TAYLOR'S

# RESEARCH
## ANNUAL REPORT & STRATEGIC PLAN 2018 - 2022

**Faculty of Innovation and Technology**
Taylor's University, Malaysia

# Research Annual Report 2018–19 & Research Strategic Plan 2019–22

**Faculty of Innovation and Technology**

**Taylor's University**, Subang Jaya, Malaysia

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# Foreword & Messages

# Foreword by Pro Vice-Chancellor (Research & Enterprise)

The Faculty of Innovation & Technology brings together expertise that is fundamental to the realization of the UN Sustainable Development Goals. Resulting from Faculty reorganisation, streamlining of activities, restructuring of research groups, and clarifying research aims and objectives in line with the launch of the Taylor's Strategic Plan 2017-2022, we expect this faculty to continue to push the boundaries of innovation in fundamental and applied engineering, design principles, heritage and architecture, data science and cyber-space, just to name a few exciting prospects. This Faculty has joined forces with other disciplines of Business, Tourism, Health, and Education to spearhead the Flagship Research Programmes in Data Analytics and Sustainable Cities resulting in the creation of groups of researchers with a common interest in solving the world's problems in these areas.

The increase in the real research output of the School's within this Faculty from 2017-2019 is commendable and with this plan to focus research in its core areas, I am confident that the leadership of this Faculty will indeed realise the goal of doubling postgraduate research students, publications and grants over the coming 2-3 years. The plans highlighted in this report reflect the forward-thinking goals of the Faculty leadership and an anchor to which the staff can rally around. Research is a long-term journey and I see the plans incorporate an ambitious but realistic plan, which requires collaboration, integration of disciplines, intense focus, development of staff, and growth of niche areas. Kudos to FIT!

Lastly, I would like to extend my appreciation to the academic staff within this faculty who have embraced the research culture envisioned in the Strategic Plan and worked hard to grow their profiles. Also, by generously assisting their colleagues as mentors and collaborators, they have exemplified the true spirit of being a Taylorian and helped to grow the research reputation of Taylor's evidenced by the steady increase in our MyRA scores and QS rankings.

On behalf of my team at Research & Enterprise, we look forward to supporting the various initiatives of FIT and the continued growth of its profile expertise.

Thank you.

**Associate Professor Dr. Anthony Ho Siong Hock**
Pro Vice-Chancellor – Research & Enterprise
*Taylor's University*

# Message from the Executive Dean, Faculty of Innovation and Technology

Taylor's University has taken some bold steps to invest heavily in Research and Development since 2018. Millions of Ringgits were invested in research projects, hiring excellent research professors, research management systems, and many more. This is just one of many initiatives that have pushed the QS Asia Ranking of the university from 179 in 2017 to 109 in 2020.

The Faculty of Innovation and Technology continues to push the boundaries in research. A total of about 400 indexed papers were published and have secured grants worth RM3.5 Million over the last 3 years. There are some interesting flagship projects under the faculty such as the Data Analytics, Travel Behaviour Modelling, Modelling and visualisation of air pollution and its impact on health, Visualisation of criminal and terrorist networks using extreme learning and predictive modeling, and the Integrated sustainable framework to address environmental, economical, health and social challenges in the planning, designing and maintaining of Asian cities.

Some of the external grants that we have received are the Fundamental Research Grants Scheme from the Ministry of Education Malaysia, Newton Fund from the UK, and industry grants from Kambyan Network, and Salesforce Malaysia.

Would like to thank all the researchers in the faculty for their initiatives in research & development and to continue to excel in their research. Special thanks to Prof. Dr. Pradeep and Dr. Anthony for providing all the research support. A word of thank you to Dr. Raja Kumar too, who helped compile this report.

Thank you.

**Professor Dr. David Asirvatham**
Executive Dean
*Faculty of Innovation and Technology*
*Taylor's University*

# Message from the Head of School

## School of Architecture, Building, and Design

Architecture and Quantity Surveying exist in the context of the built environment, the human conceived world comprised of products, interiors, structures, landscapes, buildings, and cities that interconnect with the Earth. Humans have been modifying the natural surroundings since the invention of tools and machines to create a shelter to withstand uncertain environmental conditions. From primitive cave dwellings to the humble hut to soaring skyscrapers, humans have progressively staked claim to being shapers, purveyors, and guardians of change that are vital to improving the condition of the built environment.

The integration of man-made and natural surroundings needs to be collaborative and inclusive to create expressive, profound, and healthy human-environmental effort. In shaping the built environment, humans also shape our future as asserted by Winston Churchill that "we shape our buildings, and afterward, our buildings shape us." Architects design buildings and other physical structures while Quantity Surveyors calculate the cost and manage construction projects. They have particular knowledge bases and procedures that guide their actions and govern their responsibilities. They are highly respected professionals. A dyadic relationship between Architects and Quantity Surveyors helps shape the conceptual framework that integrates research with architectural knowledge and production of buildings.

Research, according to Bruce Archer, is the "systematic inquiry whose goal is communicable knowledge". At the School of Architecture, Building, and Design, research gives voice to the spectrum of knowledge embedded in built forms. The reasons to design, plan, and build are manifold and intersect across various disciplines through the interactions of numerous components that combine to form the built environment. Guided by the Architect's ethos of responsibility for the "improvement of the built environment", the research effort laid bare in this issue is the testimony of the School's effort and commitment to enriching knowledge about our existence and engagement in the built environment through the disciplines of Architecture and Quantity Surveying.

**Associate Professor Tony Liew Voon Fun**
Head of School
*School of Architecture, Building, and Design*
*Faculty of Innovation and Technology*
*Taylor's University.*

# Message from the Head of School

## School of Engineering

Science remains a mystery wrapped in a riddle inside an enigma. The catalyst needed to unleash the true potential of science and technology revolves around research. AT the School of Engineering at Taylor's University research begins with the most fundamental question "WHY?" We strongly believe that the realisation of great concepts, products, systems, amongst many other innovative inventions that have spurred mankind to greater heights can only be realised if the purpose of the research is clearly defined and well understood. Research activities at Taylor's School of Engineering are aligned to the Grand Challenges, comprising 14 challenges that humanity needs to address to remain sustainable in the 21st century. Coupled with a robust Conceive, Design, Implement and Operate framework we are proud to be able to put theories into an application and excel in R&D activities. A proof of this is the school's MyRA score which was increased tremendously from 18 in 2013 to 47 in 2019. In 2018 -19, many staff was principal investigators for various research grants amounting to more than RM 1M in research funding. Our staff has supervised almost 40 master and Ph.D. students, resulting in numerous numbers of indexed journal papers and 180 articles in proceedings or non-indexed journals. I am delighted to witness and be part of a research-centric team that is poised to push science and technology into new frontiers for the benefit of humanity and am truly excited about the expected achievements soon.

**Ir. Dr. Sivakumar Sivanesan**
BEng (Mech), Meng, PhD, CPEng, CEng, Peng, MIE Aust, MIMechE, MIEM

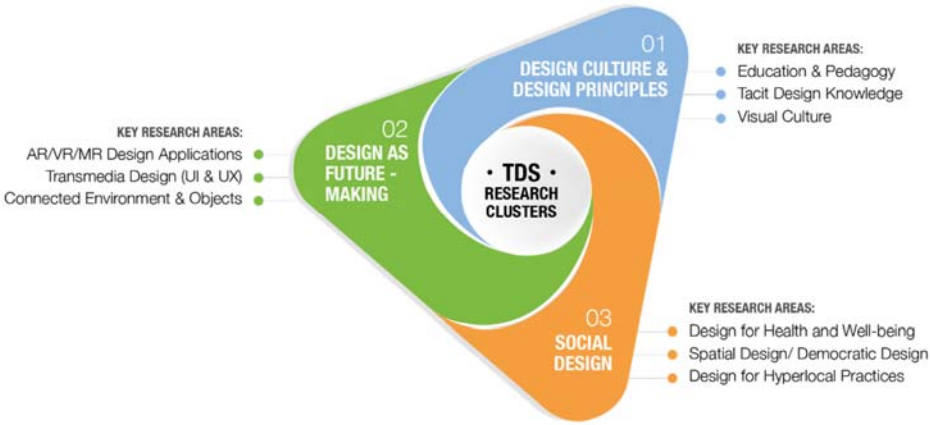
Head of School
*School of Engineering*
*Faculty of Innovation and Technology*
*Taylor's University*

# Message from the Head of School

## The Design School

Welcome to an era of unprecedented change – one built on challenges, placing a deep and empathetic understanding of users at the centre of finding innovative solutions to complex problems. In Taylor's The Design School (TDS), we consider design research an integral part of the learning experience, with students, faculty, and industries working together to challenge existing paradigms, advance emerging design practices, and deliver collaborative solutions.

To do this, our school's research and development are supported by three-pronged clusters: Design Culture and Design Principles, Design as Future-Making, and Social Design. Central to these focused clusters, we continue to grow several key research areas, responding to the expectations of rethinking and recreating viable solutions to contribute to the needs for research that occur around the world. This approach is also underpinned by the unification of our entire university aimed to increase the impact and prominence of scholarly research throughout the university.




The trust placed in the school's research strategy presents itself as a long-term commitment to Taylor's as a global university. I look forward to ensuring the research strategy is the catalyst that continues to build a reliable collaboration with students, faculty, and industries as well as a go-to partner delivering practical solutions for industry and society.

**Dr. Pouline Koh**
Head of School
*The Design School*
*Faculty of Innovation and Technology*
*Taylor's University*

# Research Groups

# Research Groups

## Architecture, Heritage, History, and Culture

### Overview

The rapid modernization of Asia in general and Malaysia in particular in the 21st century has increased the importance of celebrating a community's identity and culture in the face of rapid physical and social change. By appreciating that memory (and therefore history) contributes to culture and identity (and therefore heritage), this research group aims to study the different factors that contribute to Asia's architectural and social heritage, including the intangible elements that allow these plural identities to be appreciated as a 'living heritage'. This research group employs a multi-disciplinary approach to identify key elements that contribute towards the creation of heritage in ASEAN in particular. This includes a deep appreciation of the role of tourism and the arts, minority cultures, and social practices as well as architectural conservation, measured drawings, and their associated methods of documentation. Projects under this group should identify communities, locations, ways of life, design and/or architectural typologies that are worthy of study to facilitate either their conservation for the benefit of future generations or to assist in their evolution to encourage the survival of multiple 'ways of being' in the face of increasingly globalizing forces during the 21st century.

### Key Research Areas

- Architecture and social heritage
- Living heritage
- Heritage in ASEAN
- Tourism and the arts
- Social practices
- Architectural conservation
- Architectural typologies

- Multiple 'ways of being'

### Key Experts


### Selected Publications

- Tan, K.K.H. & Mura, P. (2019). The 'Culture Wars' and Social Polarization: Effects on Historical Monuments and Tourism, Tourism Culture & Communication (19)3, 217-223. (SCOPUS-Indexed)
- Ng, V. & Chia, L.L. (2019) Re-thinking Architecture Education: Conceptualising Curriculum through the lens of 21st-century Graduate Attributes. International Transaction Journal of Engineering, Management, Applied Sciences, and Technologies. (ISI-Indexed)
- Tan, K.K.H. (2018). From 'Artistic Ape' to tourists: How the evolution of art mirrors that of tourism. *Asia Pacific Journal of Innovation in Hospitality and Tourism*, 7(1), 101-106.
- Zahari, Z., Koh, J.H., Norhayati, H. & Isip, P. (2018). Rejuvenating the shophouse: Conservation of historical buildings in Penang's UNESCO World heritage sites. In Echari, V. & Brebbia, C.A. (eds.), *Heritage Architecture Studies*, 335-346. Southampton: WIT Press.
- Ng, V.F.P. & Ng, A.S. (2018). Old market square as a container of diasporic meaning in Chinese Kuala Lumpur. *Millennial Asia* 9(1), 66-92.

# Affordable and Liveable Asian Cities

## Overview

The rapid growth of Asian cities presents many issues to their inhabitants as cities expand beyond their comfortable limits and authorities play catch up. Given the unique composition of people, culture, heritage, and belief systems in Asia, the adoption of models built largely upon research in western developed nations may not provide viable solutions to many of the unique problems arising in Asia.

The research group aims to employ a multi-disciplinary approach to identify the key factors likely to contribute to the impending crisis in rapidly growing Asian cities. This entails developing new knowledge and understanding of Asia-centric problems and proposing solutions to overcome current problems or avert potential dysfunction.

The research programmes conducted by the Group endeavour to supply information and propose solutions that can be used by policymakers, city planners, and urban designers, in planning, designing, and maintaining Asian cities facing a plethora.

## Key Areas of Expertise

- City Planning and Urban Design
- Master Planning
- Sustainable Urbanism and Ecological Connectivity
- The New Urban Agenda
- Affordable Housing
- Heritage Conservation and Adaptive Reuse

## Key Experts


Professor Robert Powell


Dr Camelia May-Li Kusumo


Dr Sucharita Srirangam


Dr Filzani Illia Ibrahim


Prince Favis Isip


Siti Balkish Roslan


Ar Nural Alia Ahamad


Ar Sateerah Hassan


Mohamad Zafarullah Mohamad Rozaly


Ahmad Nazmi Mohamed Anuar


Delliya Mohd Zain

## Selected Publications

- Srirangam, S., Kusumo. C. (2019). Centrality through the history: a discussion on space syntax and urban morphology of South Klang City Centre. Journal of Engineering Science and Technology, Special Issue 1/2019, 1-12 (SCOPUS-Indexed)
- Yeoh, B., Powell, R., Kusumo, C. (2019) Revitalising an Urban Centre: Reviving Hentian Bas Klang Utara as a Centrifugal Force in Central Klang. International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies. (ISI-Indexed)
- Filzani Illia., Dasimah Omar., Nik Hanita Nik Mohamad (2018). Multi-Dimensional Interaction in Open Spaces: A Case Study of Open Spaces in Malaysia**.** In: *Journal of the Malaysian Institute of Planners Volume (Special Edition) Volume 16 (2018).* SCOPUS indexed.
- Robert Powell, Camelia May-Li Kusumo, and Sucharita Srirangam. Rethinking the Public Realm: Behavioural Settings in Malaysian Cities**,** 6th International Conference on Architecture and Civil Engineering (ACE 2018), Singapore, 14th–15th May 2018. ISSN 2301-394X. Published in Conference Proceedings. SCOPUS indexed
- Rozaly, M.Z.M., Shukri, S., Latip, N., & Abdullah, A. (2018. Reweaving the Urban Fabric of the Historic Riverfront Townscape of Masjid India, Kuala Lumpur**,** *International Journal of Engineering & Technology*; Vol 7, No 3.9, 81-85. (2018): Special Issue 9; UAE Indexing SCOPUS-Indexed URL https://www.sciencepubco.com/index.php/ijet/article/view/15282, doi:http://dx.doi.org/10.14419/ijet.v7i3.9.15282

# Sustainable Design and Technology

## Overview

A global perspective provides a new sustainability-oriented business strategy for real estate development which emphasises integrating sustainability principles into practical decision making and marketing. This group of research team aims to provide research and consultancy to real estate corporates by meeting the needs of the present industrial trend, without compromising the ability of future generations. The fundamental concept of suitability encompasses three dimensions, namely social, economic, and environmental, which are accepted by all stakeholders as guiding principles for both public policymaking and corporate strategies. Under the scope of architecture and building, the focus of this group centered on the interactions between nature and technology in providing 'Sustainable Design and Technology' research particularly Systems, Building Construction, Construction Law and Procurement, Facility and Project Management, Ecology and Green Architecture, Building Information Modelling (BIM), User-orientated Architecture, Access for the Disabled (OKU), and Business Management and Corporate Strategy.

## Key Research Areas

- Systems, Building Construction
- Construction Law and Procurement
- Facility and Project Management
- Ecology and Green Architecture
- Building Information Modelling (BIM)
- User-orientated Architecture
- Access for the Disabled (OKU)
- Business Management
- Corporate Strategy

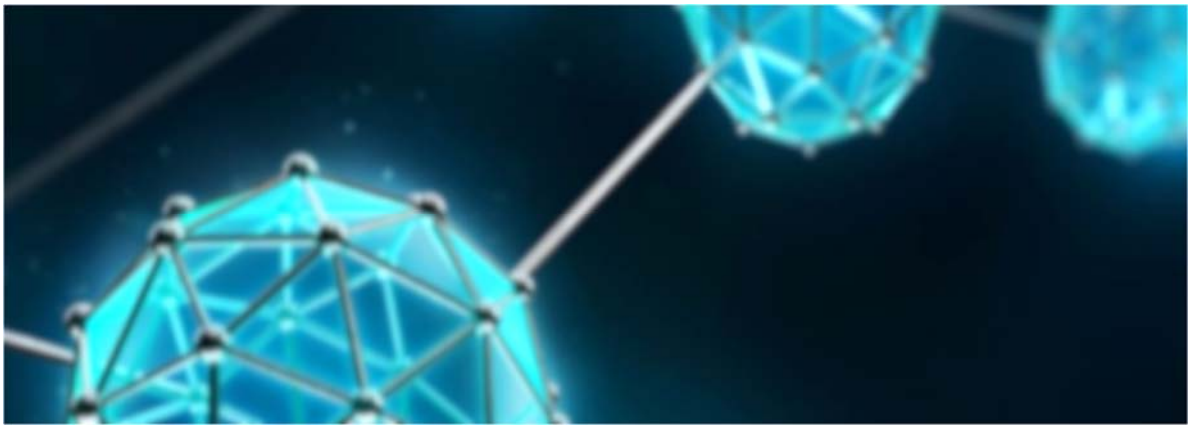
## Key Experts


## Selected Publications

- Srirangam, S. & Kusumo, C, (2019), Centrality through the History - A Discussion on Space Syntax and Urban Morphology of South Klang City Centre, Journal of Engineering Science and Technology, Special Issue, Feb 2019, pp 1-12. (SCOPUS-Indexed)
- Mohamed, M. R., Mohammad, M. F., Mahbub, R., Ramli, M. A., Gunasagaran, S., & Halim, S. M. A. (2019). Business Strategy of Small and Medium-Sized Enterprise Construction Companies in Adopting Industrialised Building System in Malaysia. International Journal of Academic Research in Business and Social Sciences, 9(9), 1127–1139. (ERA Indexed)
- Mohamed Rizal Mohamed, Mohammad Fadhil Mohammad, Rohana Mahbub, Mohd Adib Ramli, Khairool Aizat Ahmad Jamal (2018), The Issues and Challenges of Small and Medium-Sized Contractors in Adopting Industrialised Building System, *International Journal of Engineering & Technology* (Scopus indexed)
- TamilSalvi Mari and Sivaraman Kuppusamy, *Assessment of Embodied Energy: The Missing Piece – The Recurring Embodied Energy*, Second Malaysia University-Industry Green Building Collaboration Symposium (MU-IGBC 2018), UKM Bangi, Selangor 8 – 9th, May 2018. Proceedings accepted for publication in IEEE Xplore (SCOPUS indexed)

- Khairool Aizat Ahmad Jamal, Mohammad Fadhil Mohammad, Nurfashiha Hashim, Mohamed Rizal Mohamed, Mohd Adib Ramli, (2019). Challenges of Building Information Modelling (BIM) from the Malaysian Architect's Perspective, International Conference on the Built Environment and Engineering (IConBEE), MATEC Web of Conferences 266, 05003 (Scopus indexed).

# Sustainable Energy and Green Technology



## Overview

Technological advancement in the engineering field of energy efficiency and green (clean) energy is the key to environmental protection, considering their crucial impact globally and the depletion as well as environmental issues caused by the traditional fossil fuels. Thereby, alternative and more sustainable methods to harvest and enhance energy production whilst at the same time treat environmental wastes are direly sought after around the globe.

The focus of this research group is on the development of sustainable energy aiming for a greener environment that includes efficient technologies for $CO_2$ capture, making solar energy economical and sustainable, utilization of biomass for energy generation and waste minimization, improving lubrication technologies by producing novel blend lubricants that are biodegradable and cost-effective, utilization of greener solvents for waste rubber devulcanisation process, etc. These areas are identified as some of the niche areas for Taylor's School of Engineering and supported by the university

## Key Research Areas

- Nanofluids and Nanoparticles
- Heat Transfer
- Solar Energy
- Deep Eutectic Solvents
- Rubber Devulcanization
- Transformer Oil
- Environment

## Key Experts

Dr Rashmi Gangasa Walvekar

Dr Chockalingam Aravind Vaithilingam

Reynato Andal Gamboa

Eunice Phang Siew Wei

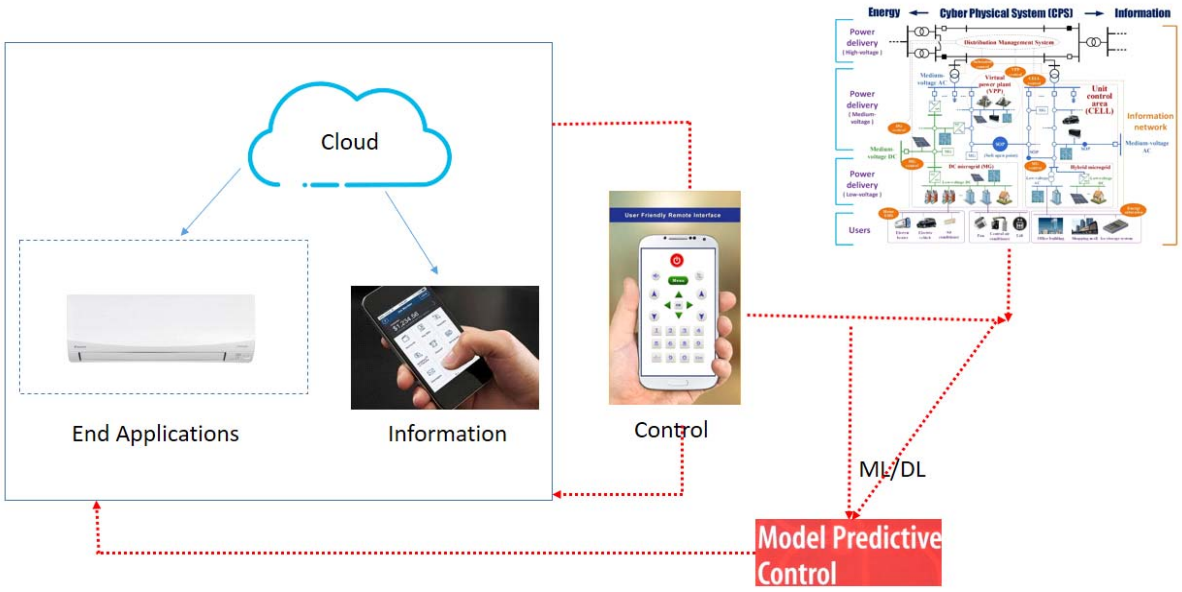
## Selected Publications

- Wong, Chun Yik & Wong, Wai & Ramya, K. & Khalid, Mohammad & Loh, K.S. & Wan Daud, Wan & Lim, Kean Long & W, Rashmi & Kadhum, Abdul. (2019). Additives in proton exchange membranes for low- and high-temperature fuel cell applications: A review. International Journal of Hydrogen Energy. Volume 44, Issue 12, 1 pp. 6116-6135. (ISI_Indexed)
- Elkelawy, Medhat & Alm Eldin, Hagar & Esmaeil, Khaled & Radwan, Ahmed & Panchal, Hitesh & Ponnamma, Deepalekshmi & Walvekar, Rashmi & Sadasivuni, Kishor Kumar. (2019). Experimental studies on the biodiesel production parameters optimization of sunflower and soybean oil mixture and DI engine combustion, performance, and emission analysis fueled with diesel/biodiesel blends. Fuel. 255. Pp. 1-12. (ISI_Indexed)
- Phang, S. W.; Sin, L. T.; Bee, S.-T.; Low, J. Y.; and Tee, T.-T. (2018). Release Behaviour Study on Controlled-Release Phosphorous Fertilizer Encapsulated by Starch-Alginate Superabsorbent Composite. Journal of Engineering Science and Technology, pp. 82–94. (ISI-Indexed)
- Ahmed, S.F., Khalid, M., Amin, N., Rashmi W. (2018). Investigation of rheological and corrosion properties of graphene-based eutectic salt, Journal of Material Science. 53(1), 692–707 (ISI-Indexed)
- Amarpreet Singh, Rashmi Walvekar, Mohammad Khalid, Wong Wai Yin, TCSM Gupta 2018. Thermophysical Properties of Glycerol And Polyethylene Glycol 600 Based Deep Eutectic Solvents (DESs). Journal of Molecular Liquids. Vol 252, pp:439–444. (ISI-Indexed)

## Patents

- An oil-based cutting fluid composition and a method of manufacturing thereof, Copyright (National).

# Value Enabled Research Through Innovations Catalysed for Long Term Sustainability (VERTICALS)




## Overview

The UN sustainable development goals addressing the pressing challenges including poverty, inequality, climate, erratic climatic variations, degradation of natural resources, the prosperity of people with prevailing justice to live in peace is targeted to be achieved by 2030. Several interconnected devices, communication networks, sensing, and instrumenting the critical data, handling of data is going to be part of any engineering solutions within the challenge. Knowing the role of a sustainable player within the academic and research enterprise Taylor's School of Engineering aligns the high impact research thrust in addressing those within the engineering education through a vertically blended approach where the technology and data as catalyse for long term sustainable solution.

The research group is working on the verticals that imbibe long term technological solutions towards clean energy, responsible consumption, and productions, sustainable cities, and communities.

