



# Engineering Research and Innovation

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FACULTY OF ENGINEERING  
PRINCE OF SONGKLA UNIVERSITY (PSU)  
THAILAND

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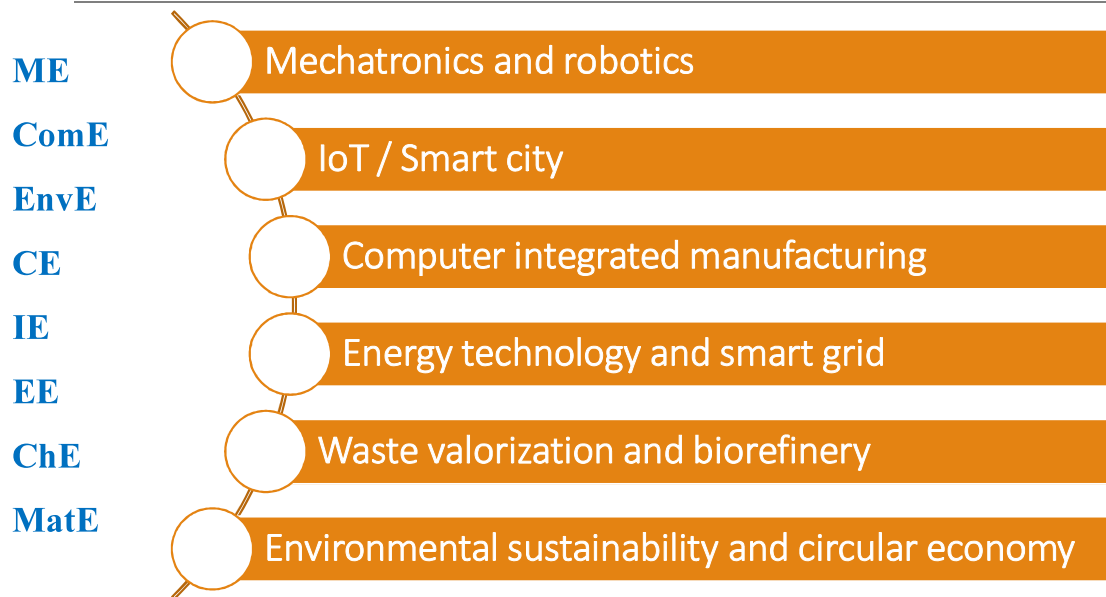
## Major Research Areas

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1. Rubber engineering
  2. Biodiesel /Oleochemicals
  3. Logistics and supply chain
  4. IoT / Smart city
  5. Computer integrated manufacturing
  6. Advanced materials
  7. Mechatronics and robotics
  8. Coastal erosion control restoration
  9. Hydropower and wind
  10. Environmental sustainability and circular economy
  11. Energy technology
  12. Waste valorization and biorefinery
-

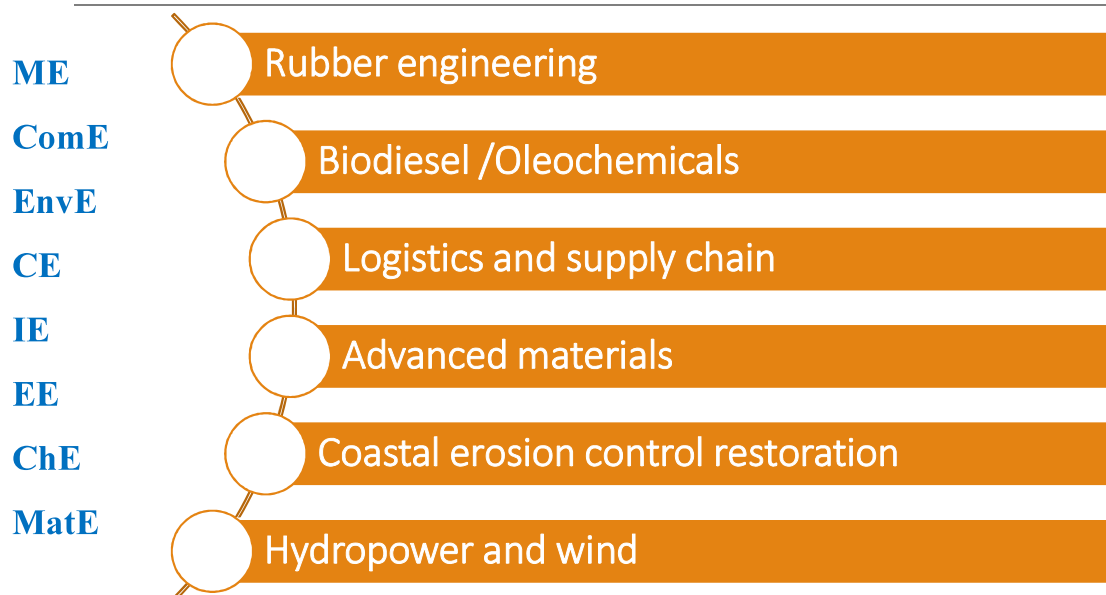
# Major Research Areas I

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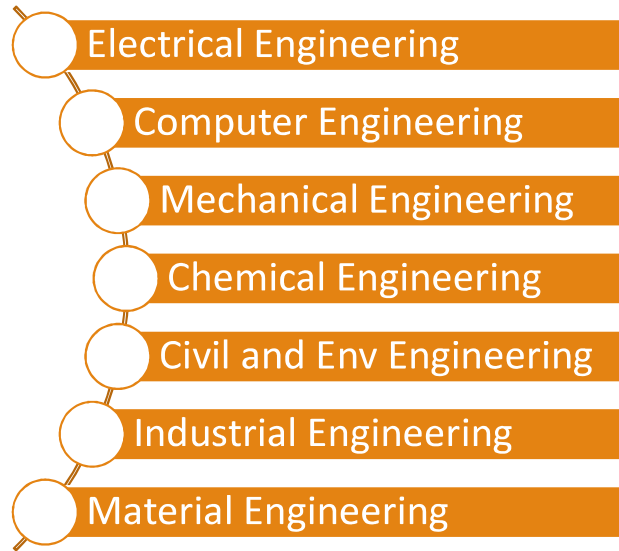
# Major Research Areas II

