sustainability of the industry."

### Impact Assessment

**1.3** billion THB

**6** million tons  
of mechanically harvested  
sugarcane per year

**630,000** rai  
(100,800 hectares)  
of sugarcane plantation

**11,000**  
sugarcane farmers

## Adapting to Change: Voices of Sugarcane Farmers

**Mr. Kittipong Jaranane**, known as Arm, is a sugarcane farmer from Nong Sano subdistrict in Lao Khwan district, Kanchanaburi province. He manages a plantation spanning 500-600 rai (80-96 hectares) and has transitioned from manual to mechanical harvesting. Arm and his father have been contract farmers for the Mitr Phol Dan Chang sugar mill for over 30 years, since the factory's inception.

Arm explained that the primary reason for investing in a sugarcane harvester was the labor shortage.

"Labor is becoming increasingly scarce. I often had to bring workers from the Northeast, but even after paying in advance, the number of workers frequently fell short, causing annual losses. About 13-14 years ago, my father and I decided to invest in a sugarcane harvester. After switching to mechanical harvesting, the most noticeable improvement was speed. We were able to harvest quickly and, with effective management, deliver the sugarcane to the factory on time. Using a harvester also meant we could deliver fresh cane instead of burned cane from manual harvesting. Additionally, we could recover cane leaves to cover the soil, retaining moisture and adding organic matter."

However, the transition was not without challenges. Arm shared that moving from manual to mechanical harvesting took considerable time. Traditionally, sugarcane was planted with a 1-meter row spacing, which created issues with mechanical harvesters, as the narrow rows damaged the stumps. This necessitated reconfiguring the planting rows. Many farmers still prefer manual harvesting because it allows plants to last longer, reducing replanting costs.

"For me, buying a harvester wasn't a decision made overnight. I had to prepare my field for about two years, gradually changing the row spacing from 1 meter to 1.60 meters," Arm explained.

Another factor to consider is the high cost of a sugarcane harvester, around 12 million THB, which raises questions about its value. However, for Arm, when considering all factors—reduced labor costs, shorter transportation time, and increased income from selling fresh sugarcane—the benefits outweigh the costs. Furthermore, he can earn additional income by providing harvesting services, charging 220 THB per ton.

## Key Drivers Behind the Success

Mitr Phol Group operates eight sugar mills across Thailand, collaborating with over 36,000 contract farmers and managing a total of 1.8 million rai (288,000 hectares) of sugarcane plantations. Mechanically harvested cane now accounts for 35% of the total delivered to the mills, sourced from more than 11,500 contract farmers, supported by over 500 harvesters and 4,800 delivery trucks.

In discussing the success factors behind their sugarcane logistics system, Mr. Paitoon highlighted the crucial role of commitment from all project partners, including the Mitr Phol team, the KMUTT research team, and the participating farmers.

"If we have good software and systems, but people implement them inconsistently, we won't obtain the necessary data. Therefore, I believe the commitment of all involved individuals is the most critical factor. The second factor is the easy-to-use system and software developed by the KMUTT research team, which facilitated adoption. The third factor is the increased sugar yield, which benefits everyone—farmers, sugar mills, and harvester operators. A win for everyone makes this project a success."

The logistics innovation, a result of the collaboration between KMUTT and Mitr Phol Group, has made a positive impact on both the organization and the community. It has not only addressed business challenges but also paved the way for the Thai agricultural industry to achieve sustainability and growth. The ever-evolving sugarcane and sugar industry has introduced new challenges that Mitr Phol must adapt to, including digital disruption, climate change, increasing competition, PM2.5 pollution, and the implementation of the Personal Data Protection Act. Continuous improvement in operation and management system to stay aligned with future demands remains essential. The partnership between Mitr Phol and KMUTT stands as a model for creating shared benefits for a sustainable future.