## Unit Objectives

- To cater to holistic sustainability research solutions through innovations
- To develop a niche research thrust that supports sustainability in the long run

## Projects Completed

Daikin Value Enabled IoT blended VRV System

## Current Projects

- Clean Energy from wind sources imbibing biological and mathematical formulations
- Clean transportations module robustness integrated into the future grid
- Value Enable IoT blended digital agriculture
- Exergy-Energy layered trapping to maximise power from the sun

## Unit Developmental Areas

- Islanded clean energy alternatives
- Bio-inspired novel techniques for engineering solutions
- Energy balance in Future Grids, its components, and framework


## Key Experts

Dr Chockalingam Aravind Vaithilingam (Head)

Mr Gowtham Raj (PhD student) (Clean Transportations)

Mr Prakash (PhD student) (Future Cities)

Mr Sridhar (PhD student) (Clean Energy)

## Selected Publications

- James, P. E., Mun, H. K., and Aravind, C. V. (2019). A Hybrid Spoken Language Processing System for Smart Device Troubleshooting. Electronics. 8(6), 681. (ISI-Indexed)
- Farhana Thariq Ahmed, H.; Ahmad, H.; Phang, S.K.; Vaithilingam, C.A.; Harkat, H.; Narasingamurthi, K. Higher-Order Feature Extraction, and Selection for Robust Human Gesture Recognition using CSI of COTS Wi-Fi Devices. Sensors 2019, 19, 2959. (ISI-Indexed)
- Kameswara Satya Prakash Oruganti, Chockalingam Aravind Vaithilingam, Gowthamraj Rajendran and Ramasamy A (2019) "Design and Sizing of Mobile Solar Photovoltaic Power Plant to Support Rapid Charging for Electric Vehicles", Energies 2019, 12, 3579 (ISI-Indexed)

- Reynato Andal Gamboa, Aravind CV, Gowtham Raj, Rajmal Joshi Dynamic Performance Assessment for Water Pump System using different controllers Jour of Adv Research in Dynamical & Control Systems, Vol. 10, 13 Special Issue, 2018
- Kameswara Satya Prakash O, Sridhar S.I, Aravind CV, R. Rajasekaran On the Dynamics of Floating Solar Power Plant: Opportunity for Sustainable Energy Generations Jour of Adv Research in Dynamical & Control Systems, Vol. 10, 13-Special Issue, 2018.
- Aravind CV, Umashankar Subramaniam, MD Shahrukh Adnan Khan, Md.Ibrahim Ibne Alam Options and Opportunities for Energy Management in Malaysian Grid Systems—Putrajaya as a Case Study Journal of Electronic Science and Technology, 16(4) Dec 2018.

## Engineering Education Lab


### Overview

The new era of Industry 4.0 (IR4.0) requires multi-disciplinary roles across cultures and countries demanding different knowledge and skills to adapt to the emerging complex industry interconnectedness setting – humans, machines, and the Internet of Things (IoT). The engineering education through the outcome-based education (OBE) framework has a very important role in fulfilling this need. The Institutions of Higher Learning (IHL) offering engineering programmes should provide adequate facilities and opportunities for students to maximise their learning potential towards acquiring the intended skills set to be job-ready upon graduation.

This research group is focused on research areas and collaboration activities such as teaching, learning, and assessment pedagogies, research collaboration, and consulting activities on engineering education, and project-based learning pedagogies among others.

### Unit Objectives

- To provide training on various pedagogies that support teaching and learning for the Millennials
- To provide support training on various design thinking strategies for engineering projects

### Unit Developmental Areas and Focus

- Teaching, Learning, and Assessment Pedagogies
- Local and International Research Collaborations on Engineering Education
- Participation in Teaching, and Learning Competitions and Conferences
- Local and International Collaborations on OBE Assessments
- Project-based Learning Pedagogies

### Awards

### 1. Best Paper Award

- "Empowered Pedagogy: Catching Up with the Future," Taylor's 11th Teaching and Learning Conference 2018, Transforming Curriculum: Empowering Learning for Life, Taylor's University Lakeside Campus, Subang Jaya, Petaling Jaya, Selangor, Malaysia September 22-23, 2018
- Authors: Assoc Prof Dr. Chockalingam Aravind Vaithilingam & Dr. Reynato Andal Gamboa

### 2. Silver Medal Award

- Humanistic Centred Curriculum for the IR 4.0
- International University Carnival on E-Learning (IUCEL 2018), Humanistic Technologies, IIUM Cultural Centre, Gombak, Malaysia September 12-13, 2018
- Project Team: Assoc Prof Dr. Chockalingam Aravind Vaithilingam & Dr. Reynato Andal Gamboa

### 3. IET Top 10 Paper Award

- Integrated Cumulative Grade Point Outcomes as a Complement to CGPA: A Case Study for Taylor's University School of Engineering, Taylor's 10th EURECA International Conference 2018, Special Session on Teaching, Learning and Assessments, Taylor's University Lakeside Campus
- Subang Jaya, Petaling Jaya, Selangor, Malaysia, June 27, 2018
- Authors: Dr Reynato Andal Gamboa and Prof Ir Dr Satesh Namasivayam

### 4. Silver Medal Award

- Semester Outcomes Assessment Review (SOAR)
- Putra Innocreative Carnival on Teaching and Learning 2018 (PICTL2018), Imagineering the 21st Century Educator, Universiti Putra Malaysia, Kuala Lumpur, Malaysia, August 1-2, 2018
- Project Team: Assoc Prof Dr. Chockalingam Aravind Vaithilingam & Dr Reynato Andal Gamboa

### Key Experts

Dr Reynato Andal Gamboa,
Head of Unit, Curriculum alignments

Professor Ir Ts Dr Satesh Narayana Namasivayam
(OBE Assessment)

Dr Se Yong Eh Noum
(CDIO Pedagogy)

Dr Siva Kumar Sivanesan
(Project Based Learning)

Mr Douglas Tong Kum Tien
(Community Service Assessment and Curriculum Alignment)

### Selected Publications

- R. A. Gamboa, and S. Namasivayam. (2019). "Integrated Cumulative Grade Point Outcomes as a Complement to CGPA: A Case Study for Taylor's University School of Engineering", Journal of Engineering Science and Technology. pp. 215-228.
- Vaithilingam, C., Andal Gamboa, R., & Chun Lim, S. (2019). Empowered Pedagogy: Catching Up with the Future. Malaysian Journal Of Learning And Instruction, 16(1), pp. 1-22.

- Sekar, V., Fouladi, M. H., Namasivayam, S. N., & Sivanesan, S. (2019). Additive Manufacturing: A Novel Method for Developing an Acoustic Panel Made of Natural Fiber-Reinforced Composites with Enhanced Mechanical and Acoustical Properties. Journal of Engineering, Vol. 2019. pp. 1-19. (ISI-Indexed)
- Sivanesan, S., Loong, T.H., Namasivayam, S., Fouladi, M.H., (2019). Two-Stage Sintering of Alumina-Y-TZP (Al2O3/Y-TZP) Composites. Key Engineering Materials 814, pp. 12–18. (ISI-Indexed)
- R. A. Gamboa, S. N. Namasivayam, R. Singh, C. A. Vaithilingam, and M.H. Fouladi. 2018. "PO Attainment vs. Employment Status: A Correlation Study for Taylor's University School of Engineering", 2018 IEEE 10th International Conference on Engineering Education (ICEED2018) Proceedings, IEEE Explore Digital Library, pp. 100-104.

# Materials, Additive Manufacturing, and Simulation (MAMS)


## Overview

As one of the focus areas under Industry 4.0, 3D printing and additive manufacturing revolutionize the way that goods are created in the coming years. This research group is aiming at novel approaches in the manufacturing of products that can support sustainable development for humankind. The area is identified as one of the niche areas for Taylor's School of Engineering and supported by the university through the Flagship Research Project fund.

The research group is working on the liveability and safety of Asian cities. One of the projects aims at providing a quiet indoor environment using sound absorbers made of natural fibers. Natural fibers are vastly available as agricultural waste in tropical countries such as Malaysia. Research has shown that these fibers can be used in acoustic absorption panels. Carbon Nano Tube (CNT) has excellent mechanical and thermal property and it is found that CNT arrays, in some cases, may provide better acoustic absorption than conventional porous materials of equivalent thickness and mass. Fibers will be mixed with CNT in different ways and their acoustical and microbial activities are evaluated. The expected outcome of this section is a natural fiber composite that has an excellent acoustic absorption coefficient throughout the frequency spectrum and can be used safely in a humid environment at a reasonable price.

## Key Research Areas

- 3D printing of natural fibers composites
- Additive manufacturing of bio-based materials
- Manufacturing of recyclable composites
- Simulation of Engineering systems

## Key Experts

Assoc. Prof.
Dr Mohammad
Hosseini,
Leader

Professor
Ir Ts Dr Satesh
Narayana
Namasivayam

Dr Choo
Hui Leng

Mr Vignesh
Sekar,
(PhD Student)

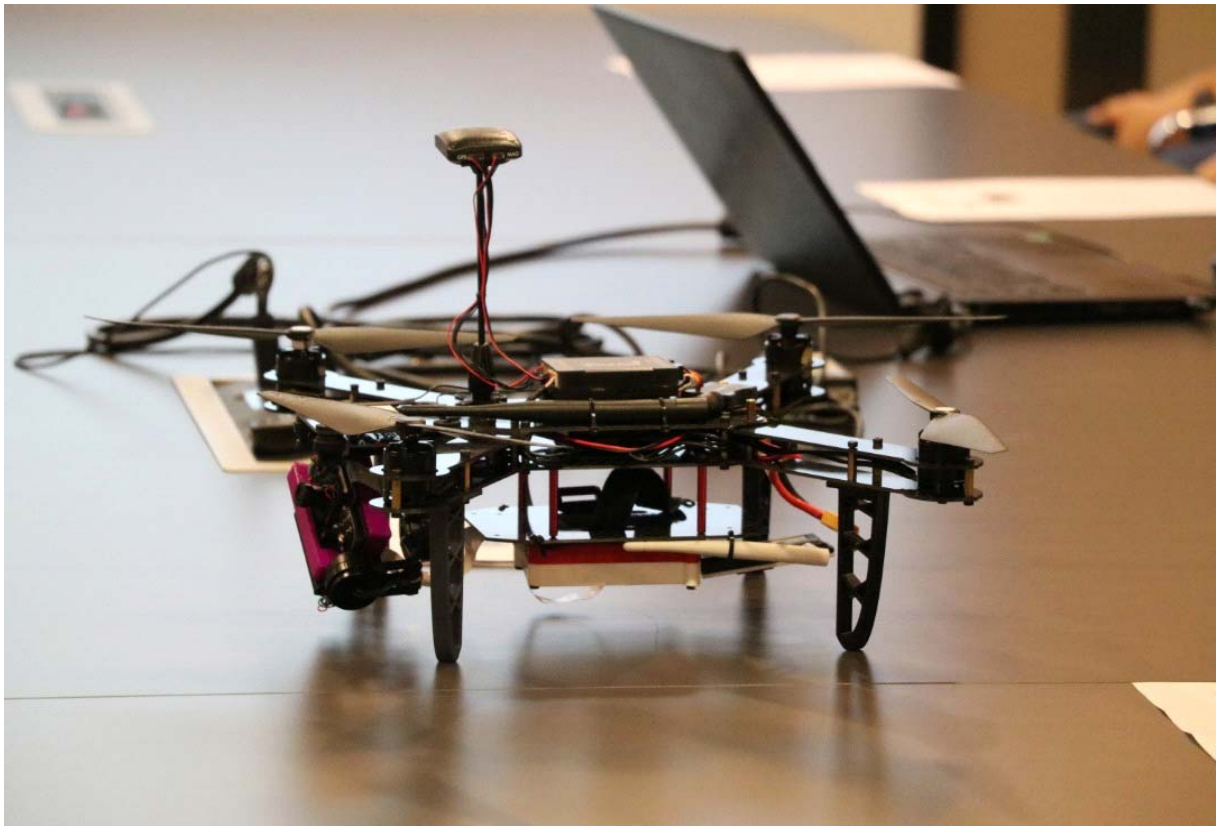
Mr Bhargav
Naidu Matcha
(PhD Student)

Mr Mansab Ali
(PhD Student)

## Selected Publications


- Laimon, A.L., Namasivayam, S.N. & Hosseini Fouladi, M. The Development of an Optimal Aerodynamic Design for a Human Powered Vehicle. Iran J Sci Technol Trans Mech Eng 43, 797–807, 2019.
- Lee, M. C., Koay, S. C., Chan, M. Y., Choo, H. L., Pang, M. M., Chou, P. M., & Tshai, K. Y. Properties of poly(lactic acid)/durian husk fiber biocomposites: Effects of fiber content and processing aid. Journal of Thermoplastic Composite Materials., 2019
- Mamtaz, H., Hosseini Fouladi, M., Narayana Namasivayam, S., Sayed, S.H., Sayed, T.H., Ghassem, M., Baniotopoulos, C. Novel implementation of natural fibro-granular materials as acoustic absorbers. Noise and Vibration Worldwide 49(9-10) 311–316, 2018.
- Lee, M.K., Hosseini Fouladi, M., Namasivayam, S.N. An analytical model for computing the sound power of an unbraced irregular-shaped plate of variable thickness. Scientific Reports, volume 8, Article number: 15355 2018, 2018.
- Niu, J., Choo, H.L., Sun, W., Mok, S.H. Analytical solution and experimental study of effective Young's modulus of selective laser melting-fabricated lattice structure with triangular unit cells, Journal of Manufacturing Science and Engineering, 2018.

# Taylor's Unmanned Aerial Vehicle (TUAV)



## Overview

Taylor's Unmanned Aerial Vehicle (TUAV) Research Group is an interdisciplinary academic and research group within the School of Engineering at Taylor's University. Founded in 2018, the TUAV Research Group is a prime unmanned systems incubator that fosters collaboration between the academic staff, the students, and the industry. The group focuses on fundamental research in UAV control systems, automation, machine vision, and machine learning.

As one of the focus areas under the Industry 4.0, the research group is working on both fundamental types of research of UAV and its practical applications. Partnering with various major industries, the group works on projects that are strongly applied to the industry's needs. There are several on-going projects at the moment. One of the projects provides a fully autonomous UAV system for surveillance purposes, where the video captured by the airborne UAV will be downloaded live to a ground station, while the UAV navigates through a pre-defined flight path on its own. Another project sees the development of a lightweight vision simultaneous localization and mapping (SLAM) algorithm to be used on-board of the UAV, such that the UAV can penetrate through foliage environment. In most of the projects, the group seeks a balance in developing cost and the performance of the UAV in the research.

## Unit Objectives

- To develop autonomous aerial vehicles for various applications both underwater and sky-based systems
- To provide support solutions to the industry players through consultancy

### Projects Completed by the Unit

- Daikin Drone Surveillance System developed for Daikin Electronic Devices Sdn. Bhd. Shahalam 2018-2019

### Unit Developmental Areas

- UAV flight control systems
- Lightweight SLAM algorithm
- Machine learning for target identification
- UAV flight path optimization
- Blade Design and Optimisation
- Image processing applications
- Data Analytics through IoT

### Key Experts

Dr Phang Swee King
(Head of the Unit)
(UAV)

Dr Chew Wei Jen
(Image Processing)

Dr Teh Aun Shih
(Materials)

Assoc. Prof. Dr Chockalingam Aravind Vaithilingam
(Wing structural design)

### Selected Publications

- Farhana Thariq Ahmed, H.; Ahmad, H.; Phang, S.K.; Vaithilingam, C.A.; Harkat, H.; Narasingamurthi, K. Higher-Order Feature Extraction, and Selection for Robust Human Gesture Recognition using CSI of COTS Wi-Fi Devices. Sensors 2019, 19, 2959. (ISI-Indexed)
- L. Zhang, F. Deng, J. Chen, Y. Bi, S. K. Phang and X. Chen, "Trajectory Planning for Improving Vision-Based Target Geolocation Performance Using a Quad-Rotor UAV," in IEEE Transactions on Aerospace and Electronic Systems, vol. 55, no. 5, pp. 2382-2394, Oct. 2019.
- S. K. Phang, M. A. Hassan, Z. Y. Wong, Z. Y. Ng and Y. L. Lai, “Development of autonomous UAV systems for low light surveillance applications using night vision camera,” Journal of Advanced Research in Dynamical and Control Systems, vol 10, no 13-Special Issue, pp. 1379-1391, December 2018.
- L. Zhang, F. Deng, J. Chen, Y. Bi, S. K. Phang, X. Chen and B. M. Chen, “Vision-based target three-dimensional geolocation using unmanned aerial vehicles,” IEEE Transactions on Industrial Electronics, vol 65, no 10, pp. 8052-8062, October 2018.

### Conferences

- S. K. Phang, S. Z. Ahmed and M. R. Abdul Hamid, “Optimized real-time 3-d feature map generation with unmanned aerial systems,” Proceedings of the 2019 International Conference on Advanced Technology in Engineering & Management, Kuala Lumpur, Malaysia, February 2019.

- S. K. Phang, S. Z. Ahmed and M. R. Abdul Hamid, “Design, dynamics modeling and control of an H-shape multi-rotor system for indoor navigation,” Proceeding of the 2019 International Conference on Unmanned Vehicle Systems, Muscat, Oman, pp. 1-6, February 2019.
- J. J. Tai, S. K. Phang, and C. L. Hoo, “Application of steady-state integral proportional-integral controller for inner dynamics control loop of multi-rotor UAVs,” Proceedings of the 2018 International Conference on Advances in Computing, Communication & Automation, Kuala Lumpur, Malaysia, October 2018.
- S. K. Phang, M. R. Abdul Hamid, X. Chen and F. Lin, “Autonomous ledge detection and landing with multi-rotor UAV,” Proceedings of the 2018 International Conference on Control & Automation, Anchorage, Alaska, US, pp. 42-47, June 2018.
- X. Chen, F. Lin, M. R. Abdul Hamid, S. H. Teo, and S. K. Phang, “Real-time landing spot detection and pose estimation on thermal images using convolutional neural networks,” Proceedings of the 2018 International Conference on Control & Automation, Anchorage, Alaska, US, pp. 998-1003, June 2018.
- K. Peng, F. Lin, S. K. Phang, and B. M. Chen, “Nonlinear flight control design for maneuvering flight of quadrotors in high speed and large acceleration,” Proceedings of the 2018 International Conference on Unmanned Aircraft Systems, Dallas, TX, US, pp. 212-221, June 2018.

# Data Science

## Overview

The Data Science and Cloud Computing research group focuses on the development and application of Big Data and Cloud Computing technologies, drawing on the best scientific traditions in Computer Science, Medicine, Biosciences, Engineering, and Business. It supports collaboration and knowledge transfer in this growing field. Hence, the team members work collaboratively with the research community and industry.

The research involves modeling, analyzing, and simulating dynamic systems characterized by complex logic and uncertain behaviors.

It also relates to latest trends and concepts for the management of cloud systems to provide intelligent solutions for high throughput and computational problems utilizing large-scale data in the cloud environment. It investigates open research issues in turning a true "Internet of Things" into reality, an Internet where low-resource nodes ("things", "constrained nodes") can communicate among themselves and with the wider Internet to partake in innovation.

This research group is interested in various areas, namely big data analytics, cloud computing, data mining, business intelligence, data visualization, and graphics, and business process re-engineering.

## Projects and Grants

- "Travel Behaviour Modelling using Data from smart mobile applications", Flagship project, Prof David (2017–2020)
- "Modelling and visualization of air pollution and its impact on health", Flagship project, Dr. Thulasy (2017–2020)

## Key Experts

## Selected Publications


- Amalina, Fairuz & Hashem, Ibrahim & Azizul Hasan, Zati & Fong, Ang & Firdaus, Ahmad & Imran, Muhammad & Anuar, Nor. (2019). Blending Big Data Analytics: Review on Challenges and a Recent Study. IEEE Access. PP. 1-1.
- Ariyaluran Habeeb, Riyaz Ahamed & Nasaruddin, Fariza & Gani, Abdullah & Amanullah, Mohamed Ahzam & Hashem, Ibrahim & Ahmed, Ejaz & Imran, Muhammad. (2019). Clustering-based real-time anomaly detection—A breakthrough in big data technologies. Transactions on Emerging Telecommunications Technologies.
- Brohi S.N., Marjani M., Hashem I.A.T., Pillai T.R., Kaur S., Amalathas S.S. (2019) A Data Science Methodology for Internet-of-Things. In: Miraz M., Excell P., Ware A., Soomro S., Ali M. (eds) Emerging Technologies in Computing. iCETiC 2019. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering, vol 285. Springer, Cham (ISI-Indexed)
- Hashem, Ibrahim & Anuar, Nor & Marjani, Mohsen & Ahmed, Ejaz & Chiroma, Haruna & Firdaus, Ahmad & Abdullah, Muhamad & Alotaibi, Faiz & Kamaleldin, Waleed & Yaqoob, Ibrar & Gani, Abdullah. (2018). MapReduce scheduling algorithms: a review. The Journal of Supercomputing.
- V N Vithana, D Asirvatham, and M G M Johar (2018). Challenges to Practice Agile Methods in Global Software Development – A Review of Literature. International Journal of Computer Applications 179(40):28-33. (SCOPUS-Indexed)

# Cyber Security

## Overview

SoCIT Cyber Security Research Cluster cybersecurity is the protection of computer systems, industrial IT-based systems, IT-based companies, and Network systems from theft or damage of their valuable resources as well as from misdirection or misuse of the services they provide. Cyber Security cluster provides a range of training, workshops, seminars for industry and community services. Besides, the cybersecurity cluster contributes to the nation by producing high-quality research in the domain to help/protect IT-based systems for possible attacks.

The cybersecurity cluster mainly contributed to the following trending research areas, which are the high demand of the current era.

Cybersecurity and Data Science: Data Science for Cyber-Security. Data science is an emerging domain, and data science use for cyber-security applications is a relatively new paradigm and highly demanding. Which includes, machine learning, deployment of statistical methodology, and Big Data analytics for anomaly detection, network modeling, forensics, risk management, etc. These applications help to identify the right solutions for the Cybersecurity domain.

Cybersecurity and AI: With time, technology paradigm is changing, with new era challenges AI is increasingly helping to Cybersecurity such as cybersecurity current and future products are increasingly integrating Machine Learning and AI technologies. By training AI software on large datasets of cybersecurity, network, and even physical information, cybersecurity solutions providers aim to detect and block abnormal behaviour, even if it does not exhibit a known “signature” or pattern.

Cybersecurity and Cognitive Science: Cognitive security is a new paradigm shift in cybersecurity, which may help to prevent cyber-attacks before happening, in several possible areas with a wider scope. Cognitive science is designed mainly on non-technical areas based on human behaviours, which affect to cybersecurity. Cognitive security helps cybersecurity in technical solutions as well by designed technical solutions to detect misleading data and disinformation and prevent its spreading.

Industry 4.0 and Cybersecurity: The fourth industrial revolution grown with smart technologies boom in the industry, it brings a great change in the industry. However, it brings great new operational risk as well for connected, smart manufacturers, and digital supply cyber networks. This 4.0 industry evolution increases the productivity and ease to handle the industry, but this interconnected nature of Industry 4.0 brings more possibilities of cybersecurity threats even before, suppliers and manufacturers are not prepared for this type of risk.

## Key Research Areas:

- Cyber Security
- Industry 4.0 and Cyber Security
- Information Security
- Application Security
- Computer System Security
- New Trends in Cybersecurity

**Website** https://socitcybersecurity.com/

## Key Experts

Assoc. Prof Dr Azween Abdullah (Head)

Dr Noor Zaman Jhanjhi

Dr Thulasyammal a/p Ramiah Pillai

Dr Ibrahim Abaker Targio Hashem

Dr Mohsen Marjani

Dr Sanath Sukumaran

## Selected Publications

- Marcus Lim, A. Azween Abdullah, NZ Jhanjhi., Mahadevan Supramaniam "Hidden Link Prediction in Criminal Network with Deep Reinforcement Learning Technique", in Computers Journal Mdpi, Vol 8., issue 1, 2019, [Indexed in ISI].
- Alyssa Anne Ubing, Syukrina Kamilia Binti Jasmi, Azween Abdullah, NZ Jhanjhi, Mahadevan Supramaniam, "Phishing Website Detection: An Improved Accuracy Through Feature Selection and Ensemble Learning", in International Journal of Advanced Computer Science and Applications (IJACSA), Vol 10, No, 1, pp. 252-257, 2019. (ISI-Indexed)
- Theyvaa Sangkaran, Azween Abdullah, N.Z. JhanJhi, Mahadevan Supramaniam, "Survey on Isomorphic Graph Algorithms for Graph Analytics", in IJCSNS International Journal of Computer Science and Network Security, Jan 2019. [Indexed in ISI]
- Teoh Joo Fong, A. Azween Abdullah, NZ Jhanjhi, Mahadevan Supramaniam, "The Coin Passcode – A Shoulder-Surfing Proof Graphical Password Authentication Model for Mobile Devices", in International Journal of Advanced Computer Science and Applications (IJACSA), Vol 10, No, 1, pp. 302-308, 2019. (ISI-Indexed)
- SH Kok, Azween Abdullah, NZ Jhanjhi., Mahadevan Supramaniam, "A Review of Intrusion Detection System Using Machine Learning Approach", in International Journal of Engineering and Research, Jan 2019. [Scopus Indexed]
- Noor Zaman, Fatimah Abdulaziz Almusali, Sarfraz N Brohi, and Azween Abdullah, "Middleware Power Saving Scheme for Mobile Applications" In IEEE, ICACCA 2018, Conference, Selangor Malaysia. 2018, pp. 1-6. (SCOPUS-Indexed).

## Artificial Intelligence, Blockchain, and IoT


### Overview

Emerging new and smart technologies are shaping the landscape of possibilities as people and things become more connected to and through the Internet to each other. AI and Machine Learning algorithms are providing solutions to problems and applications that were not seen earlier. IoT services are foreseen to provide a global reach with the proliferation of IoT and its influence in various use case scenarios. Blockchain the technology behind Bitcoin is finding a broad range of uses beyond cryptocurrencies.

The researchers of this group seek to understand and develop systems by exploring, investigating, and design solutions to real-world problems using AI algorithms and techniques, Machine Learning, Affective Computing, IoT, and Blockchain Technology where plausible. This research group actively engages with the research community through publications, participation in technical conferences, workshops, and collaborations with experts in academia and Industry.