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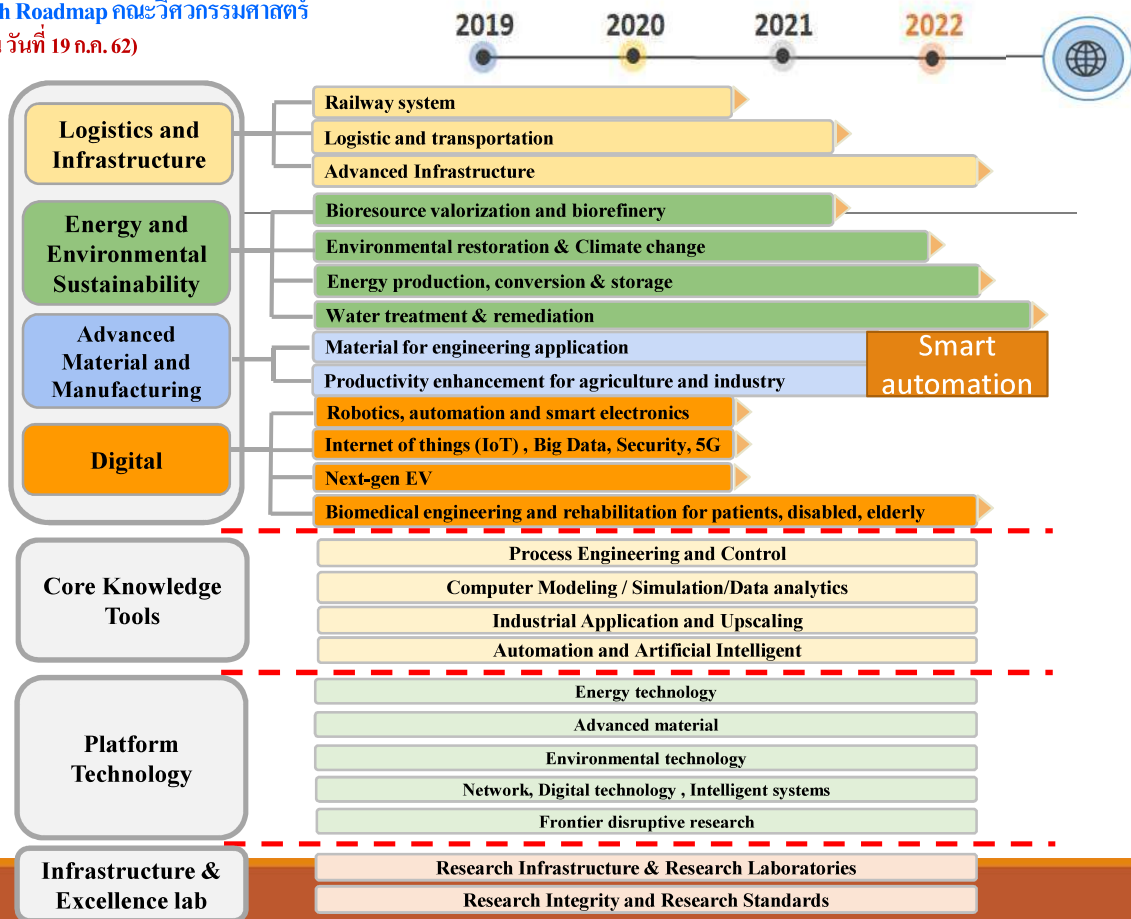
# Faculty of Engineering

- ✓ 1 Faculty
- ✓ 7 Departments
- ✓ 145 faculties
- ✓ 3 Research Centers
- ✓ 3 Research Teams



- Technology disruption
- National agenda
- Interdisciplinary Research
- Industries

Research Roadmap คณะวิศวกรรมศาสตร์  
(ข้อมูล ณ วันที่ 19 ก.ค. 62)



# Rubber Engineering

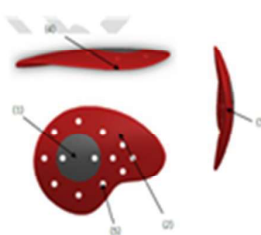
## NR-Hip Protector



## NR-Heel Protector

### Heel Soother

ยางรองส้นเท้า เพื่อสุขภาพของกระดูกสันหลัง และ ส้นเท้า  
ด้วยคุณสมบัติพิเศษ



## Parawood Horizontal Bandsaw

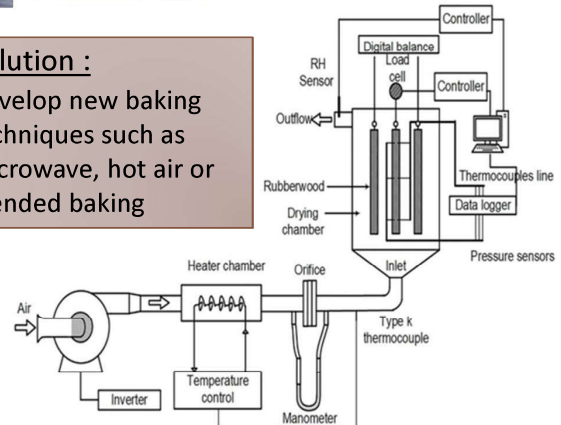


## Parawood Baking Technology



**Problem :**  
Waste wood after baking

**Solution :**  
Develop new baking techniques such as microwave, hot air or blended baking



Assoc.Prof.Dr.Wiriya Thongruang,  
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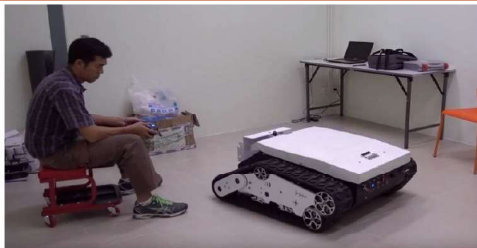
Assoc. Prof. Dr. Thanate Ratanawilai,  
Department of Industrial Engineering,  
E-mail : thanate.r@psu.ac.th

# Mechatronics & Robotics

## Beach Cleaning Robot



## Large Payload Track Robot



- Outdoor terrain
- Water repulse and dust proof
- 100kg payload

## Domestic Service Robot

Rank 3<sup>rd</sup>, RoboCup Japan Open 2014 Fukuoka, Japan  
 Rank 11<sup>th</sup>, World RoboCup 2013 Eindhoven, Netherlands  
 Rank 11<sup>th</sup>, World RoboCup 2012 Mexico City, Mexico



YouTube

<https://www.youtube.com/watch?v=xL68jx0MIYs>

- Laser Scan Mapping
- Face & object recognition
- Human tracking
- Voice command & response

- Flexible gripper



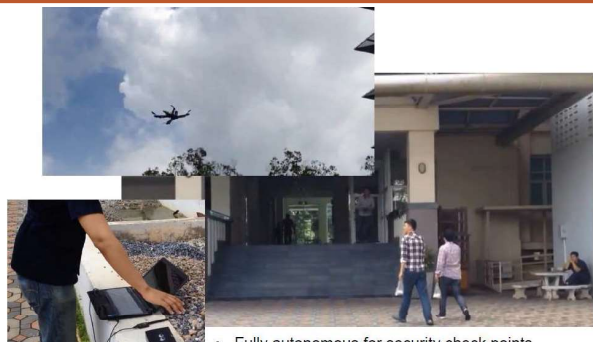
Assoc.Prof.Dr.Pruittikorn Smithmaitrie, Department of Mechanical Engineering,  
 E-mail : spruitti@me.psu.ac.th

## Obstacle Avoidance Drone at Night



- Obstacle avoidance capability both day and night
- Avoid both moving and static objects

## Alarm activating drone: auto take-off, go target, and return



- Fully autonomous for security check points

## Autopilot on Helicopter platform



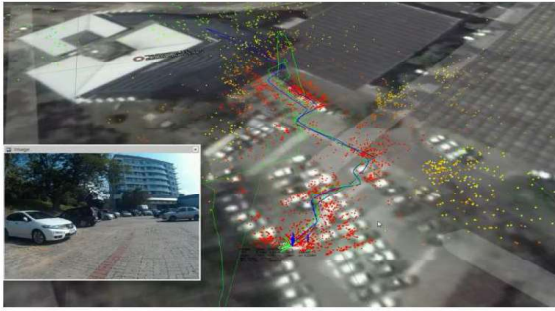
- Gasoline engine helicopter platform
- Larger payload and longer flight time
- Autonomous functions such as altitude hold, position hold, soft landing, waypoint, auto take-off, return, etc.
- 10km Ground-to-Drone communication

## Smart Military



Assoc.Prof.Dr.Pruittikorn Smithmaitrie, Department of Mechanical Engineering,  
 E-mail : spruitti@me.psu.ac.th

## 3D Mapping & Navigation Drone

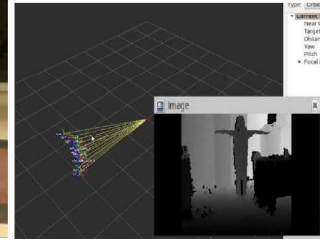


- Real time 3D-mapping by drone
- Self navigation Outdoor-to-Indoor

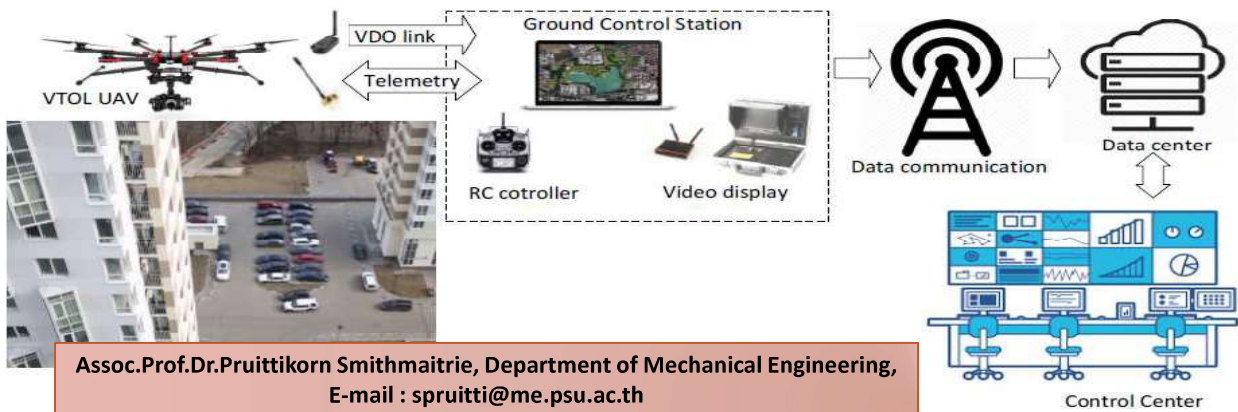
## Human Tracking Mobile Robot



- Autonomous human detection
- Robot tracking human



## Security Drone With IoT Technology



Assoc.Prof.Dr.Pruittikorn Smithmaitrie, Department of Mechanical Engineering,  
E-mail : spruitti@me.psu.ac.th

## Formula Car and EV



15th TSAE Auto Challenge 2019-  
Reward 3<sup>rd</sup> Overall

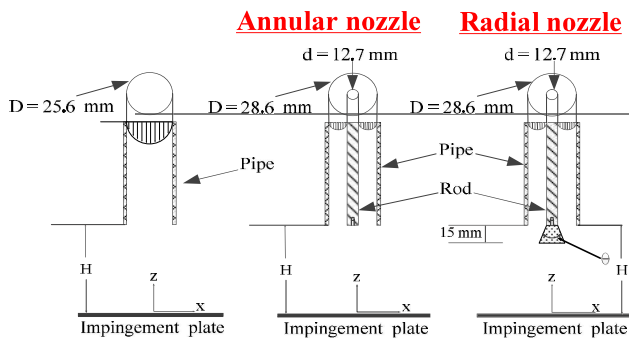
Assoc.Prof.Dr.Charoenyut Dechwayukul,  
Department of Mechanical Engineering,  
E-mail : dechwac@gmail.com

## Oil palm leaflets separator and oil palm leaflets shredder for the diet of ruminant animals



Asst.Prof.Dr.Krit Somnuk,  
Department of Mechanical Engineering,  
E-mail : krit.s@psu.ac.th

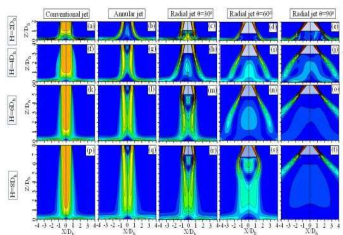
# Impinging Jet using Special Nozzles



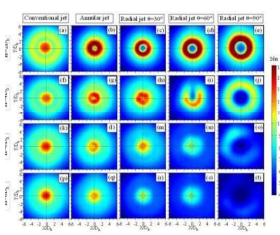
•Development of high efficiency microbubble generator nozzle  
 •Application of microbubble: Aeration, Biogas purification, Coal upgrade