### Key Research Areas:

- Machine Learning
- Fuzzy Logic
- Natural Language Processing
- Sentiment Analysis
- Affective Computing
- Brain-Computer Interaction
- IoT
- Blockchain
- Crypto Security
- Network Security
- IPv6
- Internet Governance

### Key Experts

Assoc. Prof. Dr Raja Kumar Murugesan

Professor Dr Patrice Boursier

Assoc. Prof. Dr Sagaya S. Amalathas

Dr Sophea Prum

Dr Dini Oktarina Dwi Handayani


Dr Kiu Ching Chieh


Tee Wee Jing


Sumathi Balakrishnan


Venantius Kumar Sevamalai

**Selected Publications**

- Jing T.W., Murugesan R.K. (2019), A Theoretical Framework to Build Trust and Prevent Fake News in Social Media Using Blockchain. In: Saeed F., Gazem N., Mohammed F., Busalim A. (eds) Recent Trends in Data Science and Soft Computing. Advances in Intelligent Systems and Computing, vol 843, Springer, Cham. pp 955-962.
- Puwakpitiyage C. A. H., Paramesura Rao V. R., Azizi M. S. A. M., Tee W. J., and Murugesan, RK (2019), A Proposed Web-Based Real-Time Brain-Computer Interface (BCI) System for Usability Testing, International Journal of Online and Biomedical Engineering (iJOE), Vol. 15, No. 7, pp. 111 – 123. (ISI-Indexed)
- Yaacob, Hamwira Sakti, and Omar, Hazim and Handayani, Dini and Hassan, Raini (2019). Emotional profiling through supervised machine learning of interrupted EEG interpolation. International Journal of Advanced Computer Research, 9 (43). pp. 242-251. (SCOPUS-Indexed)
- H.M, Wong, and Amalathas, S.S (2019). A New Approach Towards Developing A Prescriptive Analytical Logic Model for Software Application Error Analysis. In: Silhavy R., Silhavy P., Prokopova Z. (eds) Intelligent Systems Applications in Software Engineering. Advances in Intelligent Systems and Computing, vol 1046. Springer, Cham. Pp 256-274.
- Kamaruddin N, Rahman AWA, Handayani, D. (2018). Pornography addiction detection based on neurophysiological computational approach. Indones J Electr Eng Comput Sci. 10(1):138–45. (SCOPUS-Indexed)

# Spatio-Temporal Information Management and Analytics (SIMA)—Application to coastal erosion and flood.


## Overview

Combined with storms, floods, and erosion, this has a strong impact on coastal populations, infrastructures, and ecosystems. Strategies and solutions depend on the availability of datasets related to the topography, the meteorology, and sea data (sea level, waves, currents, etc.). These data need to be combined and analysed effectively to derive knowledge and prediction. Big Data and Internet of Things (IoT) technologies (devices and software) can help attain the objectives. Big Data relates to the storage, processing, and analysis of large volumes and varieties of data, in a fast and reliable manner. IoT relates to the real-time collection of data using sensors connected to servers. Spatial Big Data solutions combined with IoT will help predict and mitigate risks related to floods and coastal erosion.

Working on coastal erosion and floods implies that we work with geo-referenced and time referenced data, so-called Spatio-temporal data. They refer to digital maps, satellite images, and geo-referenced data sets in general (different kinds of statistical or descriptive data, related for example to population or socio-economic data, the quality of water or the air, wind measurements, height of the waves, etc). This means high volumes of structured, semi-structured, and unstructured data. These data are heterogeneous in type, format, and quality.

Work has been done on the integration of spatial data sets, but there are still many issues that have to be solved, mostly related to high volumes, data quality, data integration, data analysis, and data visualization. It is, therefore, necessary to develop specific methodologies for collecting (IoT), checking the quality and correcting (big data cleansing), integrating (big data management), analysing (big data analytics), and visualizing (3D, animated visualization) these data sets. These are common big data problems, but more advanced analytical tools need to be developed for Spatio-temporal data sets that propose unique challenges. Therefore, we need an integrated Spatio-temporal/social-network model. Spatial and social network models typically do not operate on the same scale, and they do not make consistent predictions. Moreover, current analytical models do not scale to the size of current data sets.

The overall project methodology consists in developing in parallel methodologies for (i) analysing and visualizing environmental data sets for coastal erosion and floods, (ii) integrating Spatio-temporal big data sets, and (iii) developing a spatial IoT allowing to collect in real-time data related to coastal erosion and floods. Then, prototypes will be implemented to validate the approach and methodologies.

## Key Research Areas

- (Spatio-Temporal) Data Collection
- (Spatio-Temporal) Data Management
- (Spatio-Temporal) Data Integration
- (Spatio-Temporal) Data Analytics
- (Spatio-Temporal) Data Visualization

## Key Experts

Professor Dr Patrice Boursier

Assoc. Prof. Dr Raja Kumar Murugesan

Assoc. Prof. Dr Sagaya S. Amalathas

Dr Sophea Prum

Dr Tan Ee Xion

Lim Eng Lye

Venantius Kumar Sevamalai

## Design Culture and Design Principles

### Overview

The question of design culture and practices is seemingly absent from the debate on contemporary design and especially from emerging design: a problem-based, solution-oriented design. The defining characteristic of which is not the products, services, and communicative artifacts it produced, but the knowledge, values, vision, and qualities criteria that emerge from the table of conversations occurring during design activities as well as the tools and methods it uses.

The area is identified as one of the diversified foci in design research at the design school where design/ designing can be a dynamic process with a transformative sense, that is enabling and even emancipatory. The research group works between theoretical reflection on the nature of design and case studies of design culture and practices, and from research-based perspectives to the experience-based perspectives of design insiders. The outcome of this area encompasses academic research and creative outputs.

### Key Research Areas

- Education And Pedagogy
- Tacit Design Knowledge
- Visual Culture

**Key Experts**


Dr. Yip Jinchi (Lead)


Mr Charles Naidu (Co-Lead)


Mr Vinod J. Nair


Ms Sherry Blankenship


Mr Asrizal Razali


Ms Nur Diana Rosli

**Website** www.kreatifbeats.com

**Selected Publications**

- Yip, J., Daniel, E. G. S. & DeWitt, D. (2019) Graphic Design as a Medium to Enhance Students' Knowledge of Malaysian Cultural Art Forms. Communication and Media in Asia Pacific (CMAP). 2(2), 55-75.
- Yip, J., Daniel, E. G. S. & DeWitt, D. (2019, December). Applying Interventions in a Graphic Design Classroom to Enhance Students' Knowledge of Malaysian Cultural Art Forms. Paper presented at the Eurasia Research International Conference Bali 2019.
- Nair, Vinod J. (2019). The Malaysian Number Plate: Typefaces Designed By Vinod J. Nair. KL, Wilayah Persekutuan: Taylor's Press.
- Nair, Vinod J. (2019, January 7). Should Not The Aim Of Life, Be An Aim In Education? Retrieved from:https://kreatifbeats.Com/2019/01/07/Should-Not-The-Aim-Of-Life-Be-An-Aim-In-Education
- Naidu, C.S. (2019, March 22). Read This And Level Up. Retrieved From: https://kreatifbeats.Com/2019/03/22/Read-This-And-Level-Up/
- Blankenship, Sherry (2019). Teach Less, Learn More. Retrieved From: https://kreatifbeats.Com/2019/03/16/Teach-Less-Learn-More/
- Razali, M., Ismail, N., & Hassim, N. (2018, November). The Role Of Experiential Learning In Creative Design Appreciation Among TDS Students At Taylor's University. *3rd International Conference On Creative Media, Design, And Technology (REKA 2018).* Doi:https://Doi.Org/10.2991/Reka-18.2018.46
- Yip, J., Mohd. Asrizal Razali & Noranis Ismail. (2018, September). Adapting Culturally Responsive Teaching To Enrich Experiential Learning In A Malaysian Graphic Communication Design Classroom. Paper Presented at The 3rd International Conference On Creative Media, Design And Technology (REKA 2018) https://Doi.Org/10.2991/Reka-18.2018.43
- Nair, Vinod J. (2018, September 24). Should Creative Disciplines Be Evaluated Differently In Universities? Retrieved from:https://kreatifbeats.com/2018/09/24/Should-Creative-Disciplines-Be-Evaluated-Differently-In-Universities/

- Blankenship, Sherry (2018). Immersive Oddities / When Will It All End. Retrieved From: https:/ kreatifbeats.Com/2018/11/29/Immersive-Oddities-When-Will-It-All-End-Exhibitions-At-Coda/
- Blankenship, Sherry (2018). Looking Around. Retrieved From https://kreatifbeats.Com/2018/08/01/Looking-Around/

# Design as future-making

## Overview

Design as Future-Making offers emergent models of design that are much needed today. This is especially critical now that virtually every object, place, and phenomenon is understood to exist in the ecology of forces and counterforces. This area explores how we're building possible futures through our everyday activities of talking, researching, curating, designing, and teaching – how can we intervene in this process through media inventions to build more flexible, accessible, and sensible futures?

The research group working on exploring creative and transgressive approaches to thinking about scientific and humanistic inquiry practices. It focuses and promotes the transformative design values where design/designer researchers become transformers who generate novel solutions through digital media that contribute to a more flexible world. The outcome of this area encompasses academic research and creative outputs.

## Key Research Areas

- AR/ VR/ MR Design Applications
- Transmedia Design (UI & UX)
- Connected Environment and Objects

### Key Experts


Mr Michael Choong (Lead)


Dr Noorhayati Saad (Co-Lead)


Mr Shamsul Hamimi


Mr Vickram Vijayan


Mr Charles Sharma Naidu

### Website [www.kreatifbeats.com](http://www.kreatifbeats.com)

### Selected Publications

- Nair, Vinod J. (2019, March 28). The Forgotten Stencil Typeface. Retrieved from: https://kreatifbeats.com/2019/02/28/the-forgotten-stencil-typeface/
- Wahed, W., Yusoff, S., & Saad, N. (2019). Reliability and Validity of a Questionnaire on Assessing the Aesthetic Perception of Design Motif Applied on Sarawak Pua Kumbu Cloth Using the Art Reception Survey (ARS). Journal Of Visual Art And Design, 11(2), 135-145. doi:10.5614/j.vad.2019.11.2.5 (ISI-Indexed)
- Wahed, W., Yusoff, S., & Saad, N. (2019). One Size Doesn't Fit All: Using Factor Analysis To Gather Validity Evidence When Using Art Reception Survey – Revised (ARS-Revised) On Sarawak Iban Pua Kumbu. Asia-Pacific Social Science Review.

### Intellectual Property Rights (IPR)

- NOMY Typeface © 2018
- MYNO Extended Typeface © 2018
- MYNO Typeface © 2018

# Social Design


## Overview

Social innovation based on dialogue and participation strives for new networking of the individual, civil society, government, and the economy. The social design thus presents a long-overdue study ranging from tracing the historical roots and foundations of social design, new infrastructures, and today's theoretical discourse as well as future trends of living by their inhabitants.

The area is identified as the new lines of social insistence in the world of design: that designers/ design researchers work to objectives of sustainability, access, safety to bring about social good or social change. The research group works on recognizing the value of design as a means of generating changes in the way we do things and what do we want to become. The outcome of this area encompasses academic research and creative outputs.

## Key Research Areas

- Design for Health and Well-being
- Spatial Design/Democratic Design
- Design for Hyperlocal Practices

## Key Experts


Dr Pouline Koh (Lead)


Ms Aidatul Kushairi (Co-Lead)


Mr Vickram Vijayan


Ms Norji Nasir


Ms Sharmila Sharer

**Website** www.kreatifbeats.com

**Selected Publications**

- Wong, ST., & Koh, PCL. (2018). An Investigation into the Presentation of Nutrition Claims as a Medium to Communicate Food Choices Among Malaysian Consumers. International, Journal of Advances in Science Engineering and Technology, Vol. 6, 45–50.
- Koh, PCL. & Rahman, Zainurul A. (2018). Tracing the Past: The Local Culture of Malaysian's Eating Habits and Lifestyles. Dynamism of Local Knowledge: Revisiting History and Culture. Penerbit Universiti Sains Malaysia, e-Pub 2018. eISBN: 978-967-461-202-3
- Koh, PCL., Rahman, Zainurul A., Hon, WM., Baboo, Shanti B. (2017). Design for Visibility and Wellness: Looking into Design Elements on Nutritional Labels. The International Journal of Visual Design 11(4), 17–34.

# Research Strategies & Action Plan 2019–2022

# Research Strategies and Action Plan 2019–2022

## School of Architecture, Building, and Design

| Primary Goals / Outcomes | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|
| **Number of Postgraduate students** | | | | | |
| **Number of PhD students enrolled** | 0 | 2 | 3 | 5 | 7 |
| Strategy | | To promote the visibility of the Ph.D. and nurture the Ph.D. community | To promote the visibility of the Ph.D. and nurture the Ph.D. community | To promote the visibility of the Ph.D. and nurture the Ph.D. community | To promote the visibility of the Ph.D. and nurture the Ph.D. community |
| Barriers | | 1. Competition from a public university, i.e. higher cost; visibility, and no track record<br>2. A small number of local Ph.D. students | 1. Competition from a public university, i.e. higher cost; visibility, and no track record<br>2. A small number of local Ph.D. students | 1. Competition from a public university, i.e. higher cost; visibility, and no track record<br>2. A small number of local Ph.D. students | 1. Competition from a public university, i.e. higher cost; visibility, and no track record<br>2. A small number of local Ph.D. students |
| Action Plan | | 1. To promote research programmes across universities locally and internationally via Roadshow (marketing budget to be secured for 2019 onwards) Twice per year (2019-2022) | 1. Establish 1 joint Ph.D. Programme with one foreign university (University of Adelaide – MoU to be signed by 2019) | 1. Establish 1 joint Ph.D. Programme with one foreign university (University of Salford) | 1. Establish 1 joint Ph.D. Programme by 2020 with one foreign university (University of Strathclyde) |
| PIC | | Programme Director (PhD) | Programme Director (PhD) | Programme Director (PhD) | Programme Director (Ph.D.) |
| **Diversifying research-based programmes (Master by research)** | | | | | |
| **Number of Masters by research students** | 0 | 0 | 0 | 10 | 12 |
| Strategy | | | To develop a new Master by Research programmes | | |
| Barriers | | | 1. Competition from a public university, i.e. higher cost; visibility, and no track record<br>2. High staff workload | | |
| Action Plan | | 1. New staff hire - 5 Headcounts | 1. Propose Master of Construction (Construction Law) with Massey University | 1. Propose Master by Research programme (Urban Design) | |
| PIC | | HoS | Dr. Myzatul Aishah | Dr. Camelia Kusumo | |
| Action Plan | | | | 2. New staff hire — 5 headcounts | |
| PIC | | | | HoS | |

| **Publications** | | | | | |
|---|---|---|---|---|---|
| **Impact Factor journal publications** | | | | | |
| **ISI/Scopus cited journal publications** | 0 | 15 | 20 | 30 | 35 |
| Architecture Heritage, History and Culture | | 5 | 7 | 10 | 10 |
| Affordable and Liveable Asian Cities | | 5 | 7 | 10 | 10 |
| Sustainable Design and technologies | | 5 | 6 | 10 | 15 |
| Strategy | To increase the total number of ISI/Scopus publications | To establish a Journal for the School | To leverage on external experts | To leverage on external experts | To leverage on external experts |
| Barriers | 1. A low number of research-active staff and experienced researchers<br>2. High teaching load | 1. Lack of standing in research hence challenge in gathering papers for publication<br>2. Set up a reputable Editorial Committee | Lack of visibility in the positioning of the School and research | Lack of visibility in the positioning of the School and research | Lack of visibility in the positioning of the School and research |
| Action Plan | 1. Faculty-wide workshops and training on ISI/Scopus publication to staff commencing last quarter of 2018 to improve the number of index publications | 1. Re-activate MASSA journal by last quarter of 2019 (the first issue to be published by 2020) with the first few issues to have papers from internal staff | 1. Engage experts—Appoint 1 Visiting OR Adjunct appointments to develop the research areas and outcomes *(Prof Hisham Elkadi)* | 1. Engage experts—Appoint 1 Visiting OR Adjunct appointments to develop the research areas and outcomes | 1. Engage experts—Appoint 1 Visiting OR Adjunct appointments to develop the research areas and outcomes |
| PIC | CRM | Prof Robert Rowell | HoS | HoS | HoS |
| Action Plan | 2. Research mentorship program within the School through Research Clusters | 2. Linkages - Industrial and international Collaborations (1 no. joint publications) | 2. Joint publications (Industrial and international Collaborations) (2 nos.) | 2. Joint publications (Industrial and international Collaborations) (2 nos.) | 2. Joint publications (Industrial and international Collaborations) (2 nos.) |
| PIC | All Research Clusters Lead | Dr. Camelia Kusumo | Research Cluster Lead | Research Cluster Lead | Research Cluster Lead |
| Action Plan | | | 3. Staff sent abroad to establish links (1 joint publication with International links) | 3. Staff sent abroad to establish links (1 joint publication with International links) | 3. Staff sent abroad to establish links (1 joint publication with International links) |
| PIC | | | HoS | HoS | HoS |
| **Books** | 2 | 2 | 2 | 2 | 2 |
| Strategy | Increase publishing collaboration | Increase publishing collaboration | Increase publishing collaboration | Increase publishing collaboration | Increase publishing collaboration |
| Barriers | Limited numbers of publishers focusing on architecture/construction | Limited numbers of publishers focusing on architecture/construction | Limited numbers of publishers focusing on architecture/construction | Limited numbers of publishers focusing on architecture/construction | Limited numbers of publishers focusing on architecture/construction |
| Action Plan | 1. Co-publication with the Malaysian Institute of Architects<br><br>2. MASSA publication relating to Modern Malaysian Architecture | 1. Co-publication with the Malaysian Institute of Architects<br><br>2. MASSA publication relating to Modern Malaysian Architecture | 1. Co-publication with the Malaysian Institute of Architects<br><br>2. MASSA publication relating to Modern Malaysian Architecture | 1. Co-publication with the Malaysian Institute of Architects<br><br>2. MASSA publication relating to Modern Malaysian Architecture | 1. Co-publication with the Malaysian Institute of Architects<br><br>2. MASSA publication relating to Modern Malaysian Architecture |
| PIC | Robert Powell | Robert Powell | Robert Powell | Robert Powell | Robert Powell |

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| **Visibility and International outlook** | | | | | |
| **International and National collaborations involving industry/research-related activities (MoA or Collaborations)** | | 1 International.<br>2 National | 1 International.<br>2 National | 1 International.<br>2 National | 1 International.<br>2 National |
| Strategy | | Establish linkages with industry and international stakeholders | Establish linkages with industry and international stakeholders | Establish linkages with industry and international stakeholders | Establish linkages with industry and international stakeholders |
| Barriers | | Lack of visibility in the positioning of the School and research | Lack of visibility in the positioning of the School and research | Lack of visibility in the positioning of the School and research | Lack of visibility in the positioning of the School and research |
| Action Plan | | 1. Industry collaboration - Veritas/GDP (1 output for visibility /positioning) | 1. Industry collaboration - (international - Partnership for AKTC Education programme) (1 output for visibility/positioning) | 1. Staff sent abroad to establish links (1 no.) to bring in 1 International Research Collaboration | 1. Staff sent abroad to establish links (1 no.) to bring in 1 International Research Collaboration |
| PIC | | HoS | HoS | HoS | HoS |
| **Organizing Conferences** | | | 1 | 1 | 1 |
| Strategy | | | Increase the visibility of School | Increase the visibility of School | Increase the visibility of School |
| Barriers | | | 1. Competition from organisations such as PAM and public university, i.e. visibility and no track record<br>2. Lack of expertise | 1. Competition from organisations such as PAM and public university, i.e. visibility and no track record<br>2. Lack of expertise | 1. Competition from organisations such as PAM and public university, i.e. visibility and no track record<br>2. Lack of expertise |
| Action Plan | | | 2. Organising Conference and Exhibition or the equivalent (1 no. each) | 2. Organising Conference and Exhibition or the equivalent (1 no. each) | 2. Organising Conference and Exhibition or the equivalent (1 no. each) |
| PIC | | | Dr Camelia Kusumo | Dr Camelia Kusumo | Dr. Camelia Kusumo |
| **Research Web Page** | | | | | |
| Strategy | | | 1. Increase the visibility of School through the web platform | | |
| Barriers | | | 2. Robust content to position the research projects of the School | | |
| Action Plan | | | 3. Build a research profile of the school through MASSA.net and repositioning of MASSA by 2020 | | |
| PIC | | | Koh Jing Hao | | |
| **Competitions** | | | 1 International<br>2 National | 1 International<br>2 National | 1 International<br>2 National |

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| Strategy | | | Increase the visibility of School through competitions | Increase the visibility of School through competitions | Increase the visibility of School through competitions |
| Barriers | | | Identifying suitable competitions aligned to the Curriculum and suited timing | | |
| Action Plan | | | 4. Participation in International and National Competitions | 4. Participation in International and National Competitions | 4. Participation in International and National Competitions |
| PIC | | | Stream Coordinators | Stream Coordinators | Stream Coordinators |
| **GRANT: External (within Malaysia)** | | 10,000 | 20,000 | 80,000 | 100,000 |
| Strategy | | Apply for govt. funding as well as industrial grants/sponsor | Apply for govt. funding as well as industrial grants/sponsor | Apply for govt. funding as well as industrial grants/sponsor | Apply for govt. funding as well as industrial grants/sponsor |
| Barriers | | Limited funding for-profit university, lack of experience in acquiring funding, lack of visibility | Limited funding for-profit university, lack of experience in acquiring funding, lack of visibility | Limited funding for-profit university, lack of experience in acquiring funding, lack of visibility | Limited funding for-profit university, lack of experience in acquiring funding, lack of visibility |
| Action Plan | | Increase industry/university collaboration that will bring in revenue through grant or consultancy<br>Attempt to apply for at least one international funding | Increase industry/university collaboration that will bring in revenue through grant or consultancy | Increase industry/university collaboration that will bring in revenue through grant or consultancy | Increase industry/university collaboration that will bring in revenue through grant or consultancy |
| PIC | | Dr. Keith Tan & Dr. Camelia Kusumo | Dr. Keith Tan & Dr. Camelia Kusumo | Dr. Keith Tan & Dr. Camelia Kusumo | Dr. Keith Tan & Dr. Camelia Kusumo |
| Strategy | | Increase the visibility of academics within the research community | Increase the visibility of academics within the research community | Increase the visibility of academics within the research community | |
| Barriers | | Lack of visibility | Lack of international visibility in the positioning of the School and research | The disintegrated and diversified research interest of current academics | |
| Action Plan | | All staff to build up research profile individually in at least one research network platform by 2019 (at least 1 per staff) | Build a research profile of the school through MASSA.net and repositioning of MASSA by 2020 | Refined scope of research to define core/flagship projects specific to the direction of the School | |
| PIC | | All Staff | Robert Powell | All research cluster leads | |
| **Internal** | | | | | |
| Existing Internal Grant | 250,000 | 200,000 | 170,000 | | |
| Internal | 300,000 | 50,000 | 130,000 | 320,000 | 320,000 |
| Strategy | | Collaborate within the School | Collaborate within the School | Set up flagship research projects | Set up flagship research projects |
| Barriers | | A small number of research-active staffs | A small number of research-active staffs | The disintegrated and diversified research interest of current academics | The disintegrated and diversified research interest of current academics |