## Flow patterns

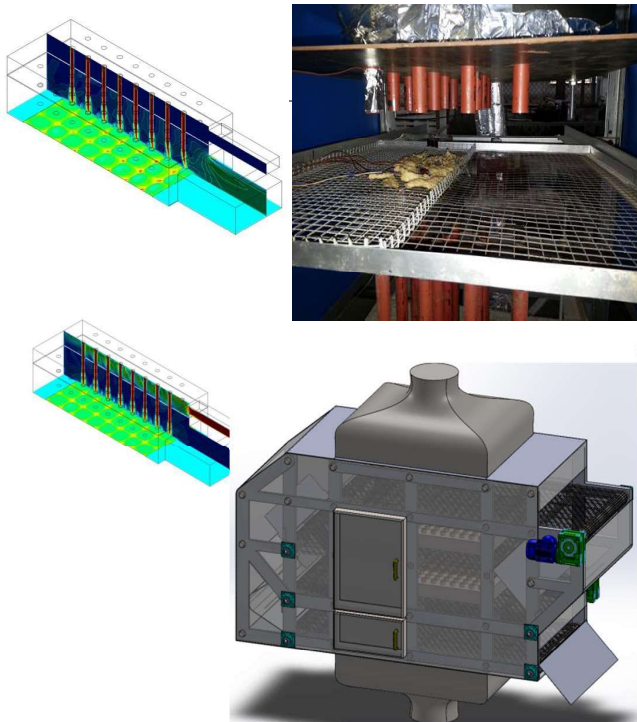


## Nusselt number on impingement surface

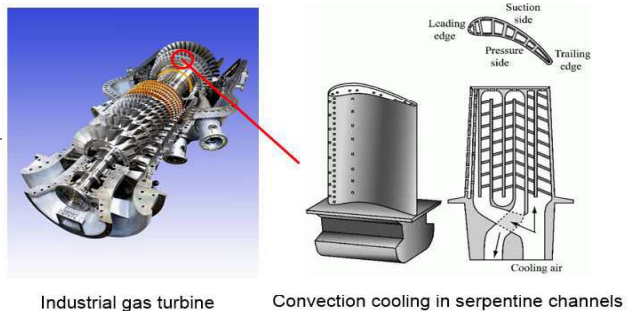


Asst.Prof.Dr.Chayut Nuntadusit, Department of Mechanical Engineering,  
 E-mail : chayut@me.psu.ac.th

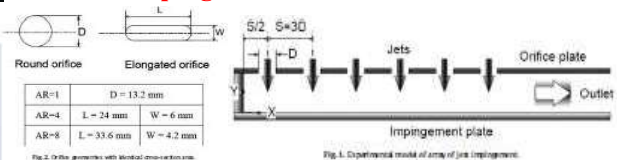
# Jet impingement dryer



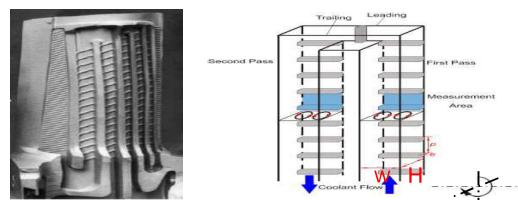
# Heat Transfer and Simulation



## Jet impingement in confined channel



## Rib turbulators in rotating serpentine channel

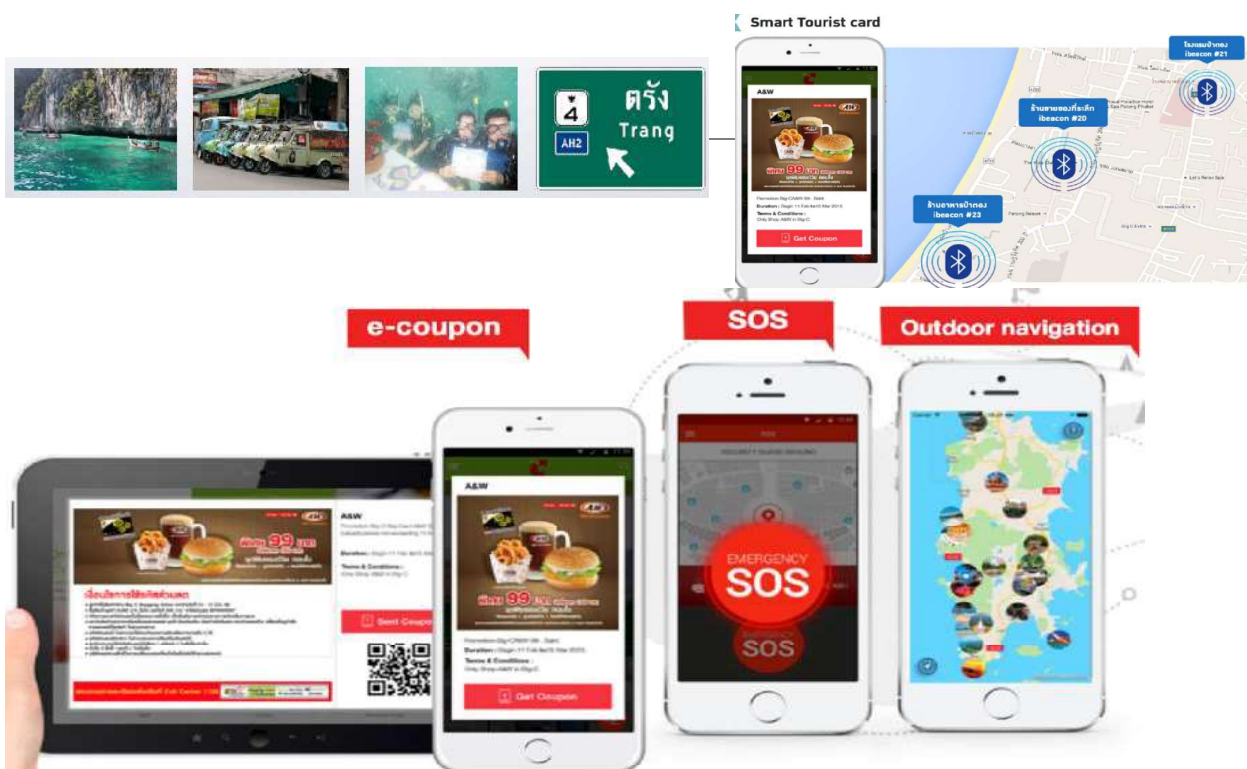


Asst.Prof.Dr.Chayut Nuntadusit, Department of Mechanical Engineering,  
 E-mail : chayut@me.psu.ac.th



# IoT & Smart City

## Smart and Sustainable City





## Phuket Smart City Initiative

### Environmental monitoring device and IOT

**IoT Environment Sensor**

- ก๊าซคาร์บอนมอนอกไซด์ (Carbon Monoxide)
- อุณหภูมิ และความชื้น (Temperature & Relative Humidity)
- ปริมาณออกซิเจนละลายน้ำ (Dissolved Oxygen)
- ปริมาณน้ำฝน (Rain Gauge)
- ระดับน้ำในคลอง / ทะเล (Ultrasonic Distance)