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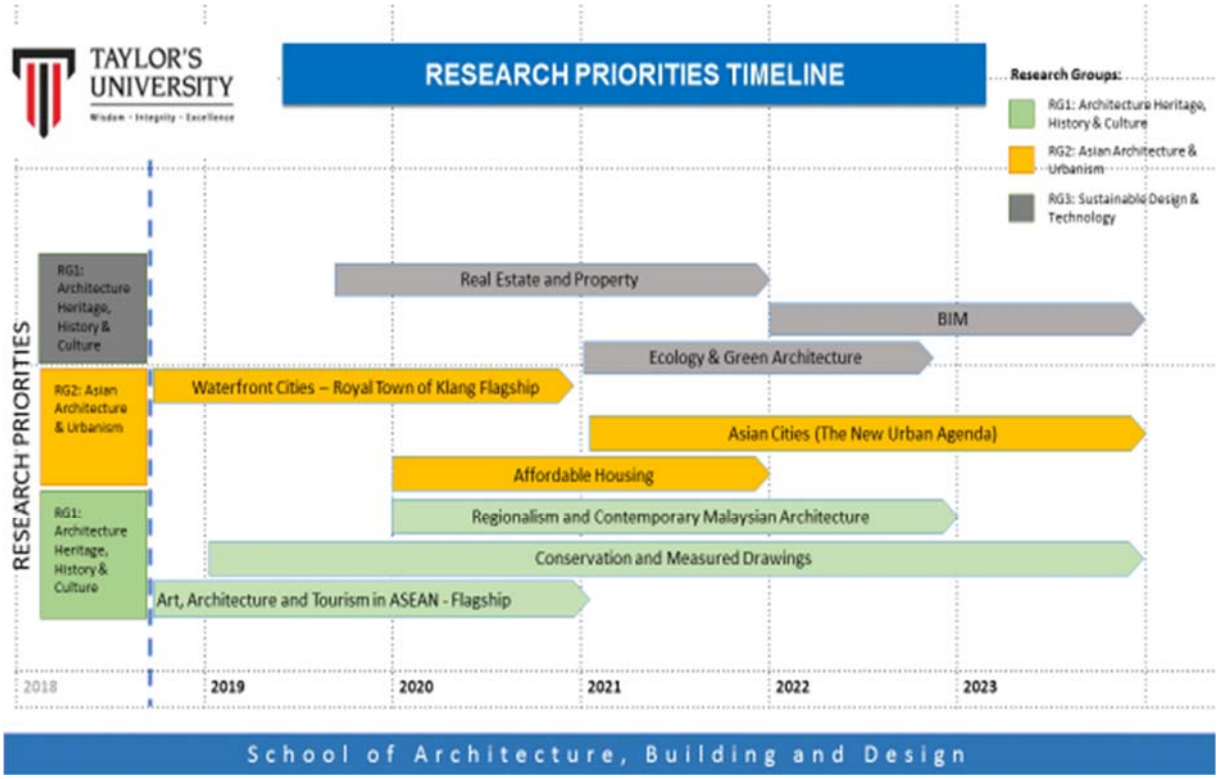
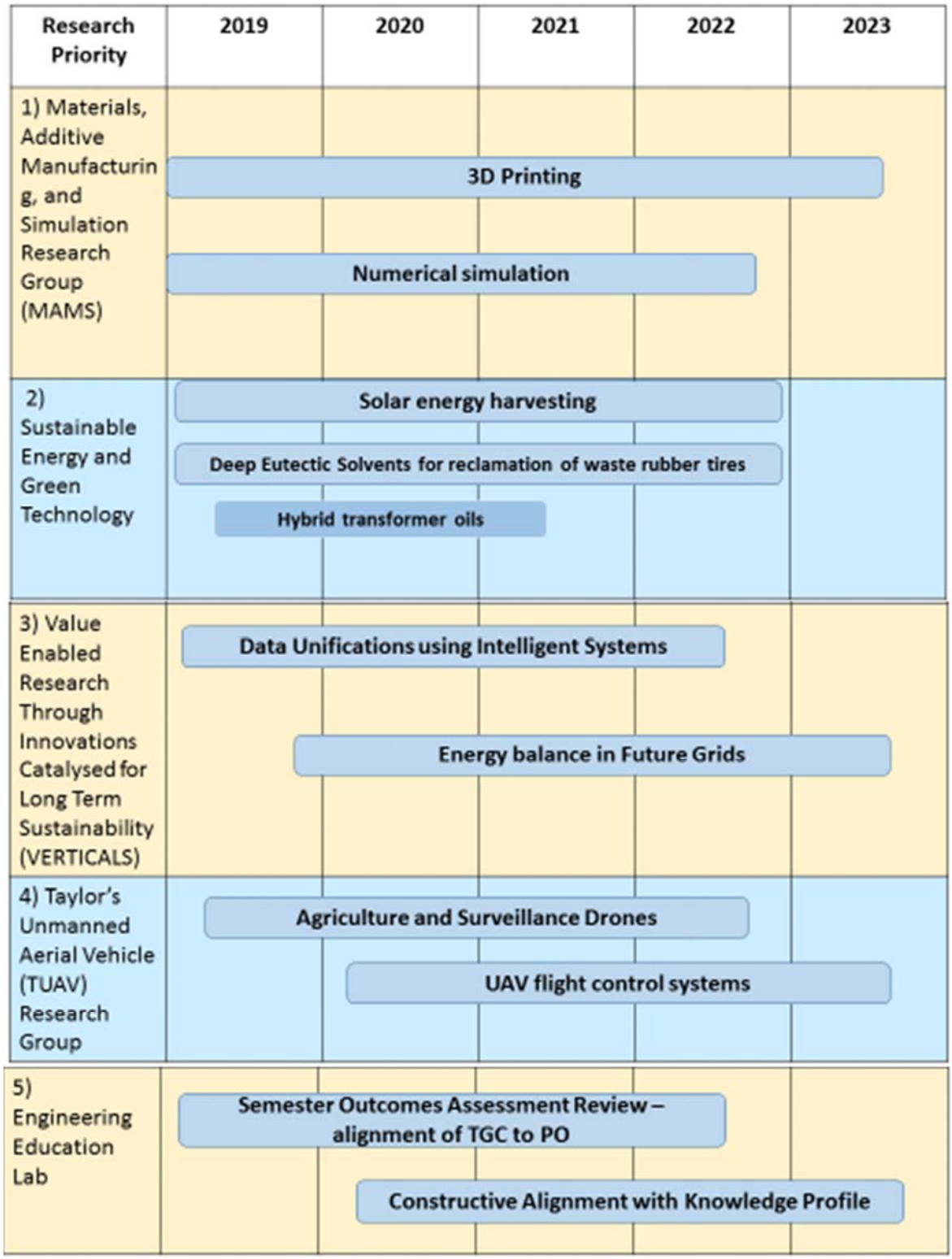
| Action Plan | | Research mentorship program within the School through Research Clusters, i.e. Collaboration between research active and non-research active staff within and across the school. | By 2020, All staffs have to apply research grant (individual/joint)<br><br>Every member of the research cluster to have published. | Identify flagship projects within research clusters to establish niche areas and apply the grant to fund a project (at least 1 per cluster) | Identify flagship projects within research clusters to establish niche areas and apply the grant to fund a project (at least 1 per cluster) |
| PIC | | All Research Clusters Lead | All Research Clusters Lead | All Research Clusters Lead | All Research Clusters Lead |
| Strategy | | Collaborate with other schools (multidisciplinary) | | | |
| Barriers | | A small number of research-active staffs | | | |
| Action Plan | | Generate multidisciplinary research proposal (School of THM, SoE, SoED, SLAS, SOCIT) | | | |
| PIC | | Dr. Keith Tan &<br>Dr. Camelia Kusumo | | | |



# School of Engineering

| Primary Goals / Outcomes | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|
| **Number of Postgraduate students** | | | | | |
| **Number of PhD students enrolled** | 14 | 25 | 33 | 41 | 50 |
| Strategy | To initiate a specific roadshow for the South Asian and Middle East market using the school's resources. | To initiate training for staff which enable them to attract external fund | | | |
| Barriers | High fees | Scarcity of scholarships high fees | Scarcity of scholarships high fees | Scarcity of scholarships high fees | Scarcity of scholarships high fees |
| Action Plan | PG roadshow July 2018, India | Staff research training workshop to be conducted in July every year | | | |
| 1) Materials, Additive Manufacturing, and Simulation Research Group (MAMS)<br>2) Sustainable Energy and Green Technology<br>3) Value Enabled Research Through Innovations Catalysed for Long Term Sustainability (VERTICALS)<br>4) Taylor's Unmanned Aerial Vehicle (TUAV) Research Group<br>5) Engineering Education Lab | Contribution of research groups (number of PG students under each RG) | | | | |
| | 1) 2, 2) 3, 3) 0, 4) 0, 5)0 | 1) 4, 2) 2.5, 3) 1.5, 4) 3, 5)5 | 1) 6, 2)4 , 3)4 , 4)6 , 5)7 | 1) 8, 2)6 , 3)6 , 4)8 , 5)9 | 1) 11, 2)9 , 3)9 , 4)10 , 5)11 |
| | 35% | 64% | 80% | 90% | 100% |
| PiC | HoS | HoS | HoS | HoS | HoS |
| **% of Publications in WoS** | 20% | 40% | 60% | 80% | 100% |
| Strategy | To build capacity, specifically train staff on how to produce high impact publications. | | | | |
| Barriers | None | None | None | None | None |
| Action Plan | To run the first research training workshop in August 2018. | To run a Research Training Workshop in August 2019. | School to support only publication that are made in WoS journals | | |
| 1) Materials, Additive Manufacturing, and Simulation Research Group (MAMS)<br>2) Sustainable Energy and Green Technology<br>3) Value Enabled Research Through Innovations Catalysed for Long Term Sustainability (VERTICALS)<br>4) Taylor's Unmanned Aerial Vehicle (TUAV) Research Group<br>5) Engineering Education Lab | Contribution of research groups (% of contribution from each RG towards the total) | | | | |
| | 1) 5, 2) 7, 3) 0, 4) 0, 5)8 | 1) 9, 2) 11, 3) 8, 4) 7, 5)12 | 1) 13, 2) 14, 3) 14, 4) 10, 5)14 | 1) 18, 2) 17, 3) 18, 4) 16, 5)16 | 1) 21, 2) 20, 3) 21, 4) 20, 5)18 |
| | 20% | 47% | 65% | 85% | 100% |
| PiC | HoS | HoS | HoS | HoS | HoS |

| | | | | | |
|---|---|---|---|---|---|
| **External Research fund/Revenue** | Consultancy/Commercialisation/Conference | | | | |
| | RM15000 | RM50000 | RM85000 | RM105000 | RM180000 |
| | External Find | | | | |
| | RM100k | RM200k | RM300k | RM400k | RM500k |
| Strategy | 1) To build capacity, specifically, train staff on how to apply for external funding.<br>2) To draft generic research proposals for utilisation when a call for proposals is announced around the key areas of research for the school. | | | To develop a programme/process for reciprocal research funding (similar to matching funds). | |
| Barriers | None | None | None | None | None |
| Action Plan | 1) To run the first training for external fund application in Aug 2018 | 1) To run a training for external fund application in Q3 of 2019 | 1) To run a training for external fund application in Q3 of 2020<br>2) To utilise the PG scholars to perform high quality lit reviews and assist research group leaders to develop generic proposals | To establish one partners for reciprocal fund application in Q2 of 2021 | To establish 2 new partners for reciprocal fund application in Q3 of 2022 |
| 1) Materials, Additive Manufacturing, and Simulation Research Group (MAMS)<br>2) Sustainable Energy and Green Technology<br>3) Value Enabled Research Through Innovations Catalysed for Long Term Sustainability (VERTICALS)<br>4) Taylor's Unmanned Aerial Vehicle (TUAV) Research Group<br>5) Engineering Education Lab | Contribution of research groups to external research fund/revenue (%) | | | | |
| | 1) 30, 2) 20, 3) 0, 4) 0, 5)0 | 1) 30, 2) 20, 3) 10, 4) 10, 5) 10 | 1) 30, 2) 25, 3) 10, 4) 10, 5) 10 | 1) 30, 2) 25, 3) 15, 4) 10, 5) 10 | 1) 30, 2) 25, 3) 20, 4) 15, 5) 10 |
| | 50% | 80% | 85% | 90% | 100% |
| PIC | HoS | HoS | HoS | HoS | HoS |
| **International Outlook— number of collaborations with international universities, including CDIO and GC network institutions (no. of MOAs)** | 1 | 2 | 5 | 7 | 9 |
| Strategy | 1) To expand a collaborative network with CDIO and GC related institutions.<br>2) To develop and sign MOAs with such institutions around items (1) - e.g. Dual PhDs and (3). | | | | |
| Barriers | None | None | None | None | None |
| Action Plan | 1) To be involved in the organising committee for Asia's first GC related workshop in August 2018<br>2) To participate in CDIO related events and enhance the profile of the school, May 2018, Vietnam | Sign 2 MoAs with CDIO/GC related institutions by Q4 of 2019 | 1) To take part in GC workshop, Q2/Q3 of 2020<br>2) Sign 2 MoAs with CDIO/GC related institutions by Q3 of 2020 | 1) To take part in CDIO Asian Regional Meeting, Q2/Q3 of 2021<br>2) Sign 2 MoAs with CDIO/GC related institutions by Q3 of 2021 | 1) To take part in GC workshop, Q2/Q3 of 2022<br>2) Sign 2 MoAs with CDIO/GC related institutions by Q3 of 2022 |
| PiC | HoS | HoS | HoS | HoS | HoS |


Research Priority
2019
2020
2021
2022
2023
1) Materials, Additive Manufacturing, and Simulation Research Group (MAMS)
3D Printing
Numerical simulation
2) Sustainable Energy and Green Technology
Solar energy harvesting
Deep Eutectic Solvents for reclamation of waste rubber tires
Hybrid transformer oils
3) Value Enabled Research Through Innovations Catalysed for Long Term Sustainability (VERTICALS)
Data Unifications using Intelligent Systems
Energy balance in Future Grids
4) Taylor's Unmanned Aerial Vehicle (TUAV) Research Group
Agriculture and Surveillance Drones
UAV flight control systems
5) Engineering Education Lab
Semester Outcomes Assessment Review – alignment of TGC to PO
Constructive Alignment with Knowledge Profile

# School of Computing and IT

| Primary Goals / Outcomes | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|
| **ISI/Scopus/ERA journals** | 40 | 25 | 30 | 40 | 50 |
| Strategy | Improve the competency of our students and staffs to publish high-quality research papers | Improve the competency of our students and staffs to publish high-quality research papers | Improve the competency of our students and staffs to publish high-quality research papers | Publishing with International collaborations | Publishing with International collaborations |
| Barriers | Limitation of experienced staff and Lack of research fund | Limitation of experienced staff and Lack of research fund | Limitation of experienced staff and Lack of research fund | Limitation of networking, lack of research fund | Limitation of networking, lack of research fund |
| Action Plan<br><br>*Implementation details*<br><br>*Target/frequency etc.* | a) Research Seminars, workshop Internal seminar 1 per month<br>+ Invite staff to present their research works<br>+ invite PG student to present their research works<br>+ invite external speaker (national and international) at least 2 times per year<br>+ organize seminar per research group 1 time per year and research group<br>+Internal workshop 1 per month<br><br>+ Main workshop<br>* How to write a scientific paper<br>* How to conduct a literature review<br>* How to conduct a Ph.D. thesis<br>* How to publish in ISI journals<br>* Machine Learning theory and hand-on<br>* Machine Learning in cybersecurity theory and hand-on<br>* AI theory and hand-on<br>* Latex<br><br>b) Mentoring staff and PG students competency<br>+ organize a meeting with PD, HOS, and supervisors 1 per semester<br>+ organize a meeting with PD, HoS, and PG student 1 per semester | a) Research Seminars, workshop<br>Internal seminar 1 per month<br>+ Invite staff to present their research works<br>+ invite PG student to present their research works<br>+ invite external speaker (national and international) at least 2 times per year<br>+ organize seminar per research group 1 time per year and research group<br>+Internal workshop 1 per month<br><br>+ Main workshop<br>* How to write a scientific paper<br>* How to conduct a literature review<br>* How to conduct a Ph.D. thesis<br>* How to publish in ISI journals<br>* Machine Learning theory and hand-on<br>* Machine Learning in cybersecurity theory and hand-on<br>* AI theory and hand-on<br>* Latex<br><br>b) Mentoring staff and PG students competency<br>+ organize a meeting with PD, HOS, and supervisors 1 per semester<br>+ organize a meeting with PD, HoS, and PG student 1 per | a) Research Seminars, workshop<br>Internal seminar 1 per month<br>+ Invite staff to present their research works<br>+ invite PG student to present their research works<br>+ invite external speaker (national and international) at least 2 times per year<br>+ organize seminar per research group 1 time per year and research group<br>+ Internal workshop 1 per month<br>+ Main workshop<br>* How to write a scientific paper<br>* How to conduct a literature review<br>* How to conduct a Ph.D. thesis<br>* How to publish in ISI journals<br>* Machine Learning theory and hand-on<br>* Machine Learning in cybersecurity theory and hand-on<br>* AI theory and hand-on<br>* Latex<br><br>b) Mentoring staff and PG students competency<br>+ organize a meeting with PD, HOS, and supervisors 1 per semester<br>+ organize a meeting with PD, HoS, and PG student 1 per semester | a) keep improving activities in writing in 2019 and 2020<br><br>b) invite researcher from overseas to conduct workshop and seminar (adjunct professors)<br><br>c) encourage research collaboration: joint research grant, joint Ph.D. or co-supervision with international partners<br><br>d) allocate budge for overseas trips for research collaboration (UWE, University of Kent, Birmingham university, FTP, ITC, NIPTICT, VIT) | a) keep improving activities in writing in 2019 and 2010<br><br>b) invite researcher from overseas to conduct workshop and seminar (adjunct professors)<br><br>c) encourage research collaboration: joint research grant, joint Ph.D. or co-supervision with international partners<br><br>d) allocate budget for overseas trips for research collaboration (UWE, University of Kent, Birmingham university, FTP, ITC, NIPTICT, VIT) |

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| | c) Allocate a budget for publications<br>+ School to allocate budge from industrial grant, consultation, etc. for publications<br>d) Improve staff personal networking<br>+ encourage staff especially supervisor to invite an external speaker to conduct a seminar at least 2 times per years | semester<br><br>c) Allocate a budget for publications<br>+ School to allocate budge from industrial grant, consultation, etc. for publications<br>d) Improve staff personal networking<br>+ encourage staff especially supervisor to invite an external speaker to conduct a seminar at least 2 times per years | c) Allocate a budget for publications<br>+ School to allocate budge from industrial grant, consultation, etc. for publications<br>d) Improve staff personal networking<br>+ encourage staff especially supervisor to invite an external speaker to conduct a seminar at least 2 times per years | | |
| PiC | SRC | SRC | SRC | SRC | SRC |
| **Grants from industry/interna-tional** | 80,000 | 120,000 | 140,000 | 160,000 | 200,000 |
| Strategy | Improve our competency, visibility, and our networks | Improve our competency, visibility, and our networks | Improve our competency, visibility, and our networks | Working with public and private sectors | Working with public and private sectors |
| Barriers | Lack of visibility, experience, expertise, research budget | Lack of visibility, experience, expertise, research budget | Lack of visibility, experience, expertise, research budget | Lack of visibility and experience | Lack of visibility and experience |
| Action Plan<br><br>*Implementation details*<br><br>*Target/frequency etc.* | a) Train staff and PG students to develop POC (please refer to the internal workshop)<br>* To conduct a special workshop on how to write a successful research grant<br><br>b) Organize joint research meetings with national /international universities (1 per year)<br><br>c) Attend local and international conferences<br><br>d) Organize meetings with Embassies, European High Commission<br><br>e) allocate budge for overseas trip for research collaboration (UWE, University of Kent, Birmingham university, FTP, ITC, NIPTICT, VIT) | a) Train staff and PG students to develop POC (please refer to the internal workshop)<br>* To conduct a special workshop on how to write a successful research grant<br><br>b) Organize joint research meetings with national /international universities (1 per year)<br><br>c) Attend local and international conferences<br><br>d) Organize meetings with Embassies, European High Commission<br><br>e) allocate budge for overseas trip for research collaboration (UWE, University of Kent, Birmingham university, FTP, ITC, NIPTICT, VIT) | a) Encourage staff and PG student to develop POC (2 POC per research group)<br><br>b) allocate budget to hire RAs or Programmers helping in the implementation<br><br>c) Organize joint research meetings with national /international universities (2 per year)<br><br>d) Attend local and international conferences<br><br>e) Organize meetings with Embassies, European High Commission<br><br>f) allocate budge for overseas trip for research collaboration (UWE, University of Kent, Birmingham university, FTP, ITC, NIPTICT, VIT) | a) Encourage staff and PG student to develop POC (4 POC per research group)<br><br>b) To organize meet-up day with universities and industrial on research and its application<br>* FinTech (inform, CIMB, Maybank)<br><br>c) allocate budget to hire RAs or Programmers helping in the implementation<br><br>d) Organize joint research meetings with national /international universities (2 per year)<br><br>e) Attend local and international conferences<br><br>f) Organize meetings with Embassies, European High Commission<br><br>g) allocate budge for overseas trip for research collaboration (UWE, University of Kent, Birmingham | a) Encourage staff and PG student to develop POC (4 POC per research group)<br><br>b) To organize meet-up day with universities and industrial on research and its application<br>* FinTech (INFOPRO, CIMB, Maybank)<br><br>c) allocate budget to hire RAs or Programmers helping in the implementation<br><br>d) Organize joint research meetings with national /international universities (2 per year)<br><br>e) Attend local and international conferences<br><br>f) Organize meetings with Embassies, European High Commission<br><br>g) allocate budge for overseas trip for research collaboration (UWE, University of Kent, Birmingham |

| | | | | | |
|---|---|---|---|---|---|
| | | | | university, FTP, ITC, NIPTICT, VIT) | university, FTP, ITC, NIPTICT, VIT) |
| PiC | SRC | SRC | SRC | SRC | SRC |
| **Gross income Consultancy/Commercialisation/Conference/KTP** | 10,000 | 40,000 | 80,000 | 110,000 | 160,000 |
| Strategy | Improve our Competency and POC productivities | Improve our Competency and POC productivities | Improve our Competency and application productivities | Improve our Competency and application productivities | Improve our Competency and application productivities |
| Barriers | Lack of Visibility, experience, and expertise | Lack of Visibility, experience, and expertise | Lack of Visibility. Lack of experience, expertise | Lack of Visibility. Lack of experience, expertise | Lack of Visibility. Lack of experience, expertise |
| Action Plan<br><br>*Implementation details*<br><br>*Target/frequency etc.* | a) Train staff and PG students to develop POC (please refer to the internal workshop)<br>* To conduct a special workshop on how to write a successful research grant<br><br>b) allocate budget to hire RAs or Programmers helping in implementation, | a) Train staff and PG students to develop POC (please refer to the internal workshop)<br>* To conduct a special workshop on how to write a successful research grant<br><br>b) allocate budget to hire RAs or Programmers helping in implementation, | a) Encourage staff and PG student to develop POC (2 POC per research group)<br><br>b) allocate budget to hire RAs or programmers helping in implementation, | a) Encourage staff and PG student to develop POC (4 POC per research group)<br><br>b) allocate budget to hire RAs or programmers helping in the implementation<br><br>c) To organize meet-up day with universities and industrial on research and its application<br>* FinTech (INFOPRO, CIMB, Maybank) | a) Encourage staff and PG student to develop POC (6 POC per research group)<br><br>b) allocate budget to hire RAs or Programmers helping in implementation,<br><br>c) To organize meet-up day with universities and industrial on research and its application<br>* FinTech (INFOPRO, CIMB, Maybank) |
| PiC | SRC | SRC | SRC | SRC | SRC |
| **Number of PhD students** | 10 | 20 | 27 | 30 | 35 |
| Strategy | Get more PG students under project grant, industrial grant, and partner universities (scheme C/D) | Get more PG students under project grant, industrial grant, and partner universities (scheme C/D) | Get more PG students under project grant, industrial grant, and partner universities (scheme C/D) | Get more PG students under project grant, industrial grant, and partner universities (scheme C/D) | Get more PG students under project grant, industrial grant, and partner universities (scheme C/D) |
| Barriers | Lack of expertise and experience in industrial project | Lack of expertise and experience in industrial project | Lack of expertise and experience in industrial project | Lack of expertise and experience in industrial project | Lack of expertise and experience in industrial project |
| Action Plan<br><br>*Implementation details*<br><br>*Target/frequency etc.* | a) refer to internal seminar and workshop<br><br>b) To organize a meeting with target universities and industries to promote scheme C/D scholarship<br>*target universities: (UWE, University of Kent, Birmingham university, FTP, ITC, NIPTICT, VIT)<br>*target companies: (MIMOS, INFOPRO, CIMB, Maybank) | a) refer to internal seminar and workshop<br><br>b) To organize a meeting with target universities and industries to promote scheme C/D scholarship<br>*target universities: (UWE, University of Kent, Birmingham university, FTP, ITC, NIPTICT, VIT)<br>*target companies: (MIMOS, INFOPRO, CIMB, Maybank) | a) refer to internal seminar and workshop<br><br>b) To organize a meeting with target universities and industries to promote scheme C/D scholarship<br>*target universities: (UWE, University of Kent, Birmingham university, FTP, ITC, NIPTICT, VIT)<br>*target companies: (MIMOS, INFOPRO, CIMB, Maybank) | a) refer to internal seminar and workshop<br><br>b) To organize a meeting with target universities and industries to promote scheme C/D scholarship<br>*target universities: (UWE, University of Kent, Birmingham university, FTP, ITC, NIPTICT, VIT)<br>*target companies: (MIMOS, INFOPRO, CIMB, Maybank) | a) refer to internal seminar and workshop<br><br>b) To organize a meeting with target universities and industries to promote scheme C/D scholarship<br>*target universities: (UWE, University of Kent, Birmingham university, FTP, ITC, NIPTICT, VIT)<br>*target companies: (Mimosa, INFOPRO, CIMB, Maybank) |

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| | c) allocate budge for overseas trip for research collaboration (UWE, University of Kent, Birmingham university, FTP, ITC, NIPTICT, VIT) | c) allocate budge for overseas trip for research collaboration (UWE, University of Kent, Birmingham university, FTP, ITC, NIPTICT, VIT) | c) allocate budge for overseas trip for research collaboration (UWE, University of Kent, Birmingham university, FTP, ITC, NIPTICT, VIT) | c) allocate budge for overseas trip for research collaboration (UWE, University of Kent, Birmingham university, FTP, ITC, NIPTICT, VIT) | c) allocate budge for overseas trip for research collaboration (UWE, University of Kent, Birmingham university, FTP, ITC, NIPTICT, VIT) |
| PiC | SRC | SRC | SRC | SRC | SRC |

## The Design School

| Primary Goals / Outcomes | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| **Number of new postgraduate students joining the PG programs** | Master: 2<br>Ph.D.: 2 | Master: 8<br>Ph.D.: 5 | Master: 14<br>Ph.D.: 8 | Master: 17<br>Ph.D.: 12 |
| Strategy | Increase marketing for transdisciplinary postgraduate design programme for higher visibility internally and externally | Increase design research network and resources to increase research capacity and supervision incentives for potential students | Identification of the most trending research topics in meeting various design strategic clusters and management | Attract high-quality potential student researchers to our design research postgraduate programmes |
| Barriers | Postgraduate programmes are new, more visibility is required to be seen and known in the market | Postgraduate programmes are new, more visibility is required to be seen and known in the market | The under-appreciation to Design Related research often perceived insignificant to national agenda compared to our immediate neighbourhood such as Thailand, Indonesia, and Singapore | Lacking in rigour and dynamic design research community and culture |
| Action Plan<br><br>*Implementation details*<br><br>*Target/frequency etc.* | 1. Market and position postgraduate programmes through in-house marketing collaterals and social media platforms (Q3).<br><br>2. Create Faculty/School Research Cluster Videos to inform/ educate the community about the postgraduate design research taking place on-campus (Q3-Q4).<br><br>3. A direct approach to industries/ companies to penetrate potential candidates (Q3-Q4). | 1. Recruit high-quality research-active new faculty, offer competitive start-up packages, and dedicate research working group on campus (Q2).<br><br>2. Develop expertise database of co-supervisor from partner universities and implement cross universities co-supervision to attract and expand research collaboration and exposure for students and staff (Q2-Q4). | 1. Correlate research trends against TDS research vision mission and research priority areas (Q1).<br><br>2. Change the basis and overcome the limitation / increase the scope of the past research - continuous building up of Knowledge overtime. (Q2).<br><br>3. Transdisciplinary Design approach and research as the bridge to exciting governmental and organisational priority areas (Q2-Q4). | 1. By communicating the excellence of our research and the vibrancy of the environment through the supervision work done in trending research topics (Q1-Q4).<br><br>2. Continue to promote the up-to-date research and commercialisation activities outputs with divesting pull of expertise through online and offline platforms (Q1-Q4). |
| PiC | HoS, D Hayati, CHDR & Marketing | 1. HoS<br>2. HoS; Dr. Hayati | Ph.D. supervisors + Ph.D. students | HoS, Dr. Hayati, CHDR & Marketing |
| **% of Publications** | Scopus cited journal publication: 2<br>Others: 2 | Scopus cited journal publication: 4<br>Others: 4 | Scopus cited journal publication: 6<br>Others: 6 | Scopus cited journal publication: 8<br>Others: 12 |
| Strategy | Translate practice & teaching documentation into basic research outputs | Increase basic research outputs through undergraduate supervisions | Increase cross-disciplinary research with other faculties/ universities by integrating the key areas of design research clusters through an annual conference | Expand cross-disciplinary research through PhDs supervision and utilize class projects with industry research. |
| Barriers | Staff lacked an understanding of how creative practice and teaching could be transformed into basic | Common expectations of research outputs across disciplines/ fields. Expecting teaching hours to be improved. | Finding common ground/ network to locate themes that incorporate existing research work. | Work between classes and programs needs more openness/ flexibility. Challenges to finding funding and support. |