ภาพจุดติดตั้งเซ็นเซอร์ตรวจสอบด้านสิ่งแวดล้อม

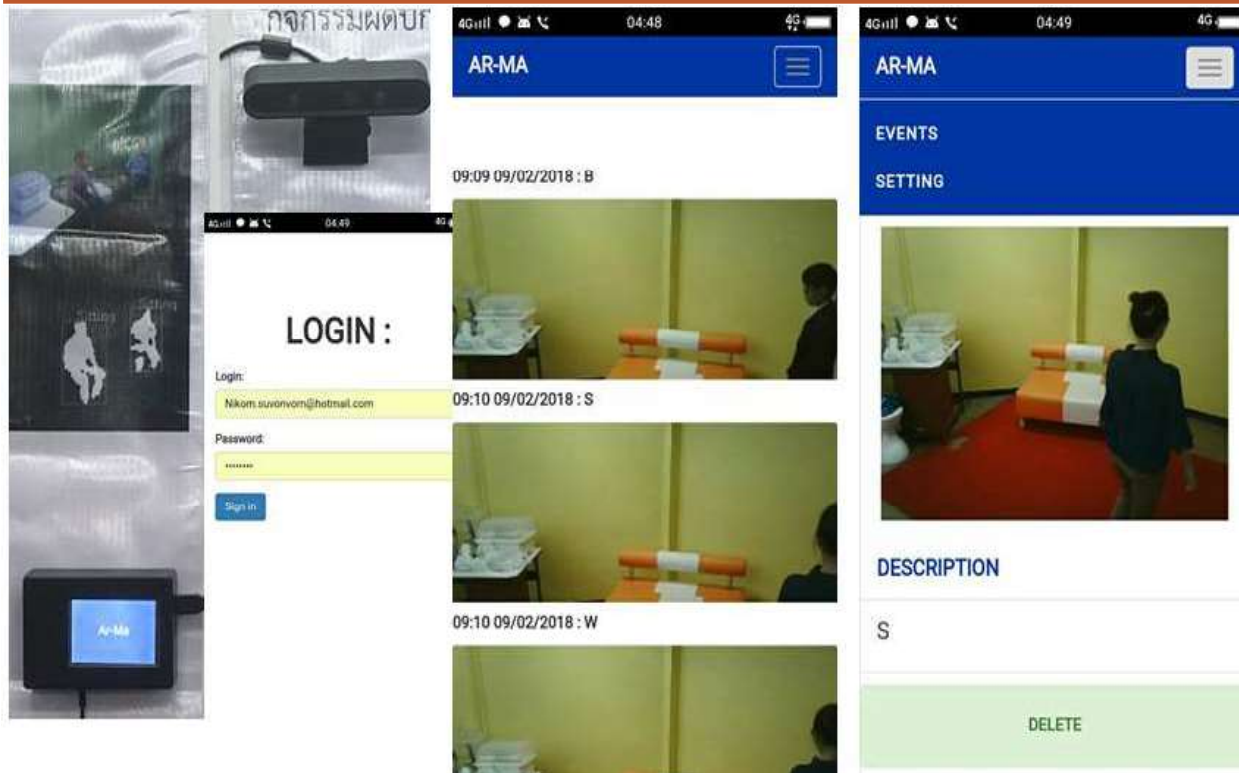
**Asst.Prof.Dr.Wannarat Suntiarnontut, Department of Computer Engineering,  
E-mail : wannarat@fivedots.coe.psu.ac.th**

## Image processing and AI for vehicle tracking

**มอ.เจ๋งเทคค้นระบบ  
ตรวจป้ายรถขงันี่'คาร์บอน'**

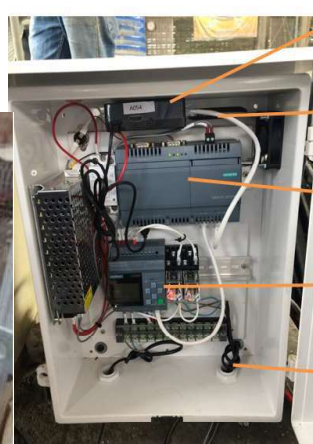
## Distant tracking and well being care for elderly

# Grandma Elderly care system



Asst.Prof.Dr.Nikom Suvonvorn, Department of Computer Engineering,  
E-mail : nikom.suvonvorn@gmail.com

# Machine Monitoring System - MMS



PSU-mms-IoT Module

3G/4G Internet

Data Collector

Sensor Interface Module

สายเชื่อมต่อไปยัง Sensor 3 จุด

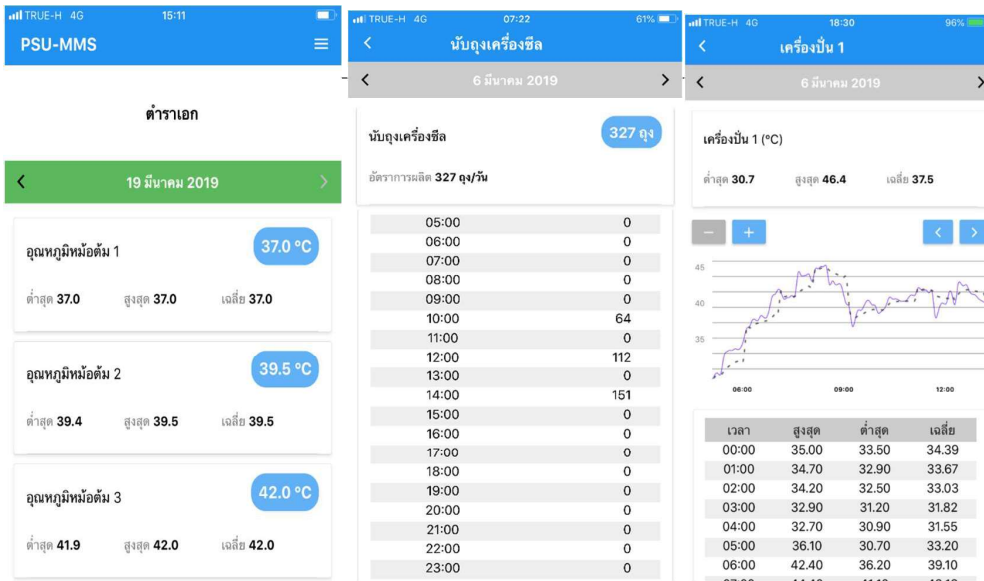
Design and installation of MMS for 104  
SMEs (equipped with 312 sensors)

Manufacturing machine monitoring system  
(MMS) for modernizing local SMEs



Asst.Prof.Dr.Nikom Suvonvorn, Department of Computer Engineering,  
E-mail : nikom.suvonvorn@gmail.com

# MMS Mobile App



Cloud Data Service  
สนับสนุนโดยศูนย์คอมพิวเตอร์

จัดเก็บข้อมูล อัตราการผลิต ขึ้น/  
ชั่วโมงตัวแปรที่มีผลต่อการผลิต  
เช่น อุณหภูมิ ความชื้น ความดัน  
การทำงานของพนักงาน อัตรา  
การใช้พลังงานไฟฟ้า  
จัดเก็บ >1 ล้าน ชุดข้อมูล/  
เซ็นเซอร์/สปี



Asst.Prof.Dr.Nikom Suvonvorn, Department of Computer Engineering,  
E-mail : [nikom.suvonvorn@gmail.com](mailto:nikom.suvonvorn@gmail.com)

## Waste valorization & Biorefinery

# Waste valorization : Biogas production from wastes and lignocellulose

## Biogas Engineering Research Laboratory



Rubber wastewater (X 35)



Cir-Plug Flow Seafood processing plant



Chicken rendering plant



Biogas cleanup



Grass + manure -> Energy + Fertilizer

Assoc.Prof.Dr.Sumate Chaiprapat, Department of Civil Engineering,  
E-mail : sumate.ch@psu.ac.th

### Application of Residual Material as Media in Ammonia Gas Removal by Biofiltration



รูปที่ 7 แสดงลักษณะของปุ๋ยหมักจากของเสียโรงงานยาง



รูปที่ 8 แสดงลักษณะของปุ๋ยคอก



รูปที่ 9 แสดงลักษณะของขี้เถ้า



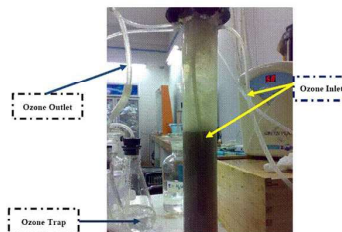
รูปที่ 10 แสดงลักษณะของเส้นใยปอ

### Comparison Colour and COD Removal Efficiency from Palm Oil Mill Effluent (POME) By Ozone, Peroxone and Fenton Process



ตั้งปฏิกริยา B

ตั้งปฏิกริยา C



Ozone Outlet

Ozone Inlet

Ozone Trap

Assoc.Prof.Dr. Thaniya Kaosol, Department of Civil Engineering,  
E-mail : thaniya.k@psu.ac.th

# Hydropower & Wind

## Wind Energy



Low speed wind turbine 10 kW (cut in 2 m/s)



# Hydropower for the community

Power plant building



1<sup>st</sup> Weir



2nd Weir



3rd Weir



4th Weir

Asst.Prof. Payom Rattanamane, Department of Civil Engineering,  
E-mail : [payom.r@psu.ac.th](mailto:payom.r@psu.ac.th)

## Biodiesel & Oleochemicals

## Biodiesel production process from palm fatty acid distillate using static mixer coupled with ultrasound



Biodiesel production using probe-type ultrasound



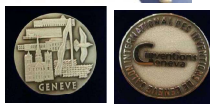
2019

The Honor Award of Research Work Award 2019, National Research Council of Thailand (NRCT)



2018

The Honor Award of Invention 2018, National Research Council of Thailand (NRCT),



2017

Bronze Prize from Korea Invention Promotion Association

Asst.Prof.Dr.Krit Somnuk, Department of Mechanical Engineering,  
E-mail : krit.s@psu.ac.th

## Diesohol fuels blended with palm fatty acid distillate as an emulsifier and a diesel extender



ข้อดี



ประยุกต์ใช้วัตถุดิบในประเทศ ต้นทุนต่ำ เนื่องจากได้จากผลพลอยได้ของอุตสาหกรรมน้ำมันปาล์ม



มีวัตถุดิบจำนวนมากกว่า 100,000 ตัน/ปี



ช่วยปรับปรุงคุณสมบัติการหล่อลื่นและการเผาไหม้ของเครื่องยนต์ดีเซลและใช้งานได้จริง



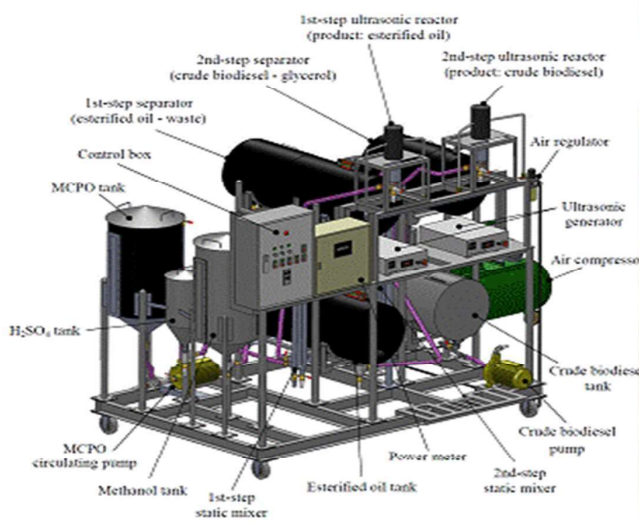
ทดแทนสารอิมัลซิไฟเออร์พาณิชย์ที่มีราคาแพงมากนำเขาจากต่างประเทศและลดต้นทุนการใส่สารเพิ่มซีเทน



Asst.Prof.Dr.Theerayut Leevijit, Department of Mechanical Engineering,  
E-mail : leetheerayut@yahoo.com



# Process intensification for biodiesel production from vegetable and waste oils



Asst.Prof.Dr.Krit Somnuk, Department of Mechanical Engineering,  
E-mail : krit.s@psu.ac.th

## Logistics & supply chain

# Traffic Eng to improve city-to-city transportation



## Infrastructure efficiency and road safety



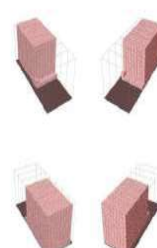
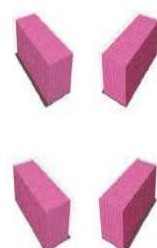
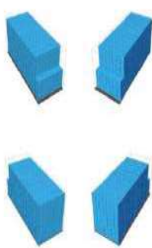
Asst.Prof.Dr.Paramet Luathep, Department of Civil Engineering,  
E-mail : paramet@eng.psu.ac.th

## Work study on container loading for seafood processing plant

Space	Qty	Length	Width	Height	Weight	Cube	Efficiency
Trailer CON_19	106	2.31	2.38	2.38	23655.742	32.662407	86.17%

Space	Qty	Length	Width	Height	Weight	Cube	Efficiency
Trailer CON_20	106	2.31	2.38	2.38	23655.742	32.662407	86.17%

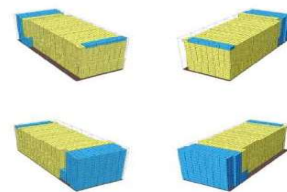
Space	Qty	Length	Width	Height	Weight	Cube	Efficiency
Trailer CON_20	106	2.31	2.38	2.38	23655.742	32.662407	86.17%



รูปที่ 1 ผลการจัดเรียงสินค้าจากโปรแกรม โปรแกรม Load Planner แบบโหลดสินค้าชนิดเดียวกัน  
Pack-6 Pack-12 และ Pack-24 ตามลำดับจากซ้ายไปขวา

Space	Qty	Length	Width	Height	Weight	Cube	Efficiency
Trailer CON_20	2269	5.89	2.33	2.38	23655.742	32.662407	86.26%

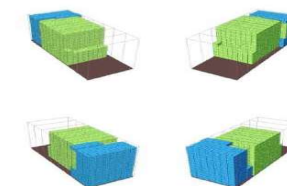
0.346  
0.261  
0.197  
0.25



(ก) ตัวอย่างผลการจัดเรียงสินค้าแบบ Pack-6+Pack-12

Space	Qty	Length	Width	Height	Weight	Cube	Efficiency
Trailer CON_20	841	5.89	2.33	2.38	23655.496	32.662407	59.42%