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| | research outputs. They're only encouraged to focus on T&L, no proper guidance within the school; overloaded of teaching hours certainly discouraged activity involvement in research. | | | |
| Action Plan<br><br>*Implementation details*<br><br>*Target/frequency etc.* | 1. Increase the variety of design research topics among FYP students (Q3) and assign experts to educate staff on transferring practice into research (with AP Maizatul by Q4).<br><br>2. Instill personal development working model to guide academic staff to translate and document practice and teaching into producing 1 research paper - embedded into KPI (Q2–Q4).<br><br>3. Encourage staff to start writing by contributing to *Kreatif Beats* website — increase the interest to write (3 writings per staff by Q4). | 1. Introduce research Capstone for FYP students by piloting Research Methodology and FYP and enhance the supervision workflow; create an internal expertise database that allows students to engaged the areas of expertise and encourage staff to at least supervise 2 students for FYP, working towards publication 1 per staff (Q2–Q4).<br><br>2. Create incentives for the exchange of academic staff for teaching and research with other universities (Q2–Q4).<br>3. TDS research cluster to submit 2 research papers for publication (Q1; Q4). | 1. Through the annual TDS Design Conference, expand research networks across faculty/ other universities to invite research opportunities.<br><br>2. Each TDS research cluster to submit at least 3 research papers for publication through Ph.D. student's supervision (Q1; Q4).<br><br>3. Identify a few universities that will collaborate in research activities on an annual basis and seek outside funding (either local or international; Q2–Q4). | 1. Through the annual TDS Design Conference, expand research networks with industry/ government partners to seek outside funding for research projects.<br><br>2. Each TDS research cluster to submit at least 4 research papers for publication through Ph.D. student's supervision (Q1; Q4).<br><br>3. Continue to collaborate with other universities in research activities on an annual basis and seek outside funding (either local or international; Q2-Q4). |
| PiC | 1. HoS; PDs<br>2. HoS<br>3. HoS, *Kreatif Beats* Team | 1. HoS; PDs<br>2. HoS<br>3. HoS, Research Clusters 1,2,3 | All faculty + PHD + masters students | All faculty + PHD + masters students |
| **External Research Revenue (Research Grants)** | External: RM 15k<br>Internal: RM 5k | External: RM 20k<br>Internal: RM 8k | External: RM 30k<br>Internal: RM 10k | External: RM 40k<br>Internal: RM 15k |
| Strategy | Increase revenue through seed projects and industry research projects | Increase revenue through seed projects and industry research projects | Increase the application of suitable yet accessible grants nationwide and worldwide | Increase the application of suitable yet accessible grants nationwide and worldwide |
| Barriers | Lack of research strength focus; few active researchers; overloaded of teaching hours certainly discouraged activity involvement in research. | Lacking in rigor and dynamic design research community and culture. | Lack of writing experience for a successful winning proposal may result in challenges. | Lack of suitable funding/s can be the drawback in sustaining motivation. |
| Action Plan<br><br>*Implementation details*<br><br>*Target/frequency etc.* | 1 Case study via module learning to study the design of the Science Centre and obtain seed project funds for design insights (Research Cluster 1 kick-off by Q3).<br><br>2. To obtain a research partnership and funding with the Design Council (Q3–Q4).<br><br>3. Leverage on TLLM to | 1. Case study via module learning and Research Cluster 1 continue with Science Centre (Research Cluster 2 kick-off by Q2).<br><br>2. Expand partnership with Design Council and other entities leveraging on creating research data (Q3–Q4).<br><br>3. Curate Art & Design-Based Journal - start with | 1. Case study via module learning and Research Cluster 1 and 2 continue with the Science Centre (Research Cluster 3 kick-off by Q3).<br><br>2. Continue to develop Art & Design-Based Journal with Cluster 1,2,3 (Q1–Q4).<br><br>3. Research taskforce to submit at least 5 research grant applications with postgraduate students (Q2– | 1. Continue the case study via module learning and Research Cluster 1,2,3 with Malaysia Science Centre and neighbouring countries (Q2–Q4).<br><br>2. Extend the editorial board of Art & Design-Based Journal to partner universities to increase reputations (Q1–Q4).<br><br>3. Research taskforce to submit at least 8 research |

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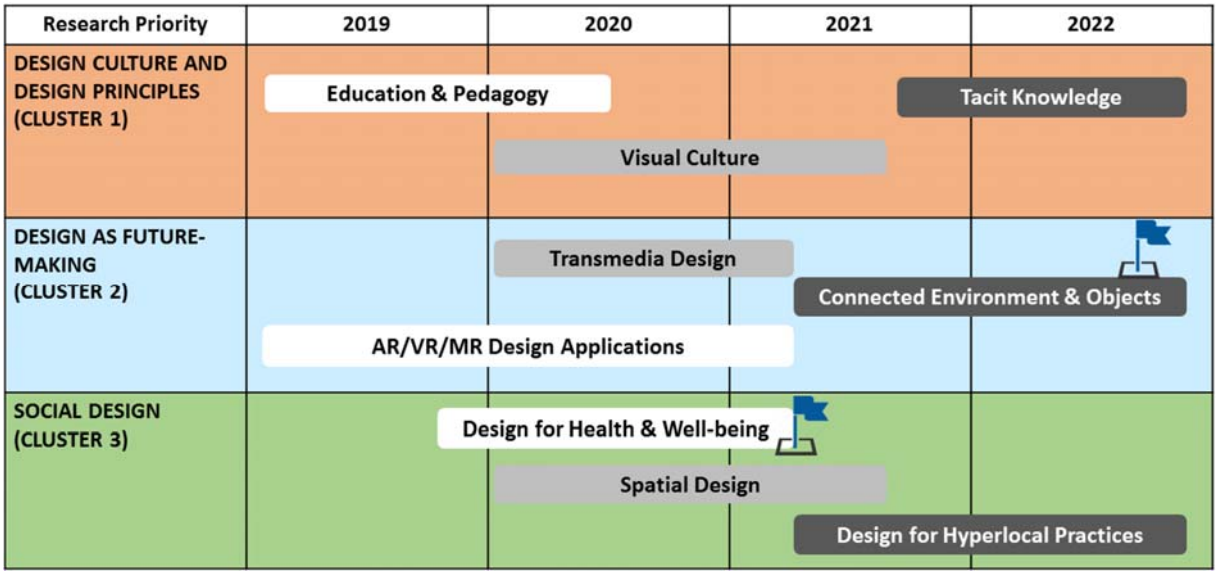
| | allow a more breathable teaching load. | Cluster 1 (Q3).<br><br>4. Set up research taskforce (all leads & co-leads) to prepare annual grant writing — at least 1 from each cluster with postgraduate students (Q2–Q4). | Q4). | grant applications with postgraduate students (Q2–Q4). |
| PiC | 1. HoS, Lecturers + Cluster Leader<br>2. HoS, Dr. Hayati<br>3. e-Learning Unit, HoS, PDs | 1. Module Lecturers + Cluster Leader<br>2. HoS, Dr. Hayati<br>3. HoS, Research Clusters<br>4. Research Clusters & Ph.D. Students | 1. Module Lecturers + Cluster Leader<br>2. HoS, Research Clusters<br>3. Research Clusters & Ph.D. Students | 1. Module Lecturers + Cluster Leader<br>2. HoS, Research Clusters<br>3. Research Clusters & Ph.D. Students |
| **External Research Revenue (Consultancy/ Commercialisation)** | RM 15k | RM 20k | RM 30k | RM 50k |
| Strategy | Promote applied research via design entrepreneurial initiatives & community engagement | The increase applied research through design innovation to deliver societal, cultural & design entrepreneurial impact | | |
| Barriers | Staff lack of understanding of how a creative project could be transformed into applied research.<br>Upskilling of staff skills to conduct training. | Finding new trending design projects to attract funding. | | |
| Action Plan<br><br>*Implementation details*<br><br>*Target/frequency etc.* | 1. TU CSR Project with social enterprise (Q3).<br><br>2. Staff conduct design/ software workshops to external participants (Q2–Q4).<br><br>3. The commercialisation of student's works (10 pcs by Q4).<br><br>4. Exhibition + Colloquium (Q4). | 1. TU CSR Project with social enterprise (Q3).<br><br>2. Staff obtains TTT cert to conduct design/ software training to external participants (Q2–Q4).<br><br>3. The commercialisation of student's works (15 pcs by Q4).<br><br>4. Organise Annual Design Conference (Q3/Q4). | 1. TU CSR Project with social enterprise (Q3).<br><br>2. Staff obtains TTT cert to conduct design/ software training to external participants (Q2–Q4).<br><br>3. The commercialisation of student's works (20 pcs by Q4).<br><br>4. Organise Annual Design Conference with industry collaboration (Q3/Q4). | 1. TU CSR Project with social enterprise (Q3).<br><br>2. Staff obtains TTT cert to conduct design/ software training to external participants (Q2–Q4).<br><br>3. The commercialisation of students works (25 pcs by Q4).<br><br>4. Organise International Design Conference (Q3/Q4). |
| PiC | 1. HoS & TU CSR unit<br>2. HoS & selected staff<br>3. TDS staff<br>4. Research Cluster 1,2,3 Lead & team | 1. HoS & TU CSR unit<br>2. HoS & selected staff<br>3. TDS staff<br>4. Research Cluster 1,2,3 Lead & team | 1. HoS & TU CSR unit<br>2. HoS & selected staff<br>3. TDS staff<br>4. Research Cluster 1,2,3 Lead & team | 1. HoS & TU CSR unit<br>2. HoS & selected staff<br>3. TDS staff<br>4. Research Cluster 1,2,3 Lead & team |
| **International Outlook: number of collaborations with international universities, including CDIO and GC network institutions (no. of MOAs** | Design School at Taylor's top 200<br>2017 QS World University Rankings by Subject | Design School at Taylor's top 150 for<br>QS World University Rankings by Subject | Design School at Taylor's top 100 for<br>QS World University Rankings by Subject | Design School at Taylor's top 80 for<br>QS World University Rankings by Subject |
| Strategy | Promote research clusters via creative collaboration with external university partners/ industry. | Increase more levels of engagement between the university and industry to foster a better understanding of capabilities and co-creation opportunities. | Expand engagement between the university and industry to increase co-creation opportunities. | |

| | | | | |
|---|---|---|---|---|
| Barriers | No research focus and clusters formed thus far, time, and assistance needed for staff to expand understanding working with the clusters. | Lack of scale and diversity of research activity; connectivity to design research network is limited. | Sustain existing and expand new working relationships. | |
| Action Plan<br><br>*Implementation details*<br><br>*Target/frequency etc.* | 1.Digital media creative collaboration (Research Cluster 2 with RMIT; Q2).<br>**1 MoU signing (Q4).<br><br>2. Embed Research Cluster 1 & 3 into the exchange of students learning with 1 ASEAN country via student activity week (Q3–Q4)<br>**1 MoU signing (Q4).<br><br>3. Increase the number of international contributors and more online visibility of *creative beats* as the design research platform of TDS (Q3-Q4). | 1. Establish creative collaboration with 3 partner universities in UK & Australia (Q2-Q4)<br>**3 MoU signing.<br><br>2. Introduce a working model for annual student activity week with 2 other countries (Q3).<br><br>3. Create incentives for the exchange of academic staff for teaching and research with other universities to expand reputations (Q2–Q4).<br><br>4. Curate art & design-based journal — start with Cluster 1 (Q3). | 1. Expand creative collaboration with 3 partner universities in the UK, Europe, Asia (Q2–Q4).<br>**3 MoU signing.<br><br>2. Expand the annual student activity week with 3 other countries (Q3).<br><br>3. Increase the exchange of academic staff/ staff to get an invitation for visiting professors to expand reputations (Q2–Q4).<br><br>4. Continue to develop Art & Design-Based Journal with Cluster 1,2,3 (Q1–Q4). | 1. Expand creative collaboration with 3 partner universities in the UK and Europe (Q2–Q4).<br>**3 MoU signing.<br><br>2. Expand the annual student activity week with 5 other countries (Q3).<br><br>3. Increase staff to get an invitation for visiting professors to expand reputations (Q2–Q4).<br><br>4. Extend the editorial board of Art & Design-Based Journal to partner universities to increase reputations (Q1–Q4). |
| PiC | 1. HoS; Research Clusters Lead 2<br>2. HoS; Research Clusters Lead 1 & 3<br>3. HoS; *Kreatif Beats* Team | 1. HoS; Research Clusters Lead 2<br>2 & 3. HoS; staff<br>4. HoS; Research Clusters 1 Lead | 1. HoS; Research Clusters Lead 2<br>2 & 3. HoS; staff<br>4. HoS; All Research Clusters | 1. HoS; Research Clusters Lead 2<br>2 & 3. HoS; staff<br>4. HoS; All Research Clusters |

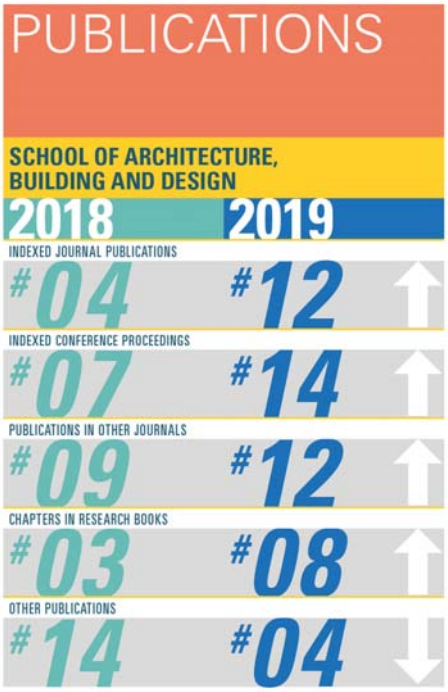


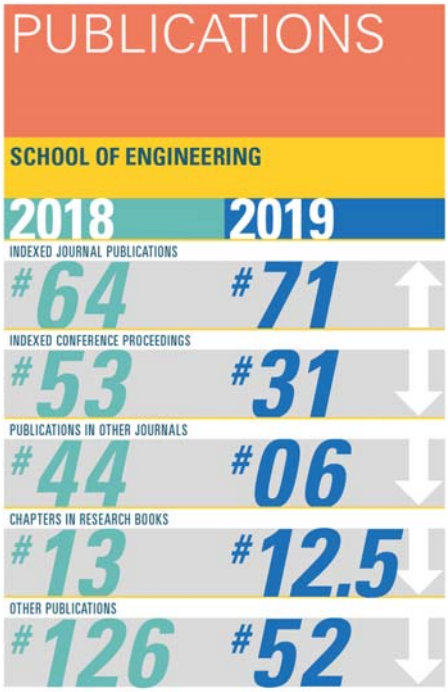
# Research Annual Report 2018 & 2019

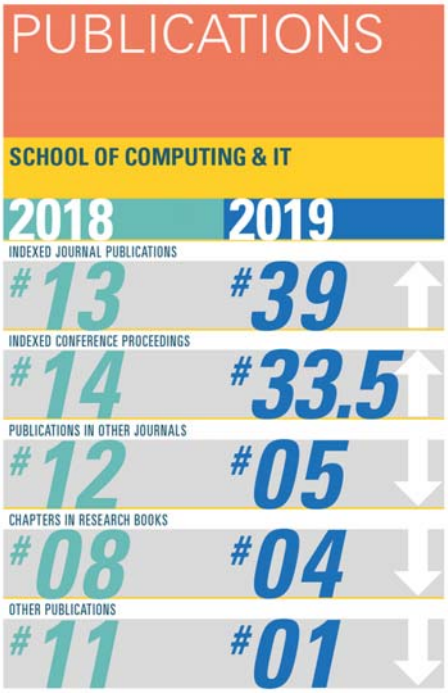
# Research Annual Report 2018 and 2019

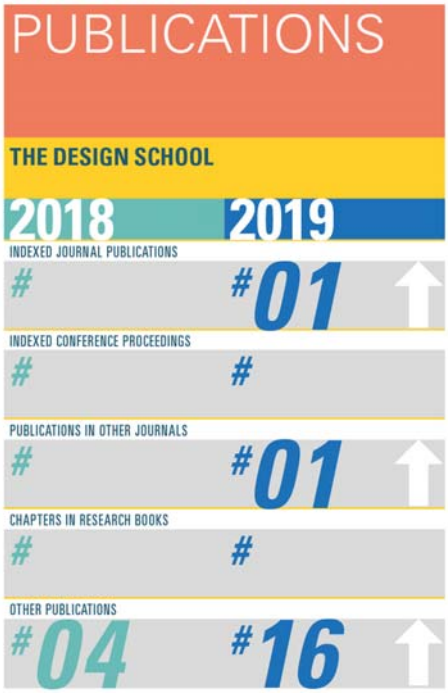
## Research Publications

The number of research papers published by the academic staff in the Schools across the Faculty of Innovation and Technology for the year 2018 and 2019 is given below.



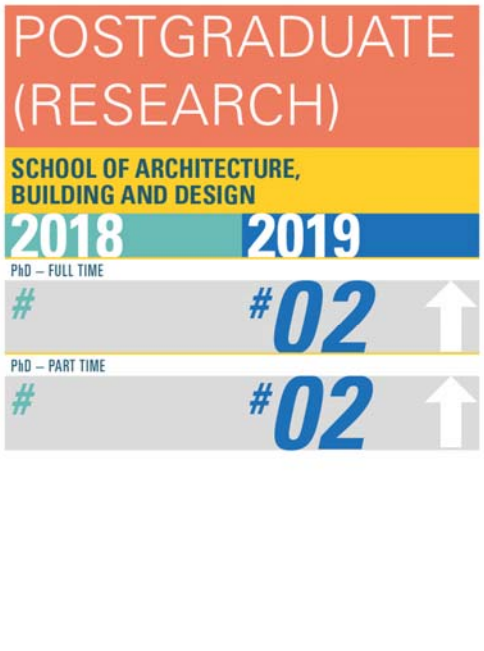



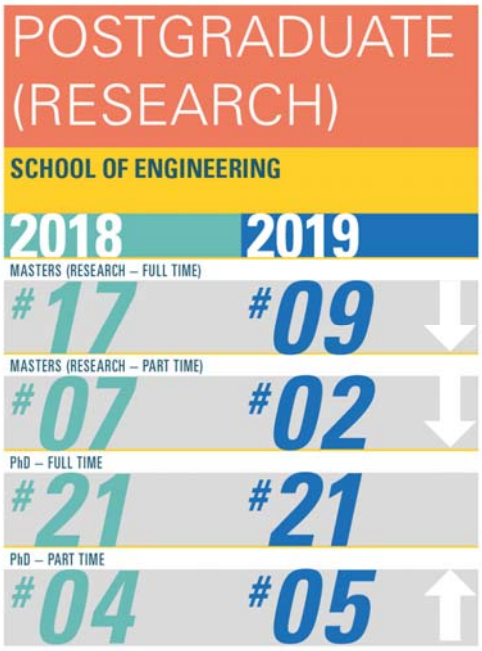
## Research Grants Obtained

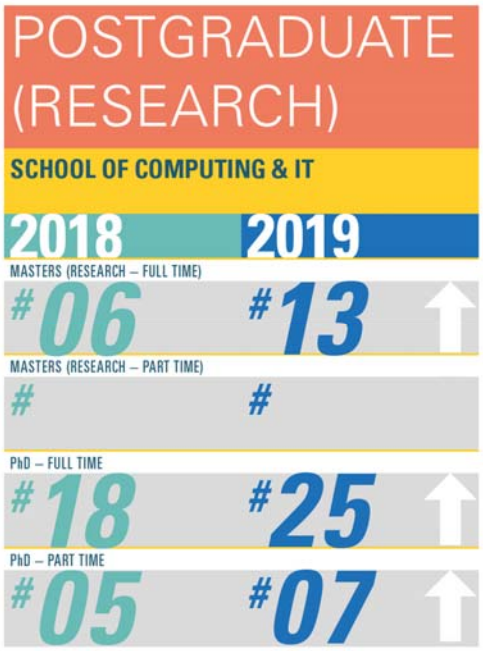
The amount of research grants obtained by the academic staff in the Schools across the Faculty of Innovation and Technology for the year 2018 and 2019 is given below.

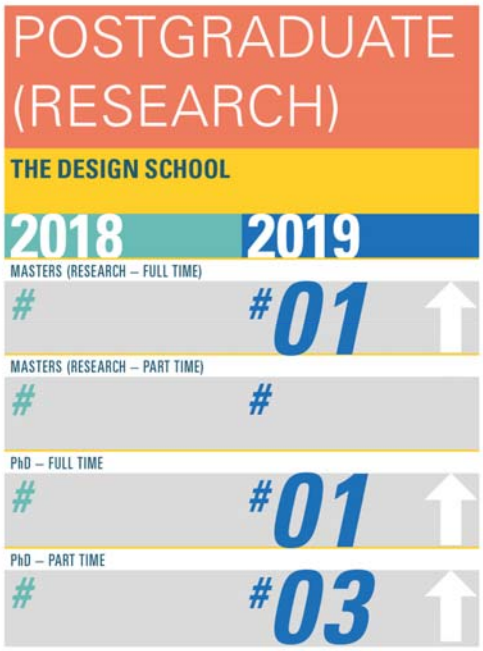
## Higher Degree by Research Students

The number of active postgraduate students by Research in the Schools across the Faculty of Innovation and Technology for the year 2018 and 2019 is given below.



# Research Grants

# Research Grants

## Energy-efficient rail brake for railway vehicles derived from linear switched motor technology

**Project Team**

Principal Investigator/Project Leader: Associate Professor Dr. Chockalingam Aravind Vaithilingam
Co-Researcher: Dr. Reynato Andal Gamboa

**Collaborating Organizations**

Dr Fairul Azhar, UTEM Malaysia
Dr Arthanari Jagadeeswaran, SONASPEED, India

**Synopsis**

A new double-mover configuration of a Linear Switched Reluctance Motor (LSRM). The design is based on the optimization of the emotional forces, to ensure a high-grade electromechanical energy conversion process. The force densities within and throughout a conventional linear reluctance machine (SRM) show that most of the force that is produced in its radial direction of the yoke and does not contribute to motion or twisting force of the rotor. If the normal forces happen to be in the direction of motion, a larger emotional force profile for SRM is yield. Based on these guidelines, a new LSRM investigated for a new version, to compare the energy conversion efficiency of LSRM with that of the conventional SRM; a finite element model is constructed. An experimental prototype of the proposed machine is developed, and the motor constant square density through the computations of the phase inductance is measured. The results presented based on prototype hardware testing indicate that the proposed geometry offers superior performance in terms of high-power density and a higher percentage of the national forces.

**GRA/Ph.D./Master candidates working on this project**

Aminath Saadha/MSc (Graduated)

**Funding Source**

TRGS – MFS
Taylor's University
RM 44,000
Project completed

# Rejuvenating forgotten waterfront settlements in Malaysia, with specific reference to the Royal Town of Klang

**Project Team:**

Principal Investigator/Project Leader: Dr. Camelia May Li Kusumo

Co-Researchers:

Professor Robert Powell

Hema Letchamanan, MSc

Dr. Mary Varghese

Dr. Elise Line Mognard

Dr. Sucharita Srirangam

Professor Moses Samuel

Dr. Jasmine Jain

Dr Logendra Stanley Ponniah

**Collaborating Organizations:**

Klang City Rejuvenation

Think City Sdn Bhd

**Synopsis**

Once, Klang as a Royal Town prided itself as the principal port of the state of Selangor, the gateway to the Malayan peninsula as well as a major agricultural center. Due to rapid urbanization and the rise of manufacturing activities in Malaysia in the 1970s, Klang is deteriorating rapidly. One of the essential elements to restore Klang's identity as a waterfront town and revitalize the economy and sense of place is by an understanding of its history, its dynamic, and the process of growth.

The intended research embraces a multi-disciplinary approach that is intended to produce an Integrated Sustainable Framework for reviving declining waterfront towns in Malaysia using Klang as an urban laboratory. The project draws upon expertise within the Faculty of Innovation and Technology and the Faculty of Arts and Social Science. There are five research components outlined above. It is expected that the outcomes of the research will be replicable in other waterfront towns and cities in Malaysia.

**Impact on society, economy, nation**

- The project has been presented at the World Urban Forum 2018
- To ensure that the research output addresses the issues of the society, an MoU between Taylor's University, Klang City Rejuvenation (KCR) and Think City Sdn Bhd has been signed on 11th August 2019. The MoU event has been widely covered by the national media.
- The work on Klang rejuvenation also has been covered by *The Star* newspaper and Taylor's University Research Insight.
- The research components 1 & 2 have a spin-off research project "Learning Space in Low-Cost Housing in Port Klang". A prototype of the Learning Space project was made in PPR Seri Berembang, Port Klang, with the funding from Urbanise Malaysia, which is the Think Tank of the Ministry of Housing and Local Governance of Malaysia (KPKT). The project has also been presented to Dato Maimunah Sharif, the Executive Director of UN-Habitat during the Malaysian Urban Forum in February 2019 (under the theme of Malaysian 100 Years Cities). This project has also been exhibited in Port Klang, during the Malaysian Urban Forum, and in Taylor's University.
- The research component 3 has developed an urban design proposal for a street and a square in downtown Klang. The research team, together with KCR and Think City, has presented the proposal to Dato' Menteri Besar of Selangor on 25th April 2019 and was covered by the Selangor media.