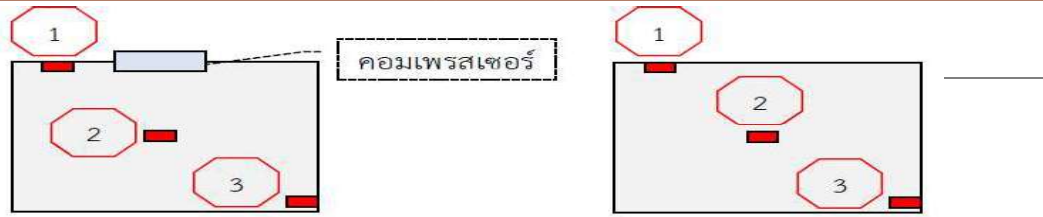
0.346  
0.261  
0.234 / 26.5



(ข) ตัวอย่างผลการจัดเรียงสินค้าแบบ Pack-6+Pack-24

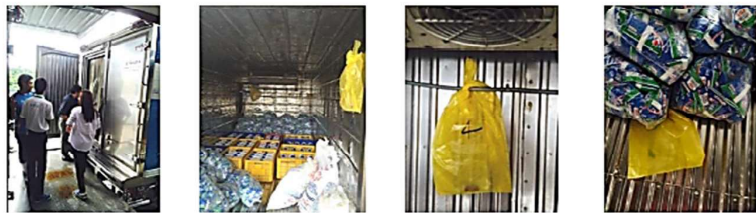
รูปที่ 2 ตัวอย่างผลการจัดเรียงสินค้าแบบผสม  
ระหว่าง Pack-6+Pack-12 และ Pack-6+Pack-24

# Local pasteurized milk industry case study of logistic control



รูปที่ 1 ตำแหน่งการติดตั้ง Data Logger รถที่มีคอมเพรสเซอร์ (ซ้าย)  
และรถที่ไม่มีคอมเพรสเซอร์ (ขวา)

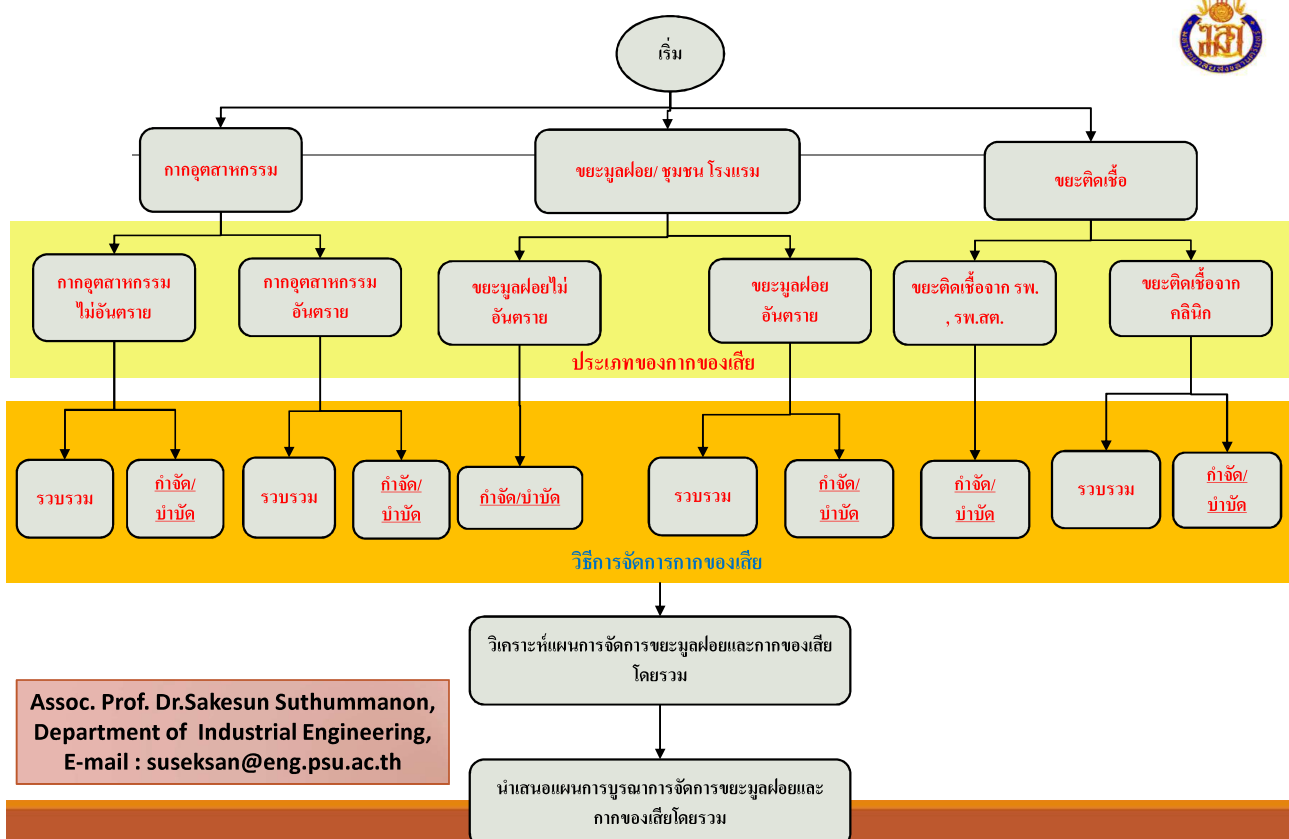
หมายเหตุ: หมายเลข 1 ตำแหน่งผนังรถด้านหน้า  
หมายเลข 2 ตำแหน่งตรงกลางรถ  
หมายเลข 3 ตำแหน่งประตูรถด้านหลัง