**Research Output**

- Sucharita, S and Kusumo, C. (2019) K*lang Centrality Through History: A Discussion on Syntax and Urban Morphology*. Journal of Engineering Science and Technology
- Powell, R, and Kusumo. C. (2018) *Rethinking the Public Realm: Behavioural Settings in Malaysian Cities.* Proceeding of 56th International Conference on Architecture and Civil Engineering (ACE 2018), Singapore.
- Kusumo, C., and Powell, R. (2019). *Kaki Lima: Why We Should Keep Five Footways in the Historic Core of Klang*. Proceedings of Architecture, Civil Engineering and Urban Design Conference (ACEU2019), Global Science & Technology Forum, Singapore
- Powell, R., and Kusumo, C. (2019). *Behaviour Settings Theory and the Rejuvenation of the Royal Town of Klang,* Proceedings of Architecture, Civil Engineering and Urban Design Conference (ACEU2019), Global Science & Technology Forum, Singapore
- Yeoh, B., Powell, R., and Kusumo, C. (2019). *Revitalizing an Urban Centre: Reviving Klang Bus Terminal as a Centrifugal Force in Central Klang*, International Transitional Journal of Engineering, Management & Applied Science and Technology, ISSN2228-9860

Seven academic papers on the project have been presented at different international conferences.

**GRA/Ph.D./Master candidate working on this project**

Afsara Akter, Master of Science (Tourism)

An exploratory study on the role of food trucks as a contribution to the food heritage making and improving interactions between Malaysians and tourists from the perspective of food truck operators and the tourism board of Malaysia.

**Funding Source**

TRGS
Taylor's University
RM 292,200
1 October 2017 – 30 September 2020

# Enhancement of human health and wellbeing in Asian cities

**Project Team**

Principal Investigator/Project Leader: Assoc Prof Dr. Mohammad Hosseini

**Co-Researchers**

- Prof Satesh Narayana Namasivayam
- Assoc Prof Dr Ghafour Amouzad Mahdiraji
- Assoc Prof Dr. Wong Eng Hwa

**Collaborating Organization**

Dr Faisal Rafiq Mahamd Adikan (Universiti Malaya)

**Synopsis**

Traditional acoustic materials, which have provided acceptable absorption rates for nearly all frequency bands, cannot satisfy all the issues related to environmental pollution and waste management. Acoustic materials from natural waste materials have received attention to address the dominant use of expensive and non-biodegradable materials. The natural substance has a high potential for sound absorption because of its lightweight, natural abundance, cost efficiency, biodegradability, and eco-friendliness. Thus, natural and recycled acoustic materials are valid alternatives to conventional synthetic materials. Recycled and natural granular materials are highly sustainable, non-combustible, and moisture-resistant acoustic absorption materials. Most granular absorbents contain air-filled pores, where sound absorption takes place due to the viscous boundary layer effect. The viscous loss occurs in the boundary layer of air adjacent to pore walls utilizing friction between the air molecules and the pore walls. This phenomenon causes the sound energy to be dissipated as heat. This research is focusing on the liveability and safety of Asian cities in two aspects. Firstly, it focuses on providing a quiet indoor environment using sound absorbers made of natural fibres. The second focus is to enhance the safety and well-being of humans using Structural Health Monitoring (SHM). Natural fibres are vastly available as agricultural waste in tropical countries such as Malaysia. Research has shown that these fibres can be used in acoustic absorption panels. The expected outcome of this section is a natural fibre composite that has an excellent acoustic absorption coefficient throughout the frequency spectrum and can be used safely in a humid environment at a reasonable price. SHM and geohazards such as landslide monitoring are very important for a sustainable living environment. The objective of this section is to make an integrated real-time monitoring system with affordable optical sensors. The reliability of the real-time monitoring system will be examined by installing various optical sensors on Taylor's University buildings while the performance of the landslide sensor after laboratory calibration will be validated in real in-situ in comparison to other commercial sensors.

**GRA/Ph.D./Master candidates working on this project**

Mansab Ali Saleemi, Ph.D. in Engineering programme
Vignesh Sekar, PhD in Engineering programme
Merlin Asha Manoah Johnson, Ph.D. in Engineering programme

**Funding Source**

TRGS
Taylor's University
RM 294,2001
Oct 2017 — 30 Sep 2020

# Spatial Big Data and IoT for coastal erosion and floods mitigation and prediction

**Project Team**

Principal Investigator/Project Leader Prof Dr. Patrice Boursier

**Co-Researchers**

- Dr. Sophea Prum
- Assoc Prof Dr. Sagaya Sabestinal Amalathas
- Assoc Prof Dr. Raja Kumar Murugesan
- Dr. Tan Ee Xion
- Tee Wee Jing

**Collaborating Organizations**

Dr. Effi Helmy Ariffin, Institute of Oceanography and Environment, Universiti Malaysia Terengganu

Dr. Tan Mou Leong, School of Humanities, Universiti Sains Malaysia

Prof Dr. Mike Phillips, University of Wales TSD, UK

Prof Dr. Florence Sedes, University Toulouse 3, France

Assoc Prof Dr. Frédéric Rousseaux, University of La Rochelle, France

**Synopsis**

With sea level rising, the number of people living in coastal areas is continuously and rapidly growing. Combined with storms, floods, and erosion, this has a strong impact on coastal populations, infrastructures, and ecosystems. Strategies and solutions depend on the availability of datasets related to the topography, the meteorology, and sea data (sea level, waves, currents, …). These data need to be combined and analysed effectively to derive knowledge and prediction. Big Data and Internet of Things (IoT) technologies (devices and software) can help attain the objectives. Big Data relates to the storage, processing, and analysis of large volumes and varieties of data, in a fast and reliable manner. IoT relates to the real-time collection of data using sensors connected to servers. Spatial Big Data solutions combined with IoT will help predict and mitigate risks related to floods and coastal erosion.

The research methodology will consist in developing in parallel methodologies (i) for analysing and visualizing environmental data sets for coastal erosion and floods, (ii) for integrating spatial big data sets, (iii) for developing a spatial IoT allowing to collect in real-time data related to coastal erosion and floods. Then, two prototypes will be developed to validate the approach and methodologies, one for coastal erosion and the other one for floods.

The overall objective is twofold:

- develop a methodology for integrating micro-computer based IoT (Raspberry Pi, Arduino) combined with GIS technology for coastal erosion and floods prevention and mitigation based on spatial data analysis,
- implement two prototypes to validate the methodology.
- The expected outcomes of the project are the following:
- a methodology for analysing and visualizing environmental data sets for coastal erosion and floods,
- a methodology for integrating spatial big data sets,
- a methodology for spatial IoT development,
- two prototypes validating the approach and methodologies.

The latest progress report was been submitted on 31 May 2019.

**GRA/Ph.D./Master candidates working on this project**

Venantius Kumar Sevamalai, staff / Ph.D. student
Lim Eng Lye, staff / Ph.D. student
Sohaib Al-Yadumi / full-time Ph.D. student
Christina Kang / Master student
Nicholas Lau / Master student

**Funding Source**

Taylor's Flagship Grant
Taylor's University
RM 261,200
October 2017–September 2020

# A framework for graphical visualization of criminal and terrorist networks using extreme learning and predictive modeling

**Project Team**

Principal Investigator/Project Leader: Associate Professor Dr. Azween Bin Abdullah

**Co-Researchers**

- Dr. Thulasyammal Ramiah Pillai
- Dr. Noor Zaman Jhanjhi
- Associate Professor Dr. Ramachandran Ponnan
- Dr. Sanath Sukumaran
- Professor Dr Murali Sambasivan

**Collaborating Organization**

Professor Aisha Abdallah Hashim, International Islamic University, Malaysia

**Synopsis**

Criminal network analysis (CNA) involves the use of graph theory models in the investigations of organised crimes (eg. narcotics trafficking, terrorism, armed robbery, fraud, etc.) and has been getting attention among law enforcement agencies globally as a powerful tool in the gathering of analytic intelligence for the identification of entities (both individuals or organisations) and their associated parties in syndicated criminal activities. Most of the methodologies and techniques based on graph mining used in CNA have been adopted and adapted from the field of Social Network Analysis (SNA). However, CNA poses its additional challenges in comparison to SNA due to the nature of criminal networks which tends to operate in a covertly and stealthy manner to evade law enforcement. This characteristic of criminal networks results in the collection of criminal activities data that tends to be incomplete and inconsistent which is topologically reflected in the criminal network in the form of missing nodes (actors) and links (relationships). In this respect, SNA models provide the mathematical models, algorithm computation, and metrics for the identification of possible interaction, connection, association, and the relationship between the nodes in the network which enables CNA to predict the possible hidden links between the entities of the criminal network. Analytical models rely on machine learning techniques to improve the performance of the model in terms of predictive accuracy and computational power. However, due to the nature of criminal networks, the dataset is relatively small compared to the social network. This poses additional challenges in the training of machine learning which relies on the availability of huge datasets to train machine-learning models. Taking into consideration recent developments in Deep Reinforcement Learning (DRL) techniques and the availability of the Graphical Processing Unit (GPU), the primary objective of this research is to develop a Criminal Network Link Prediction Model based on SNA link prediction metrics. This model, leveraging on DRL, is expected to overcome the need for a huge dataset for training purposes through a self-generated dataset. The performance of

this model is then be evaluated against classical supervised machine learning models such as Gradient Boosting Machine (GBM), Random Forest, and Support Vector Machine (SVM).

**GRA/Ph.D./Master candidates working on this project**

Lim Teng Soon, Ph.D. in Computer Science,
Leveraging Deep Reinforcement Learning For Criminal Network Hidden Link Prediction
Theyvaa Krishnan, Master of Computer Science,
Isomorphic Graph Analytic for Community Detection of Criminal Network

**Funding Source**

TFRS
Taylor's University
RM 255,200
1 October 2017–30 September 2020

# Modeling & Visualisation of Air Pollution and Its Impact on Health

**Project Team**

Principal Investigator/Project Leader: Dr. Thulasyammal Ramiah Pillai

**Co-Researchers**

- Prof Dr. Mohd Talib Latif (UKM)
- Assoc Prof Anna Marie Nathan (UM)
- Assoc Prof Dr. Jessie Anne De Bruyne (UM)
- Dr. Ibrahim Abaker Targio Hashem (TU)
- Dr. Kees De Hoogh (Swiss Tropical and Public Health Institute)
- Dr. Mohsen Marjani (TU)
- Dr. Rafiza Binti Shaharuddin (Institute for Medical Research)
- Dr. Sapna Shridar Patil (TU)
- Dr. Sarfraz Brohi (TU)
- Dr. Shajan Koshi (TU)
- Ms. Sukhminder Kaur (TU)

**Collaborating Organizations:**

Institute Medical Research of Malaysia
University Kebangsaan Malaysia
University Malaya
Swiss Tropical and Public Health Institute
Ministry of Health Malaysia

**Synopsis:**

Air pollution is one of the major public health concerns among developing countries such as Malaysia. Studies have shown that air pollution is associated with respiratory and cardiovascular morbidity and mortality. Cardiovascular and respiratory diseases are among the top causes requiring hospitalization and resulting in deaths based on the data of the Ministry of Health in Malaysia (Manan, 2016). Hence, there is a need to study the effects of air pollution on human health in Malaysia.

The pollutants, namely ozone ($O_3$), nitrogen dioxide ($NO_2$), carbon monoxide (CO), particulate matter ($PM_{10}$) and sulfur dioxide ($SO_2$) samples will be collected from the study area namely Greater Kuala Lumpur. The hybrid land-use regression (LUR) model will be developed to estimate the concentration of the pollutant ($\mu gm^{-3}$) using the predictor variables namely density residential land, industry, port, urban green, forest area, number of buildings, area of water, and traffic intensity. The LUR model is one of the most widely used exposures assessment tools in air pollution epidemiological researches to estimate pollutant concentration. These estimations will be used for

the quantification of the health impact namely all-cause mortality and respiratory and cardiovascular morbidity. The health impact due to air pollution will be determined and the concentration-response functions will be established. The concentration-response functions (odd ratios) will be obtained using three types of regression models (linear, logistic, cox).

This project will consolidate the findings of the air quality and health researches, data scientists, department of environment, ministry of health, and the public to have a deeper knowledge of Airborne Particulate Matter (PM) and its impact on human health. This study will develop and implement a methodology to assess the health impacts of particulate matter resulting from air pollution in Kuala Lumpur. This study will provide a database of measurement of health impact and air pollution exposure estimation for Kuala Lumpur.

Expected Outcome: At least 4 indexed publications, 1 Ph.D. and 2 Masters students

The data namely air pollution data, land use data, and health data for this project had been collected. We are currently doing the pre-processing of the data. Soon we will build the hybrid models to estimate the population exposure to air pollutants and quantify the health impact.

**GRA/Ph.D./Master candidates working on this project**

Abdullahi Akibu Mahmoud, Ph.D. (Computer Science)
Traffic-Related Air Pollution Model for Health Impact

Nurul Wan Farahm, Ph.D., Bio-Sciences
Modeling air pollution exposure for health impact assessment in an urban environment

Raja Sher Usmani, Ph.D. (Computer Science)
Predictive spatial model for cardiovascular effects of outdoor air pollution

**Funding Source:**

TFRS
Taylor's University
RM 211,200
1 October 2017–30 September 2020

# Stress Monitoring in Vehicles' Driveshaft

**Project Team**

Principal Investigator/Project Leader: Dr. Ghafour Amouzad Mahdiraji

**Co-Researchers**

- Mrs. Noor Zafirah Abu Bakar, Taylor's University
- Mr. Hazlan bin Meera Hussain, Proton Holdings
- Dr. Mohsen Nabi Poor
- Prof Dr Faisal Rafiq Mahamd Adikan, University of Malaya

**Collaborating Organizations**

Prof Dr Faisal Rafiq Mahamd Adikan, University of Malaya
Mr. Hazlan bin Meera Hussain, Proton Holdings

**Synopsis**

The optimal design of driveshaft components in vehicles requires detailed knowledge of the load distribution introduce into the system. The driveshaft abuse test is conducted by delivering excessive torque loading by sudden engaging the clutch. This event produces high transient torque and it is transmitted across the driveline. Currently, the test is conducted experimentally and the final torque at wheel is measured. The test is considered successful if no driveline components fail or there is no abnormal noise or vibration detected. If the component failed, for example, the driveshaft was broken, the engineer would investigate the failed component to improve the design. Once the design has been improved, the test is conducted again. This process is very costly and time-consuming. Even if the test is successfully conducted without any failure, there is no data to indicate the tendency of the components to fail.

In current technology, the torque of a rotating shaft is usually measured by strain gages combined with either a slip ring or telemetry. However, due to the bulky size, these methods are suitable only for one-point measurement.

This study proposes the development of a multiple points real-time stress monitoring system for rotating shaft that can provide load distribution over the entire driveshaft length with a centimeter resolution using fiber Bragg grating (FBG) sensors. In the past decade, FBG sensors have been used extensively in structural health monitoring systems. Very recently, a limited number of reports demonstrated torque and strain measurement using FBG sensors too. However, in all cases, it is used as a point measurement. While in this study, the goal is to map the load distribution over the entire driveshaft using arrays of FBG sensors distributed per centimeter. This allows the vehicle manufacturers to have the detail stress distribution on the driveshaft and provide significant cost and timesaving.

**Funding Source**

TRGS
Taylor's University.
RM 53,400
1 July 2018–31 December 2019

# Biometric and non-Biometric Authentication Systems on Smart Mobile Device: A survey

**Project Team**

Lim Eng Lye
Magdalene Chew Meow Khee

**Synopsis**

One of the most severe security threats to any computing device is the impersonation of an authorised user. User authentication is the first in the line of defense against this threat. Biometric and non-biometric approach have been developed to help to recognise and authenticate individual user of their devices. Three conventional authentication systems have been developed and used to verify user identity. Single-Factor Authentication (SFA) — use of a password (or a PIN code) to confirm the ownership of the user ID. The researcher then realised that SFA is not reliable to provide adequate protection due to several security threats. Then, they proposed Two-Factor Authentication (2FA). This authentication method couples the representative data (username/password combination) with the factor of personal ownership, such as a smartcard or a phone for a one-time password. Subsequently, Multi-Factor Authentication (MFA) was developed to provide a higher level of safety and facilitate continuous protection of computing devices (which includes mobile devices) as well as other critical services from unauthorised access. MFA uses biometrics, which is the automated recognition of individuals based on their behavioural and biological characteristics. However, the safety of these methods is questionable as there are many cases that sensitive data are still exposed due to theft or data breach. Hence, analysing the existing authentication systems (SFA, 2FA, and MFA) and new approaches can help to identify authentication techniques for various settings effectively. With this knowledge, an educational platform would be able to facilitate users to recognise a threat.

The methodology is as follows:

- 1. To identify the existing and new authentication systems that have been or are being used in different contexts.
- 2. To evaluate the solutions of authentication that have been currently used and the future.
- 3. To propose an implementation plan on a platform to educate vulnerable online users.

Current Progress

This research is divided into two parts. Prototype development and reviews of current authentication methods used in portable devices.

To date, the prototype is completed, and working on the literature/ journals related to biometrics and non-biometrics authentication has been gathered from various e-databases. At the moment, a poll of 300 journals and articles from various conferences. Systematic Review method will be used to categorise the journals to identify gap(s) within this subject area.

A conference paper was submitted to a Scopus index conference in May 2019 and waiting for the review outcome.

**Funding Source**

Taylor's University
RM 19, 500
1 May 2019–30 April 2019

# Energy Performance Assessment for Taylor's University

**Project Team**

Assoc Prof Dr. Chockalingam Aravind Vaithilingam
Ir Prof Dr. Satesh Namasivayam

**Synopsis**

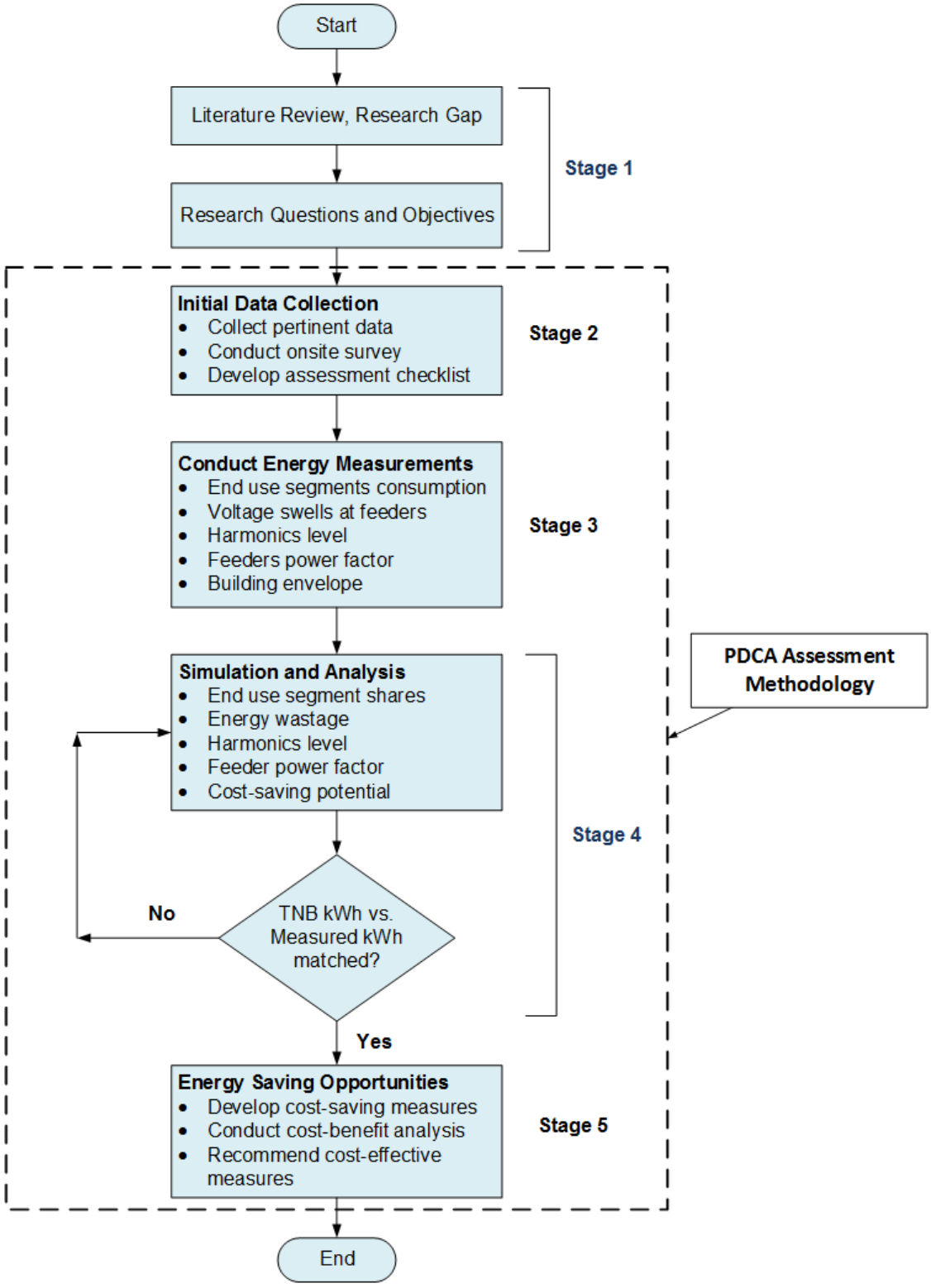
An energy end-use analysis is a periodical assessment embarked by the company if and when energy cost shows a substantial portion of the company's operating costs. Taylor's University (TU) in particular is heavily using energy in its day-to-day operations. According to the TU facilities management office, the latest 3-months electricity bill showed monthly consumption of 1,072,236 kWh, 1,130,720 kW, and 1,021,680 kWh for May to July 2017 respectively. This constitutes a monthly bill of RM 510,645.76, RM 533,532.65, and RM 485,764,17 for May to July 2017 respectively. In the same period, the peak demand registered 3,340 kW, 3,261 kW, and 3,097 kW with monthly demand charges of RM 98,172, RM 98,808, and RM 93,839 respectively. The bill is believed to be a significant portion of TU's monthly operating cost and the significance is much evident on the peak demand (maximum demand use) where, on average, it is roughly about 20% of the monthly bill. Peak demand is the power consumed over a predetermined period, typically between 8 to 30 minutes. The power is calculated using a power demand meter, which records the highest kW value in the period of measurement, over a month. The purpose of demand control is not to exceed the contracted maximum demand limit. The objective of this project is focused on the following:

- To formulate an energy management system that covers the active energy consumption (kWh), reactive energy consumption (kVARh), peak demand (kW), and operational power factor;
- To develop a strategy for reduction of kWh consumption addressing the reactive energy demand to improve the system power factor;
- To conduct a cost-benefit analysis of potential energy-saving opportunities through appropriate cost-effect effective recommendations.

To carry out the aforementioned objectives, the investigators will follow the proposed methodology detailed in Figure 1. The main activities in this assessment include the following:

- Initial Data Collection. This activity entails the initial planning by the investigating team that includes preparatory data collection, an onsite visit, and preparation of the assessment checklist.
- Energy Consumption Measurements. This activity will cover the actual measurements of energy consumption to include potential harmonics level, voltage swells, and feeder power factor at various points in the system. Measurements will be conducted using Fluke meter, model 435 series II.
- Simulation and Analysis. This pertains to the simulation and analysis of audit results to identify the prevailing issues on energy consumption wastes, potential harmonics level, voltage dip, and system power factor among others.

- Energy Saving Opportunities. This activity focuses on developing energy-saving opportunities with corresponding cost-benefit analysis.



**Progress to Date**

- Two RAs and one chargeman were hired to help conduct the actual energy audit of Taylor's University Facilities Energy consumption and organization of related documents and journal papers.
- One master student was registered in August 2018 to fulfill the grant PI but the student quit the program after 1 month due to his company work status. This left the project hanging.
- Two indexed publications were achieved in May 2019.
- In March 2018 semester, a grant extension of 6 months was requested budget reallocation was requested and was approved.
- Also, In March 2019 semester 4 RAs were hired to continue and finish the work left in the project to fulfill the adjusted PI.

**Funding Source**

TRGS
Taylor's University
RM 52,800
1 Feb 2018–19 July 2019)
Committed Outcome: 1 indexed publication, 1 Master student

**Project Extension Approved**

Extended Duration: 6 months (1 August 2019–31 January 2020)
Committed Outcome: Three indexed publications
Budget Reallocation Approved

| Vote | Allocation | Approved (RM) | Revised (RM) |
|---|---|---|---|
| Vot 11000 | Salary and Wages | 32,400.00 | 23,400.00 |
| Vot 21000 | Travelling Expenses | 1,000.00 | 1,000.00 |
| Vot 24000 | Rental | 10,000.00 | 10,000.00 |
| Vot 27000 | Research Materials and consumables | 400.00 | 2,400.00 |
| Vot 28000 | Maintenance, Minor Repair and Services | - | - |
| Vot 29000 | Professional Services | 9,000.00 | 16,000.00 |
| Vot 35000 | Equipment | - | - |
| **TOTAL** | | **52,800.00** | **52,800.00** |

# Effects of Microwave Sintering on the Properties of Manganese Oxide doped Y-TZP Ceramics

**Project Team**

Mr. Jeffrey Chin Kong Leong *(formerly at Taylor's University)*

**Collaborating Organizations**

Prof. Ir. Dr. Ramesh Singh, Universiti Malaya

**Synopsis**

Despite possessing key attributes of a biomaterial such as good mechanical properties, wear resistance, inertness, and biocompatibility, the aging or low-temperature degradation (LTD) behaviour of yttria-stabilized tetragonal zirconia polycrystals (Y-TZP) ceramic remains a major obstacle to the application of Y-TZP ceramic for biomedical applications. Premature failures of the zirconia femoral head component in hip prostheses had warranted an international recall of several batches of biomedical implants and left a questionable future of zirconia as a biomaterial. The application of manganese oxide ($MnO_2$) as a sintering aid for Y-TZP ceramics was found to result in good densification and superior aging resistance compared to undoped Y-TZP when sintered via conventional pressureless sintering. However, the relatively long soak time during the conventional sintering leads to significant grain growth and coarsening of grains that lowers the mechanical properties of the sintered ceramic. Microwave sintering is an alternative sintering method that leads to volumetric heating and allows for full densification to be achieved in shorter durations and possibly at lower temperatures compared to conventional sintering.

The present research aims to investigate the effects of microwave sintering on the properties of $MnO_2$-doped Y-TZP ceramics via different thermal profiles and dopant contents. Sintered samples will be characterized for their mechanical properties, phase content, and LTD resistance. The results of the research contribute to knowledge by elucidating the role of $MnO_2$ as a sintering aid for microwave sintering of Y-TZP ceramics. The outcome of the research could pave way for the development of Y-TZP ceramic with enhanced mechanical properties and aging resistance as a biomedical implant material. The microwave sintering process reduces the product cycle time for manufacturing zirconia ceramic implants. These outcomes of the research potentially contribute to two entry point projects underscored by the healthcare National Key Economic Areas (NKEA) - EPP 8: Create Next Generation of Core SUD (Single-Use Devices) Products and EPP 9: Build Hub for High-Value Medical Device Contract Manufacturing.

The project is still in progress under the Principle Investigator due to no postgraduate student had enrolled. Most project consumables have been purchased and experimentation is on-going.

**Funding Source**

Taylor's University
RM 46,000
June 2016–November 2017 (extended to May 2018)

# Variable-Sized Point Cloud Stitching

**Project Team**

Principal Investigator/Project Leader: Dr. Chew Wei Jen

**Co-Researchers**

- Dr. Lim King Hann (Curtin University, Malaysia)
- Dr. Chou Pui May

**Synopsis**

In the early days of computer vision, information of an object is kept using 2-dimensional (2D) data obtained from images taken using ordinary cameras. Information about the object was usually extracted out from its colour or intensity values. However, since most objects are 3 dimensional (3D), there is another range of information that has not been tapped into. The advantage of having the 3D model of an object is that various angles of the object can be explored. For example, for face recognition, using conventional 2D images, the unknown face obtain will need to be in the same angle as the face in the database to get a match. However, if the database consists of 3D images, then an unknown face captured at any angle can be used to make a match. 3D scanners are used to capture 2.5D point clouds from different angles of an object to help create a complete 3D model. This is achieved by combining the overlapping areas to help build the 3D model from multiple 2.5D point clouds. A few scanners located at different positions can be used at the same time to capture the various angles simultaneously. Usually, it is assumed that the point clouds obtained from various angles capture the image of the whole object from a common distance where the overlapping areas can easily be detected. However, if the object is closer to one scanner compared to another scanner, there is a possibility one of the 2.5D point clouds shows the whole object while another point cloud will only have one part of the object. Therefore, combining these point clouds will become an issue. In this research project, it is proposed that the overlapping portion of the point cloud from the smaller section will be extracted out and compared with the bigger point cloud section by section to find the accurate location on where the two-point clouds join each other. A combination of sliding window search and iterative closest point method will be used to help determine the best-matched section.

**Funding Source**

ERFS
Taylor's University
Amount approved: RM 20,000
1 November 2017–31st October 2018 (extended to 30th April 2019)

# Turning agricultural waste into nanocellulose via enzymatic extraction technique

**Project Team**

Principal Investigator/Project Leader: Dr. Chou Pui May

**Co-Researchers**


- Dr. Kelvin Chew Wai Jin
- Dr. Koay Seong Chun
- Dr. Lim Joon Hoong


**Synopsis**

Cellulose is the most natural polymer derived from plants. It can be extracted from agricultural wastes such as rice husks, coconut husks, and corncobs. The development of cellulose nanofibers has attracted significant interest in the last decade, owing to their unique characteristics such as high surface-area-to-volume ratio, high Young's modulus, and low coefficient of thermal expansion. Also, their excellent biocompatibility, large abundancy of economic sources, and low cost make them promising material for a variety of applications such as polymer nanocomposites, packaging, drug delivery, tissue engineering, and superabsorbent hydrogels. Various studies were reported on the preparation of cellulose via chemical treatment, *i.e.* acid hydrolysis. However, chemical treatment produces unwanted byproducts that lead to environmental problems, such as a huge generation of effluents and water consumption. Alternatively, a more environmentally friendly method, *i.e.* enzymatic treatment was introduced. Nevertheless, a study on the production of cellulose nanofibers using kapok husk and sago pith using enzymatic treatment has not been reported yet. Hence, the present study aims to synthesize cellulose nanofibers from kapok husk using an enzymatic treatment. The effect of processing parameters on the morphology, chemical composition, crystallinity, and thermal properties of the synthesized cellulose nanofibers will be investigated using field emission scanning electron microscopy (FESEM), Fourier transforms infrared spectroscopy (FTIR), X-ray diffraction (XRD), thermogravimetric analyzer (TGA) and differential scanning calorimetry (DSC). It is expected that a higher yield of cellulose nanofibers exhibiting excellent thermal properties will be produced using enzymatic treatment as compared to the conventional chemical treatment.

In current experimental works, the influence of reaction time and temperature on the yield, morphology, crystallinity, and thermal properties of the synthesized cellulose was studied and investigated. In this work, cellulose was successfully extracted from agricultural waste via enzymatic extraction technique. Different reaction times (i.e., 30, 60, 90, and 120 minutes) and different reaction temperatures (i.e., 45, 60, 75, and 90 °C) for the enzymatic extraction process were studied in detail. Characterization of the synthesized cellulose was carried out using, Scanning Electron Microscopy (SEM), Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), Thermogravimetric Analysis (TGA), and Differential Scanning Calorimetry (DSC). Based on the result obtained, the yield and thermal stability of the synthesized cellulose was decreasing as decreased reaction time and temperature during the extraction stage. The cellulose exhibited yield

up to 17.7%, high thermal stability with onset temperature up to 329 °C, melting point up to 281 °C and a crystallinity index of 71.88%. The results obtained clearly show that the chrysanthemum stem is one of the promising agricultural wastes to produce cellulose. However, the size of the cellulose was not in nano-sized. In other words, further modification of the synthesis method is required, aiming to produce nano-sized cellulose.

**Funding Source**

ERFS, Taylor's University
RM 24,600
1 May 2019–30 April 2019 (extended to 30 October 2019)

# Typologies of Design Thinking

**Project Team**

Associate Professor Dr. Veronica Ng,
Dr Sujatavani Gunasagaran &
Dr. Tamil Salvi Mari

**Collaborating Organizations**

Faculty of Built Environment, University of Malaya

**Synopsis**

The research aims to offer critical discourse on various perspectives on design studio teaching pedagogy. The research begins by exploring the generic literature that focuses on a range of instruments, approaches, and actions; the tools that the designers deploy to steer specific thought process in design. By keeping the learners at the core, the subjectivity of designers brought to the main focus here. Although there is much research works on studio environment and studio framework, only a very few focus on capturing evidence of the learners' creative thinking, and this research is an attempt to fill this gap and keeps the learners at the core of the analysis. The Case Study was the methodology and the methods were in-studio observations and online questionnaires. Two studios of Final Year studies of Part I, from University Malaya and Taylor's University, have been the case studies. The findings suggested 9 typologies of design thinking which could be categorized into 3 groups, based on the domain of the constructs. The typologies were: i) History | Materiality, ii) History | Memory, iii) User | Activity, iv) User | Settings, v) Professional Merit | Sustainability, vi) User | Perspectives, vii) Radical | Nature, viii) User | Economy and ix) User | Senses. These can be categorized into a) Positivistic or Hard typologies: pertinent to the elements of design such as form, function, circulation. The constructs are usually about objects and ideas; b) Critical or Soft typologies: pertinent to the intangible aspects of design such as concepts, principles, and qualities. The constructs are usually about people; and c) Interpretative and in-between or the hard/soft typologies: pertinent to the middle ground of both extremes, such as the articulation of things to form an experience. The constructs are usually about activity and events. The research concludes by reinforcing the importance of learner-led teaching pedagogy for architecture design studios, through formulating typologies of design thinking.

**Progress**

Completed

**Output**

- 1 paper published: PAM International Conference on Architectural Education, 7th August 2018
- 1 Paper accepted for publication: International Conference on Architecture and Civil Engineering, ICACE 2019, 26-27 June 2019

**GRA/Ph.D./Master candidates working on this project**

GRA: Ms. Kian Soon Jean, Master of Architecture
RA: Mr Vanarasu Vasudevan, BSc (Hons) in Architecture

**Funding Source**

TRGS
Taylor's University
RM 17,200
1 May 2018–30th April 2019

# Graduate Readiness: The Gap Between Learning and Employability

## Project Team

Principal Investigator/Project Leader (full name): Dr. Tamil Salvi Mari

## Co-Researchers

- Dr. Sujatavani Gunasagaran
- Dr. Sucharita Srirangam

## Synopsis

Employability is an imperative outcome of higher education, particularly in a professional degree such as architectural education. The pressure on Higher Educational Institutions (HEI) to produce employable graduates has intensified. In times of rising unemployment among highly educated, questions have been raised about the ability of graduates to meet the needs of the employers and the labor market. Current studies in the fields suggest two findings: a) that there is a critical need for evaluation of the learning in architectural education and the immediate need for interventions to prepare its graduates for the real world and b) that there are abundance employability skills related research in other fields with very limited in the architectural education in the Malaysian context. The study investigates and compares the experience and expectations of employers and graduates of architecture graduate work readiness to employability skills using a quantitative method. A total of 141 graduates and 85 employers completed a set of a survey measuring the same variables but from different perspectives. The collected data was analysed using SPSS v 25. Study findings show that perception of employers and graduates are similar for the architecture course and how it trains the graduates for practice: there is a small gap in graduates work readiness; of the architecture course curriculum which emphasizes theoretical knowledge to practical skills, and how it trains the graduates for the practice. The results revealed that the student's confidence level in their work readiness is at a moderate level ($M$ = 3.42., $SD$ = 0.843), concurring with the employers who reported that graduates are not entirely ready ($M$=3.62., $SD$=0.648). However, the employers' score employability skills are lower than the graduate's score, especially in areas such as knowledge of Uniform Building By-Law (UBBL) requirements and sustainable approaches (RK) (M=3.29, SD=0.881) and CTS (M=3.41, SD=0.837) respectively. Thus, the study suggests a set of opportunities in the current learning in architecture education can be transformed using "work-based learning" to enhance their employability skills

## Progress

Completed

**Output**

- 1 paper under publication and 2nd paper under review (the requirement was one paper)

**Funding Source**

TRGS
Taylor's University
RM19,700.00
1 May 2018–30th April 2019

# Improving Natural Frequency of an Engine Oil Pan – A Structural Optimization Approach

**Project Team**

Principal Investigator/Project Leader (full name): Noor Zafirah Abu Bakar

**Co-Researchers**

- Mohd Farid Aladdin
- Muhammad Ammar

**Collaborating Organizations**

Azmi bin Osman, PROTON, RND

**Synopsis**

Major sources of external vehicle noise and vibration come from the powertrain. The engine's oil pan contributes to a major percentage of the overall powertrain vibration particularly during idling and full load acceleration due to its thin wall structure. Designing an oil pan that optimally fulfills requirements in terms of structural, natural frequency, weight, costs, and packaging space for vehicles can be challenging. These requirements often compromise one another if the design has imbalanced priorities. Currently, structural optimization methods are being used to increase the natural frequency of an oil pan to avoid resonance that could contribute to excessive vibration but compromise with the addition of weight and material. This project's scope was to address a new structural optimization combination and to improve the design of an oil pan supply by Proton Sdn. Bhd. The research started with a modal analysis on the original oil pan using the finite element method and validated using a hammer test as experimental modal analysis. The baseline study shows the original oil pan with a natural frequency of 742Hz. before optimization of the new design, a curve base shape concept was used as a master template. Afterward, three structural optimization methods were used to evaluate using the finite element method. Using the intended method, the natural frequency of the new design can be as high as 1273Hz (70.7% improvement) with weight as low as 2.78kg (42.3% weight reduction). IP claim is in progress.

**Funding Source**

TRGS
Taylor's University
RM 14,070

# Sustainable energy harvesting unit for remote location

**Project Team**

Principal Investigator/Project Leader: Mohammad Taghi Hajibeigy

**Co-Researcher**

- Dr. Chockalingam Aravind Vaithilingam

**Synopsis**

The purpose of this work is to examine the energy and exergy in translucent Photovoltaic/Thermal (PVT) systems. Solar energy can cover a significant percentage of infrastructures, while the hybrid PVT systems cover heat demand electricity production. The analysis of the balance between the energy available and the energy utilized in the process of energy conversion is highly important in making this technology toward a mature level. The proposed system includes a PV array unit, enhanced solar collectors through the translucent model, a PowerPoint controller for optimized energy harvesting, and a converter-inverter module with robust controllers. The effect of the layered phase changing setup used to remove the thermal energy with an aluminium base, heatsink configuration on the thermal performance and efficiency of the solar collectors is to be studied. The proposed system involves a translucent PVT with improvised energy conversion for storing purposes using a layered phase changing topology where the conduction, convection, and radiation energy are taken away within the operational range through the estimator.

A two-layered phase changing topology is to be introduced to the calculated aluminium base to the PVT system and the heat sink model integrated into the aluminium surface for the removal of the heat from the integrated system model. The system, including a differential controller to increase the improvement of heat transfer by the circulating fluid. A metallic heat exchanger is placed on the PV rear surface for heat transfer. A maximum power point tracking logic is used to optimize the energy pickup from the sun through the experimental period. An inverter is used for inverting the voltage level to support the AC loads. The Integrated converter with MPPT— inverter-load setup as displayed. We have developed the full-system design and built the system accordingly.

**Objectives of the Research**

- To study the exergy balance in a photovoltaic thermal system
- To design layer to layer phase changing setup with heatsinks as a convective heat removing agent
- To test the PVT solar systems on the thermal performance and efficiency

We have developed the full system design and build the system accordingly. Presently we are on the last part of the milestone “Field test – mid-2019” and are set up on the second floor of Block E on the open area to collect data.

**Expectation outcome**

Have one master student on the grant (there is one master student currently). Submit a paper for publication, which has been submitted and is under review.

**Master candidates working on this project**

Mohamed Nazer, Mechanical Engineering
Sustainable Energy Harvesting Unit for Remote Location

**Funding Source**

TRGS
Taylor's University
RM 55,900
1 Feb 2018–31 Jul 2019

# A Material Flow Cost Accounting (MFCA)-based Approach for Sustainable Waste Treatment Plant Synthesis

**Project Team**

Dr. Wan Yoke Kin

**Co-Researchers**

- Dr. Yoon Li Wan
- Dr. Chow Yi Hui

**Synopsis**

Please provide an overview of the research that includes the *background of research*, *purpose* and *aim/objective*, *methodology*, *expected outcome* (output produced if the project is completed), and current *progress*.

Due to the dramatic rise of the human population and the rapid growth of industries, the waste production rate is getting higher. According to Hoornweg et al. (2015), 3 million tonnes of wastes were produced per day in the year 2000, and this amount is expected to hit 6 million tonnes by the year 2025. As a well-known fact that the wastes will cause severe impacts on the environment and the public's health if the wastes are not being treated properly. Hence, waste treatment is one of the important processes in the industry. To select proper and effective treatment technology, a selection tool is vital to be developed to synthesise a sustainable waste treatment plant. Apart from waste treatment, waste recovery is another important strategy to achieve environment-friendly production while also enhancing economic performance. In the past decade, a concept called Material Flow Cost Accounting (MFCA) has been used in numerous industrial applications (e.g., chemical, healthcare and pharmaceutical production, etc.). This concept has been proven in improving the overall economic performance of companies by reducing waste generation. MFCA is a tool of Environmental Management Accounting (EMA) (Fakoya and Van Der Poll, 2013) that focuses on imputing cost shares to waste streams (Kokubu et al., 2009). The ultimate purpose of MFCA is to mitigate environmental issues and concurrently improve economic performance (Onishi et al., 2008). Recently, Wan et al. (2016) developed a new approach by extending the concept of MFCA in the prioritisation of waste recovery. The developed approach can identify the waste stream to be prioritised for recovery. This helps to further improve the cost-saving plan in the waste treatment plant. Therefore, it is believed that MFCA is a potential concept that can be incorporated into sustainable waste treatment plant synthesis.

However, limited research has been done for the synthesis of a sustainable waste treatment plant using the concept of MFCA, especially on biological wastewater. Therefore, this research work aimed to develop an MFCA-based approach to synthesise a sustainable biological wastewater treatment plant. To develop the approach, data collection and data analysis have been conducted. The data collected include the characterisation of wastewater, the removal efficiency of wastewater treatment technologies, etc. Also, the developed approach has involved a series of chemical engineering-based

equations (i.e., volumetric flow balance, contaminant balance, and cost computation equations) and have been solved using commercial optimisation software, LINGO.

The approach is developed as one of the decision-making tools in selecting the treatment technologies for the synthesis of a wastewater treatment plant to have better economic performance. This initiative is aligned to one of the key focus under the Eleventh Malaysia Economic Plan (2016-2020), which is pursuing green growth for sustainability and resilience to ensure the sustainability of the nation's natural resources, minimise pollution, and strengthen energy, food, and water security.

**Funding Source**

TRGS-ERFS, Taylor's University
RM 20,900
I November 2017–30 April 2019

# Diagnosis of lung-related diseases by assessing vibration patterns of structures in the thoracic cavity

**Project Team**

Principal Investigator/Project Leader: Assoc Prof Dr. Mohammad Hosseini

**Co-Researchers**

- Prof Dr. Satesh Narayana Namasivayam
- Dr. Narendiran Krishnasamy
- Assoc Prof Dr. Wong Eng Hwa
- Dr. Priya Madhavan

**Synopsis**

In the field of engineering, diagnosing a faulty machine and monitoring a patient's health status are the main areas in which vibrations are used as an assessing or measuring tool. By conducting frequency analysis using conventional analysers, these vibrations can be measured to determine the life span and to predict any impending problems within a machine or structures within a human's chest wall or thoracic cage. A human chest wall encloses structures such as lungs, ribcage, and muscles that support their movements that undergo dynamic motion during the act of breathing. This dynamic motion is referred to as vibrational energy at the human chest wall. Medical students are taught to measure these chest wall movements by placing their hands over the front and back of the chest wall. Malaysia is currently facing challenges due to the long waiting time for radiological diagnostic services. The conventional approach for detecting lung-related diseases is to capture the x-ray image of the chest and examine for lung deformations. This research is proposing a new technique for preliminary diagnosis of lung-related diseases based on processing the vibration patterns of structures in the thoracic cavity. Data will be obtained from two resources; one from an available online database, and the other by conducting experiments using accelerometers connected to a data acquisition system which is controlled by Labview software. Accelerometers are connected to the chest wall to capture the time-domain data, which will be stored and pre-processed on a PC. Power Spectral Density (PSD) and Short-Time-Fourier-Transform (STFT) will be used to post-process the data and characterize patterns related to signals obtained from healthy subjects and those from patients with lung problems. A computer program is developed at the last stage to make the pattern recognition automatic; spontaneously pinpoint the potential lung-related issues after feeding the chest wall vibration signal into the program. The continuation of this study has the potential for IP and commercialization in the future. In that case, the computer program has to be embedded into handheld hardware that can be used at home or clinics for preliminary investigation of lung problems.

**GRA/Ph.D./Master candidate working on this project**

Muhammad Hadi bin Saleh, Research Assistant

**Funding Source:**

Taylor's University Major Research grant scheme
RM55880
1 July 2017–30 July 2019

# The fabrication and characterisation of self-cleaning, bioinspired micro-topographies developed with 3D printing and benchtop methods

## Project Team

Principle Investigator: Dr. Felicia Wong Yen Myan

## Co-Researchers

- Dr. Yong Leng Chuan
- Dr. Cheah Kean How

## Collaborating Organizations

Dr. Cheah Kean How (Herriott-Watt University, Malaysia)

## Synopsis

Research background

Self-cleaning surfaces consist of topographies that are micrometers in scale [1]. Conventional lithographic methods to fabricate micro-sized topographies usually require precision equipment and infrastructure [2]. Aside from the high costs, current methods for microfabrication do not provide the flexibility to produce microstructures on larger surface areas (i.e. more than 6 inches in width and breadth) in a reasonable period. 3D printing is a potential alternative for microfabrication yet to be investigated to produce self-cleaning topographies.

Objectives

- To develop moulds of bioinspired micro-topographies with a 3D printer
- To cast bioinspired micro-topographies from the 3D printed moulds using the silicone rubber, Polydimethylsiloxane (PDMS).
- To investigate if the PDMS topographies possess physical properties that are comparable to the literature.

Methodology

- *Development and fabrication of moulds for micro-topographies* Three-dimensional (3D) CAD models of 3 bioinspired micro-topographies will be drawn using SolidWorks, saved in STL format, and uploaded into the 3D printer for printing. The printed products will be moulds for the next stage of the methodology (i.e. stage ii)
- *Replication of topographies using PDMS casting* The PDMS material consists of a two-part Sylgard 184 silicon elastomer kit (Dow Corning Corporation) that was prepared according to the recommendations of the manufacturer. Ten parts of the resin will be mixed with one part of the curing agent and degassed for at least 20 minutes. The mixture will then be poured into the moulds and degassed for another 20 minutes. Next, both mould and resin mixture will be

placed on pre-heated hot plates (40°C) for 30 minutes. Moulds with partially cured PDMS are then removed from the hot plate and allowed to cool and cure completely at room temperature. Cured PDMS sheets will be carefully peeled from the moulds.

- *Characterisation of the topographies with Laser Confocal Scanning Microscopy* Findings in the literature often discusses the correlation between surface roughness with the efficacy of self-cleaning surfaces [1]. LCSM will be used to measure the roughness parameters of the printed topographies.

**Current status of the project.**

The project is in its last stages. The end date or the grant has passed. The only thing that remains is the submission of the final report and submission of another manuscript for publication into a suitable journal.

**GRA/Ph.D./Master candidates working on this project**

Darwen T. Balakrishnan, School of Engineering (Mechanical Engineering). The rapid prototyping of bio-inspired topographies by developing a mould using a 3D printer

Goeh Kar Jian, School of Engineering (Mechanical Engineering). Development of hierarchical topographies with benchtop methods and comparisons of its self-cleaning characteristics with single-layered micro topographies

Leow Zyncoln, School of Engineering (Mechanical Engineering). The numerical analysis to understand the characteristics of flow around a honey-comb topography to biofouling control.

**Funding Source**

Taylor's University
RM 29,500
1 November 2017–30 April 2019

# Polylactic Acid Biocomposites for Biodegradable Disposable Plastic Product

**Project Team**

Principal Investigator/Project Leader: Koay Seong Chun

**Co-researchers**

- Pang Ming Meng
- Chou Pui May
- Chan Ming Yeng
- Tshai Kim Yeow
- Chantara Thevy

**Collaborating Organizations**

Chan Ming Yeng, HELP College of Arts and Technology
Tshai Kim Yeow, University of Nottingham Malaysia
Chantara Thevy, Malaysian Nuclear Agency

**Synopsis**

The market demand for biodegradable bioplastic is increasing annually. Polylactic acid (PLA) is a biodegradable bioplastic commonly used to produce short life span disposable products (e.g., tray and utensil), but it is very expensive which limited its application. Thus, the addition of agricultural waste materials as filler to PLA can effectively reduce the cost of the final product. Furthermore, agricultural waste is a major component of municipal solid waste. The utilization of agricultural waste as filler in plastic materials will benefit solid waste management. Durian husk and chrysanthemum flower wastes are the agricultural wastes that are readily abundant in Malaysia and are not being utilized. In present projects, the durian husk and chrysanthemum flower wastes are processed into the filler and incorporated with PLA resin to make biocomposites. The PLA biocomposites produced from durian husk and chrysanthemum flower wastes contain filler-content up to 60 PHR and can biodegrade more than 50% after 6 months of burial in soil. The mechanical strength of this biocomposite is not very high, but it is suitable for non-structural and biodegradable applications, for instance in short life span disposable products.

**Funding Source**

TRGS
Taylor's University
RM 18,000
1 Nov 2017–30 April 2019

# Investigation of Synergistic Effect of Lignin and Waterborne Polyurethane on the Physico-chemical and Mechanical Properties of Eco-Friendly Coating Films

**Project Team**

Principal Investigator/Project Leader: Dr. Low Jiun Hor

**Co-Researchers**

- Dr. Pang Ming Meng
- Dr. Yoon Li Wan
- Dr. Lim Joon Hoong

**Collaborating Organizations**

Assoc Prof Dr. Wan Aizan Wan Abdul Rahma, Universiti Teknologi Malaysi
Dr. Rohah A. Majid, Universiti Teknologi Malaysia

**Synopsis**

Coatings have acquired a steady position in an increasing number of production processes. Solvent-borne polyurethane is one of the popular coatings utilized in many products due to its fascinating properties — for instance, excellent chemical and physical resistance, excellent transparency, high levels of wear-and-tear resistance, and outstanding ultra-violet(UV) protection. Nevertheless, the utilization of solvent-borne polyurethane has resulted in the emission of volatile organic compounds (VOCs), which, in turn, has aroused wide public concern. Waterborne polyurethane (WPU) has recently gained attention and holds the potential to replace the conventional solvent-borne polyurethane due to its nontoxicity and because it contains no VOCs. Nonetheless, the mechanical properties of WPU are inferior to the solvent-borne polyurethane. This phenomenon has attracted the attention of industry and consumers who were not so interested in WPU. Lignin, a class of lignocellulosic biomass, that is left behind during the pulping process, can be reused as the reinforcing filler to enhance the WPU coatings due to the intrinsic nature of lignin. With the aforementioned, the objective of the present study is to investigate the effect of lignin incorporation on the Physico-chemical properties and mechanical performance of WPU coatings. The lignin will be incorporated into the WPU coatings at different proportions and the Physico-chemical properties, namely solid content, thermal stability, water absorption, viscosity, density, Fourier transform infrared spectroscopy, and surface morphology will be investigated. Moreover, the mechanical performance of the WPU coating will also be evaluated in terms of tear resistance and tensile properties. It is expected that a new eco-friendly coating material, namely lignin-filled waterborne polyurethane will be developed in the present study. Meanwhile, the research findings will also contribute to the new knowledge to fill up the research gaps in the field of WPU coatings.