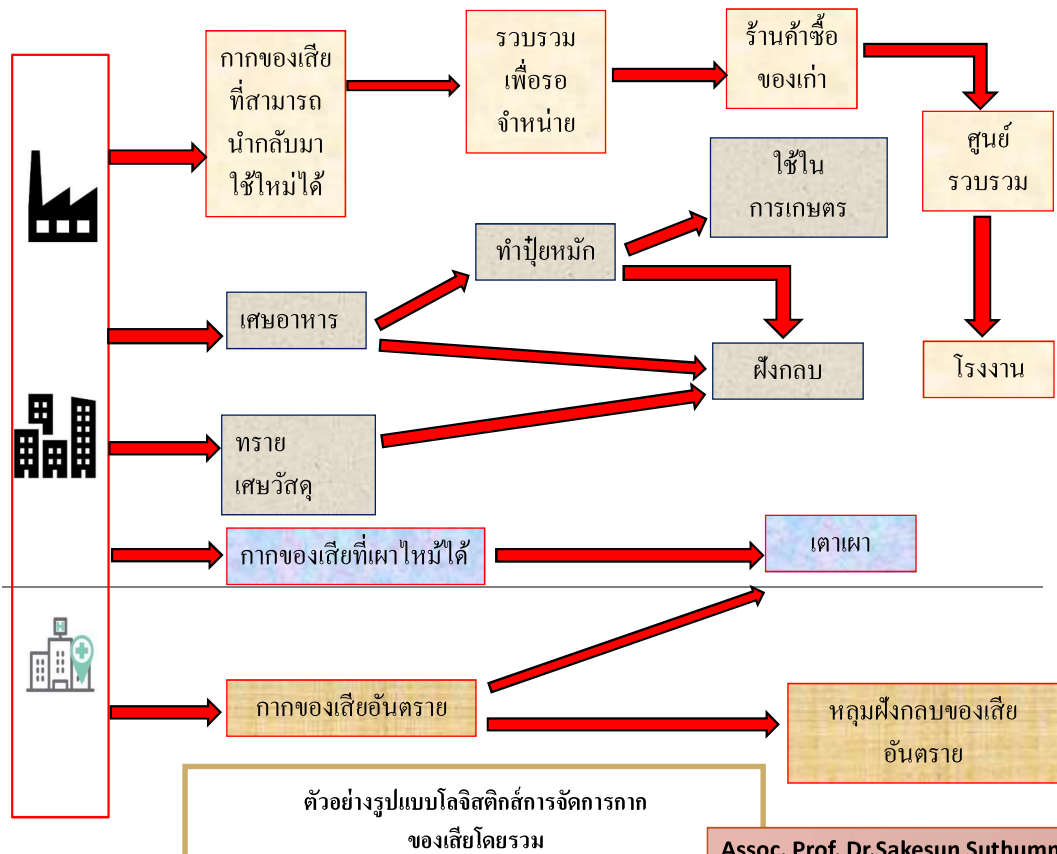


Tracking sensor and data logger for pasteurized milk delivery

Assoc.Prof.Dr.Nikorn Sirivongpaisal, Department of Industrial Engineering,  
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## Logistics for solid wastes for Trang province





Assoc. Prof. Dr.Sakesun Suthummanon,  
 Department of Industrial Engineering,  
 E-mail : suseksan@eng.psu.ac.th

# Advanced materials

## Thermochromic & Photochromic Materials

## Interactive wireless endoscope

**Chromism** is a reversible change in a substance's colour resulting from a process caused by some form of stimulus. Many materials are chromic, including inorganic and organic compounds and conducting polymers, and the property can result from many different mechanisms. There are also several types of chromism, which are detailed below.

**T**hermochromism is the reversible colour change of a substance induced by temperature change. A large variety of substances, organic, inorganic, organometallic, supramolecular and polymeric systems exhibit this phenomenon. Thermochromic has also been applied to important technical areas that involve other external influences as well as heat in the observed colour change, e.g. thermochromic pigments.

**P**hotochromism is the reversible transformation of a chemical species between two forms by the absorption of electromagnetic radiation, where the two forms have different absorption spectra. Photochromism has attracted much interest due to its potential for use in automobile and building glazing as well as energy conservation.



Assoc. Prof. Dr. Pornchai Phukpattarant, Department of Electronic engineering,  
 E-mail : pornchai.p@psu.ac.th

## Wood-Plastic Composites

### ❖ Materials and processes



Polypropylene (recycled)

Para wood power

Additive

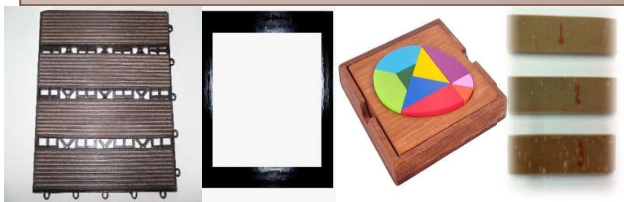


composite materials

Forming process

Composite sheet

### ❖ Products



Pedestrian Flooring

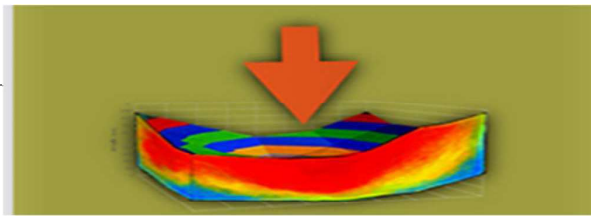
Picture frame

TOYS

Wood-Plastic

Assoc. Prof. Dr. Thanate Ratanawilai,  
Department of Industrial Engineering,  
E-mail : thanate.r@psu.ac.th

## Impact absorber material prepared from natural rubber



### Materials



### Products



Asst.Prof.Pornsiri Kaewpradit,  
Department of Chemical Engineering,  
E-mail : pornsiri.k@psu.ac.th

# Environmental sustainability

## Installing the Flood Warning Sensor System



Assoc.Prof.Dr. Tanit Chalermyanont, Department of Civil Engineering, E-mail : tanit.c@psu.ac.th

## Flood Management : Hatyai Model



↑ ↑ ↑ ↑ ↑  
การแก้ปัญหาเชิงโครงสร้าง การวิจัย การสร้างความเข้มแข็งให้สังคม

# Carbon, water, and ecological footprints

## Products

- Rice
- Crude palm oil
- Rubber products
- Tapioca flour
- Sugar
- Molasses ethanol
- Molasses and Sugarcane ethanol

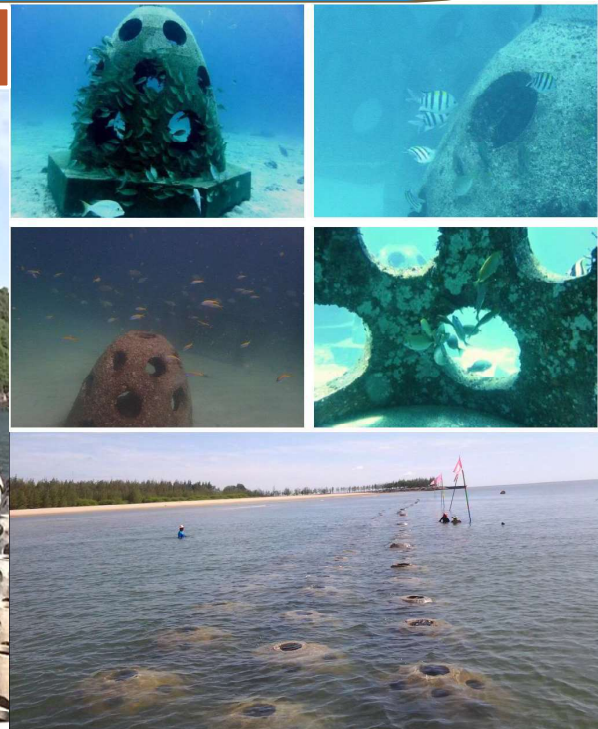


## Policy Recommendation

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# Coastal restoration

## PSU Seadome



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