**Funding Source:**

Taylor's Research Grant Scheme (TRGS, Emerging Grant)
Taylor's University
Total Research Grant Approved: RM 22,600.00
Duration: 1 May 2018–31 October 2019

# Preparation and characterisations of biobased conductive polymer composite for packaging application

**Project Team**

Principal Investigator/Project Leader: Dr. Pang Ming Meng

**Co-Researchers**

- Dr. Koay Seong Chun
- Assoc Prof Dr. Tshai Kim Yeow
- Dr. Yose Fachmi Buys

**Collaborating Organizations**

Assoc Prof Dr. Tshai Kim Yeow (Nottingham University Malaysia)
Dr. Yose Fachmi Buys (Universiti Islam Antarabangsa Malaya)

**Synopsis**

Polymers are normally insulators; they can be converted into conductive polymer composite (CPC) with the addition of conductive filler such as carbon black, graphene, or carbon nanotube. However, current CPC is mostly produced from petroleum-based polymers such as polypropylene which is not environmentally friendly. Thus, the objective of this project is to produce biobased CPC which is derived from renewable resources to replace the conventional CPC.

The typical biobased polymer such as polylactic acid (PLA) is an insulator with a surface resistance of $10^{11}$ ohm, with the addition of graphene conductive filler, the surface resistance could reduce to the dissipative region ($10^{6}$-$10^{10}$ ohm) or even the conductor region (below $10^{5}$ ohms). The preparation of the biobased PLA/graphene conductive composite was performed via a melt blending method followed by compression moulding. The characterizations test including electrical resistivity, tensile test, thermal test, and morphology study. The application of the CPC is very wide, e.g., antistatic, electrostatic field, and used for semiconducting material such as power cable, sensing component. When compared with a metallic conductor, CPC has such benefits as easy to shape, low density, and a wide range of electrical conductivity as well as corrosion resistance.

This research project showed that with the addition of 7 wt% of graphene filler, the PLA resistivity was reduced from $10^{11}$ ohm to $10^{4}$ ohms. This also means its property has been converted from insulative into conductive. The properties of the biobased CPC also showed improvement in the aspect of electrical conductivity, tensile modulus, and thermal stability as compared to neat PLA.

The outcome of this project is in one indexed proceeding (IOP Conference Series: Materials Science and Engineering 458 (1), 012004). At present we are preparing a closure report and writing a manuscript for publication submission.

**Funding Source**

TRGS/ERGS, Taylor's University
RM 19 600
1 Nov 2017–Apr 2019

# Authentication of navigation signals

**Project Team**

Principal Investigator/Project Leader: Dr. Chua Bee Lin

**Co-Researchers**

- Dr. Jee Jap Meng
- Dr .Aneta Wojdylo
- Prof Dr. Adam Figiel
- Dr. Antoni Szummy

**Collaborating Organizations**

Dr. Aneta Wojdylo (Institute of Agricultural Engineering, Wroclaw University of Environmental and Life Sciences, Poland)

Prof Dr. Adam Figiel (Institute of Agricultural Engineering, Wroclaw University of Environmental and Life Sciences, Poland)

Dr. Antoni Szummy (Department of Chemistry, Wroclaw University of Environmental and Life Sciences, Poland)

**Synopsis**

Medicinal plants have the potential of being a source of antioxidant compounds, given the variation of chemical structures. Influence of convective drying (CD), vacuum-microwave drying (VMD), and convective pre-drying followed by vacuum-microwave drying (CPD-VMFD) on the drying kinetics, antioxidant activity, TPC, volatile and sterol concentration, energy consumption, colour, and water activity of *Phyla nodiflora* were investigated. Fresh and freeze-dried samples were control samples. The kinetics of drying methods was modeled. Also, the profile of fatty acids in *Phyla nodiflora* was ascertained. The Modified Page model was the best to describe drying kinetics. VMD recorded the shortest drying duration. Water activity analysis suggested all samples were microbiologically safe. FD samples produced the lightest coloured leaves, while CPD-VMFD samples achieved the greenest colour. GC-MS analysis revealed 1-octen-3-ol as a major volatile compound. The most abundant plant sterol and fatty acids were β-sitosterol and α-linolenic acid, respectively. CPD-VMFD yielded the highest total concentration of volatile and sterol compounds. VMD consumed the least energy while the CD has the highest energy requirement. CPD-VMFD was the best drying method to dry *Phyla nodiflora* leaves as high antioxidant activity, TPC, totally volatile and sterol concentration can be achieved. Also, a lower energy consumption compared to CD, assured low water activity, and better colour properties.

**Publications**


- A. Ali, X. Y. Lim, C. H. Chong, S. H. Mah, and B. L. Chua, "Ultrasound-assisted extraction of natural antioxidants from betel leaves (Piper betle): Extraction kinetics and modelling," *Sep. Sci. Technol.*, vol. 53, no. 14, pp. 1–14, 2018.
- B. L. Chua, Y. K. Ng, and A. Ali, "Ultrasound Assisted Extraction of Pectin from Dragon Fruit Peels," *J. Eng. Sci. Technol.*, vol. 13, no. Special Issue July, pp. 65–81, 2018.
- B. L. Chua and Y. C. Chong, "Drying Kinetics and Optimisation of Pectin Extraction from Banana Peels via Response Surface Methodology," *MATEC Web Conf.*, vol. 152, 2018.
- B. L. Chua and Y. L. Chen, "Solid-Liquid Extraction Kinetics of Total Phenolic Compounds (TPC) from Red Dates," *MATEC Web Conf.*, vol. 152, 2018.
- B. L. Chua, J. Poh, and A. Ali, "Extraction Kinetic of Ziziphus jujuba Fruit Using Solid-liquid Extraction," *J. Eng. Sci. Technol.*, vol. 13, no. Special Issue July, pp. 27–39, 2018.


**GRA/Ph.D./Master candidates working on this project**

Ms. Lisa Chua Yen Wen, Master of Science in Engineering

**Funding Source**

TIRGS (MFS)
Taylor's University
RM 50,800
8 January 2016–31 July 2018

# Authentication of navigation signals

**Project Team**

Principal Investigator/Project Leader: Dr. Chua Bee Lin

**Co-Researchers**

- Dr. Mah Siau Hui
- Dr. Chow Yin Hui
- Dr. Tee Lee Hong

**Collaborating Organizations**

Prof Dr. Adam Figiel (Institute of Agricultural Engineering, Wroclaw University of Environmental and Life Sciences, Poland)

Prof. Dr. Luqman Chuah Abdullah (Department of Chemical and Environmental Engineering, Faculty of Engineering, UPM)

Assoc. Prof. Ir. Dr. Chong Chien Hwa (Chemical Engineering Programme School of Engineering and Physical Sciences Heriot-Watt University Malaysia)

**Synopsis**

*Acmella paniculata* (AN), *Pogostemon cablin* (PC), *Cymbopogon nardus*(CN), *Eucalyptus camaldulensis* (EC), *Rosmarinus officinalis* (RO), *Origanum vulgare* (OV), and *Mentha Asiatica* (MA) will be selected for this research. The crude extracts of these herbal plants were reported to possess a strong antioxidant capacity. Previous studies reported a significant linear correlation between the concentration of phenolic compounds and antioxidant activity contributes to the strong antioxidant activity. However, bioactive compounds such as phenolic and flavonoids compounds can be easily degraded due to factors such as drying, extraction, and storage conditions. Therefore, it is important to establish an optimum drying, extraction, and storage conditions for the above-mentioned plants to maintain its high antioxidant activities and to retain bioactive compounds.

The first phase of this research focuses on the drying of herbal plants. The above-mentioned plants will be dried using hybrid drying technique and the efficiency of the hybrid drying technique will be improved and optimized based on five criteria such as pre-screening of phytochemical analysis of the presence of alkaloids, flavonoids, terpenoids, saponins, glycosides, phenols, and steroids, antioxidant activity, total phenolic content (TPC), total flavonoids content (TFC) and lastly total saponins content (TSC). Phenolic and flavonoids will be identified using ultra-high-performance liquid chromatography (UHPLC). Three different drying methods will opt which are single-stage hybrid microwave vacuum drying (MVD), 2-stage convective hot-air pre-drying, and microwave vacuum finish drying (CHP-MVFD) and freeze-drying as control. There are limited past studies that focused on the investigation of the influence of combined hybrid drying methods and extraction

techniques in the retention of bioactive compounds of medicinal herbs by employing hybrid drying methods for the above-mentioned herbal plants, therefore, in this research, optimization of hybrid drying conditions is performed by employing response surface methodology (RSM) to obtain a maximal yield of bioactive constituents in dried plants.

After drying, the optimization of drying conditions will be conducted using response surface methodology. Following the establishment of the optimum drying that gives the best results for the selected criteria, the drying kinetics will be modeled and the goodness of fit of each model will be evaluated. Furthermore, the identification and quantification of the pre-dominant compounds that confer antioxidant activity will be studied through gas chromatography/mass spectroscopy (GC/MS) and LCMS/MS analysis. The extracted sample may contain impurities such as proteins and polysaccharides. The total protein concentration in the sample will be quantified using the Bradford method

The last section of this research involves the stability study of the predominant bioactive compounds, TPC, TFC, TSC, antioxidant activity for 6 months under different storage conditions (real-time and accelerated conditions). To the best of our knowledge, there is limited stability study regarding the antioxidant activity, degradation study of the related major compounds after RSM optimization of drying conditions as well as the drying kinetics study available for the selected plants. Therefore, with these optimized drying and storage conditions, this research aims to achieve maximal retention of bioactive compounds that lead to the highest antioxidant activity.

**List of Publications**

- Influence of Drying Methods on the Antibacterial, Antioxidant and Essential Oil Volatile Composition of Herbs: a Review
  LYW Chua, CH Chong, BL Chua, A Figiel
  *Food and Bioprocess Technology* 12 (3), 450-476
- Characterisation of the Convective Hot-Air Drying and Vacuum Microwave Drying of Cassia Alata: Antioxidant Activity, Essential Oil Volatile Composition, and Quality Studies
  LYW Chua, BL Chua, A Figiel, CH Chong, A Wojdyło, A Szumny, K Lech
  *Molecules 24* (8), 1625
- Antioxidant Activity, and Volatile and Phytosterol Contents of Strobilanthes Crispus Dehydrated Using Conventional and Vacuum Microwave Drying Methods
  LYW Chua, BL Chua, A Figiel, CH Chong, A Wojdyło, A Szumny,
  *Molecules 24* (7), 1397
- Drying of Phyla nodiflora Leaves: Antioxidant Activity, Volatile and Phytosterol Content, Energy Consumption, and Quality Studies
  LYW Chua, BL Chua, A Figiel, CH Chong, A Wojdyło, A Szumny, J Łycko
  *Processes 7* (4), 210
- Effect Extraction of Natural Antioxidants from Piper Betle with the Aid of Ultrasound: Drying and Extraction Kinetics
  ALI AMEENA, B CHUA, A GINISHA
  *Journal of Engineering Science and Technology 13* (August Special Issues 2018. 1-16)

**GRA/Ph.D./Master candidates working on this project**

Mr. Choo Choong Oon (GRA), Master of Science in Engineering

**Funding Source**

TIRGS (MFS)
Taylor's University
RM 52,400
01 February 18–31 July 19

# Selective recovery of amylase from pitaya (Hylocereus polyrhizus) peels by using alcohol-salt aqueous two-phase system (ATPS)

## Project Team

Principal Investigator/Project Leader: Dr. Chow Yin Hui

## Co-Researchers

- Dr. Chan Sook Wah
- Dr. Chua Bee Lin
- Dr. Yoon Li Wan

## Synopsis

Amylase, which can hydrolyze starch into oligosaccharides, is a significant enzyme with diverse applications in various industries. In comparison to microbial amylases, plants can serve as a rich source of plant-derived amylase for industrial production at lower cost and toxicity. In this study, the ethanol/phosphate aqueous two-phase system (ATPS) was adopted to recover the amylase from the red pitaya peel. The effects of several ATPS parameters such as concentrations of ethanol and phosphate, the system pH, and the concentration of sodium chloride (NaCl) on the recovery of amylase were investigated. Based on these results, a central composite design (CCD) was used to optimize the recovery of amylase from the red pitaya peel. Results demonstrated that the optimal conditions for recovery of amylase were observed for the ATPS containing 19% (w/w) ethanol, 26% (w/w) phosphate pH 7.0, and 3.8% (w/w) NaCl. The amylases were recovered to the ethanol-rich top phase with an optimum yield and a purification factor of 92.48% and 5.75, respectively. Therefore, this study demonstrated the feasibility of ethanol/phosphate ATPS as a promising tool for the simultaneous recovery and purification of amylase from the red pitaya peel.

## Funding Source

TRGS
Taylor's University
RM 21,800
15 March 2017–31 August 2018

# Composition Dependence Study of Thermoelectric Properties in Doped $CuFe_2O_4$ and $Ni_xZn_{1-x}Fe_2O_4$ for Waste Energy Harvesting

**Project Team**

Principal Investigator/Project Leader: Dr. Lim Joon Hoong

**Co-Researchers**

- Dr. Ku Pei Xuan
- Dr. Low Jiun Hor

**Synopsis**

The continuing energy crisis has led to much research being done on alternative fuel sources. However, the majority of these investigations have focused on these alternative fuels and not on the waste heat energy which may account for as much as 70% of the input energy. This research aims to study the use of copper ferrites ($CuFe_2O_4$) and nickel-zinc ferrites ($Ni_{(x)}Zn_{(1-x)}Fe_2O_4$) as thermoelectric materials for waste energy applications. Thermoelectric materials enable energy conversion from heat to electricity, which has great potential in sustainable energy industries. The conversion mechanism is based on the diffusion of mobile charge carriers in a material. Metal typically has a low Seebeck coefficient, while semiconductors are ideal thermoelectric materials due to their band structure and electrical transport properties. However, efficiency is a great concern in a thermoelectric application. The development of new materials brought new concepts and inspired approaches to improve the performance of thermoelectric materials. Therefore, to effectively increase the thermoelectric efficiency is to maximize the value of electrical conductivity and Seebeck coefficient. In this study, the band structure shows CuxFe2O4 had the valence band maximum (VBM) at point M and the conduction band minimum (CBM) at point A. This indicated that $CuFe_2O_4$ is an indirect bandgap material. The bandgap becomes smaller with increasing Cu content. The bandgap of $Cu_xFe_2O_4$ (x = 0.2) was 2.323 eV which decreased to smaller values 2.249 eV (x = 1.0). The electrical conductivity of CuxFe2O4 increased with increasing amounts of Cu. The electrical conductivity of CuxFe2O4 was about 7 % higher compared to pure ferrite. The magnitude of the Seebeck coefficient for CuxFe2O4 increased with increasing the amounts of Cu. The figure of merit for CuFe2O4 was Z ~ 4.26 x10-9, which was higher compared to ferrite (Z ~1.34 x10-9) due to larger electrical conductivities. The successful application of thermoelectric materials in the energy harvesting sector may account for significant cost reductions and improvements in fuel efficiency.

**Funding Source**

Taylor's Research Grant Scheme (ERGS)
Amount approved: RM 19,000.00
Grant duration: 1 May 2018–31 Oct 2019

# Analysing architecture: Dissecting the Malaysian 'house

**Project Team**

Principal Investigator/Project Leader: Dr. Veronica Ng Foong Peng

**Synopsis**

One of the areas of interest in architecture is the rhetorics of What is contemporary Malaysian architecture? Prior and existing studies and publications on Malaysian architecture focussed on documentation and anthologies of building from the 1960s to the 1980s (the post-independence architecture) and emphasis on the "tropical" approach to Malaysian houses. While there are publications that documented Malaysian architecture particularly in its formative years and on modern architectural heritage, the common focus is on documentation of information rather than critical analysis on Malaysian architecture. There is a lack of studies on recent and contemporary works that form the directions towards defining Malaysian architecture.

The current state of documentation and research on recent and contemporary architecture suggests a need to take a more critical look into the design thinking and narratives or contemporary Malaysian architects and architecture. Taking this as a point of departure, this research aims to identify alternative views on recent and contemporary Malaysian architecture through theorizing a project. It examines the design thinking and narrative of Malaysian architects by using the "house" as an object for analysis as the house forms an ideal object for the manifesto of architectural ideals due to its complexity albeit its relatively intimate scale compared to other building types, which allows for critical and thorough analysis. To achieve the aim, this study will analyse the architectural construct of context, form, space, tectonics in the production of architecture, and subsequently theorizes the house as an architectural form which reflects the design thinking and narrative of the architect

Through interpretive research, this study analyses eight (8) houses completed between the 1980s and the present. Qualitative by nature, the interpretation is informed by a synthesis of interviews carried out with the selected architects, and observations through site visits and analytical and diagrammatic studies following the framework of Simon Unwin and Geoffrey Baker.

The research will argue that through disserting architecture, the discursive relations between context, form, space, and tectonics offers a critical approach to identify themes that defines Malaysian architecture.

**GRA/Ph.D./Master candidates working on this project**

Teow Hai P'ng, Master of Architecture

**Funding Source:**

TRGS, Taylor's University
RM 23,050
November 2017–October 2018

# An Affective Assessment Model to Improve Learning Outcome with Emotion Recognition via Brain-Computer Interface

**Project Team**

Principal Investigator/Project Leader: Tee Wee Jing

**Co-Researcher**

- Assoc Prof Dr. Raja Kumar Murugesan

**Collaborating Organizations**

Dr. Muhammed-Dzulkhiflee Hamzah, Senior Application Test Engineer, Hilti Asia IT Services Sdn. Bhd. (HAITS)

**Synopsis**

Emotions play an important role in the daily life of human beings. How emotions affect learning has been a grey area, not much research has been done to study the correlation between student's emotion and the effects on the student learning outcomes. In this research, we concentrate on the recognition of "inner" emotions from electroencephalogram (EEG) signals via Brain-Computer Interface (BCI) systems. The user emotions are recognized and visualized in real-time adding one more so-called "emotion dimension" to human-computer interfaces. We can then use these obtained signals from BCI to control external devices or computers depending on the application. Traditionally, EEG-based technology has been used in medical applications. Currently, new wireless headsets that meet consumer criteria for wearability, price, portability, and ease-of-use are coming to the market. Our research has shown that reading and responding to students' emotions could help boost engagement levels and academic performance. The exact problem that this research intends to address is to study the correlation between student's emotion and the effects on the student learning outcomes and to propose an effective assessment model to optimize student learning outcomes using affective computing with emotion recognition via the BCI system. The purpose of the proposed model is to optimize student learning outcomes using affective computing to produce good quality graduates.

Two research papers have been accepted for presentation and publications in IEEE (indexed by Scopus) at the ICACCA2018 International Conference at Taylor's University from 26 to 28 October 2018. Details are as below:

- M.S. A. Muhammad Azizi, C. A. Hewawasam Puwakpitiyage, V. R. Paramesura Rao, W. J. Tee, R. K. Murugesan, M. D. Hamzah (2018). "Authentication with brainwaves: a review on the application of EEG as an authentication method". 4th IEEE International Conference on Advances in Computing, Communication & Automation (ICACCA2018), Taylor's University, Subang Jaya, Malaysia.
- V. R. Paramesura Rao, C. A. Hewawasam Puwakpitiyage, M. S. A. Muhammad Azizi, W. J. Tee, R. K. Murugesan, M. D. Hamzah (2018). "Emotion Recognition in E-Commerce Activities using EEG-based Brain-Computer Interface". 4th IEEE International Conference

on Advances in Computing, Communication & Automation (ICACCA2018), Taylor's University, Subang Jaya, Malaysia.

One research paper has been accepted for presentation at International Conference on Future Internet Systems and Applications (ICFISA'18) at EDC Hotel, Kuala Lumpur, Malaysia from 10 to 11 December 2018, and the paper has been accepted to publish in the International Journal of Online and Biomedical Engineering (iJOE) (indexed by Scopus), details are as below:

- C. A. Hewawasam Puwakpitiyage, M. S. A. Muhammad Azizi, V. R. Paramesura Rao, W. J. Tee, R. K. Murugesan, M. D. Hamzah (2018). "A Proposed Web-Based Real-Time Brain-Computer Interface (BCI) System for Usability Testing". International Journal of Online and Biomedical Engineering (iJOE), Vol 15, No 07 (2019). Retrieved from: https://www.online-journals.org/index.php/i-joe/article/view/10447

**GRA/Ph.D./Master candidates working on this project**

V. R. Paramesura Rao, Bachelor of Software Engineering (Hons), Final Year Project (FYP)
C. A. Hewawasam Puwakpitiyage, Bachelor of Software Engineering (Hons), FYP
M. S. A. Muhammad Azizi, Bachelor of Computer Security and Forensics (Hons), FYP

**Funding Source**

TRGS
Taylor's University
RM 28,000
26 October 2017–30 April 2019

# A cruising fixed-wing mini-UAV: Optimization of aerodynamics and performance for civil applications

**Project Team**

Principal Investigator/Project Leader: Assoc Prof Dr. Abdulkareem Sh Mahdi Al-Obaidi

**Co-Researchers**

- Prof Dr. Mushtak Talib Ali Al-Atabi (Heriot-Watt University Malaysia)
- Dr. Cheah Kean How (Heriot-Watt University Malaysia)

**Synopsis**

The applications of unmanned aerial vehicles (UAVs) have been extended through the recent decades and they are utilised for both civil and military applications. The urge to utilise UAVs for civil purposes has brought researchers and industries attention more towards the Mini-UAV (MUAV) category due to its suitable configurations and capabilities for multidisciplinary civil

purposes. This study is another effort to further enhance the aerodynamic efficiency of a cruising MUAV through a parametric study of the wing and proposing a new wing design. The research is conducted utilising numerical simulation and experimental validation. The simulations are conducted using ANSYS Fluent 15.0 and experiments are conducted utilising a custom-designed measurement for Taylor's University low-speed wind tunnel. This research provides a better understanding of different wing parameter(s) effect on the aerodynamic performance of the wing and MUAV.

A new optimized wing configuration with enhancing aerodynamic efficiency is designed and implemented which is desired by aviation industries due to improvements in MUAV aerodynamic efficiency and flight endurance.

Also, the Installation and development of an accurate measurement system on TUWT will enable students, researchers, engineers, and industries to conduct experiments at Taylor's University. The developed measurement system enables users to obtain accurate and reliable results in form of graphs and tabulated data.

A complete user manual is prepared to guide the users on the operation of the wind tunnel, design, installation, and calibration of the test models, conducting experiments and data collection.

**GRA/Ph.D./Master candidates working on this project**

Mr. Shahrooz Eftekhari Ph.D. Student, Taylor's University

**Funding Source**

TIRGS, Taylor's University
RM 43,400
01 July 2017 to 30 June 2019

# Determination of NPK Nutrients Contents of Fertilizer Using Microwave Microstrip Sensor

**Project Team**

Principal Investigator/Project Leader: Dr. Mun Hou Kit

**Co-Researchers**

- Dr. The Aun Shih
- Dr Mimi Faisyalini Ramli

**Collaborating Organizations**

Dr You Kok Yeow, Universiti Teknologi Malaysia

**Synopsis**

Accurate determination of fertilizer nitrogen, phosphorus, and potassium (NPK) nutrients contents are very important in the fertilizer industry because it can ensure the product quality, reduce the fertilizer production cost, and can increase the revenue of the company. However, the standard chemistry method for NPK nutrients contents determination is time-consuming. From the literature review, few common measurement principles of the NPK nutrients contents sensor are based on (1) electrical conductivity, (2) fibre optic, and (3) nuclear magnetic resonance. The aforementioned methods only focused on identifying nutrients contents of soil, aqueous solutions of soil, effluent, or animal slurry. Measuring electrical conductivity is only reliable in potassium concentrations estimation. The fiber optic based color sensor can only be applied to the aqueous solution. The radiation base nuclear magnetic resonance sensor is costly, complex, and only can be applied to the semi-solid material. None of them were implemented in the fertilizer industry.

This project is proposing a new measurement method, that is using a non-radiation, microwave-microstrip system that is capable of estimating the N, P, and K contents in fertilizer used in the plantation. In principle, a microwave is sensitive to the variation of permittivity corresponding to different percentages of NPK nutrients contents. Among microwave-based sensor designs, microstrip sensors are low-cost, portable, lightweight, and easy to fabricate. The microwave microstrip sensor will be designed to operate within microwave frequency ranges from 1 GHz to 3 GHz with the aids of Microwave Office (MWO) and AutoCAD software. The sensor's design will be delineated on RT/Duroid 5880 substrate by standard photolithography and acid etching. Then, the sensor will be soldered with two SubMiniature version A (SMA) connectors and held on an aluminium ground. Then, a sample holder made from acrylic plates will be mounted on the sensor. Lastly, the sensor will be connected to a network analyzer for NPK nutrients contents measurements. Currently, a microstrip ring sensor was fabricated. A conference paper was published.

This project is expected to successfully develop an inexpensive microwave sensor system that can determine the NPK nutrients contents on fertilizer.

**Funding Source**

ERFS, Taylor's University
26,100
1 May 2019–30 April 2019 (extended to 30 October 2019)

# Research Projects

# Research Projects

## Novel Amine-based Eutectic Solvents as an Alternative and Sustainably Green Approach to Ultrasonically Devulcanize NR/SBR and Applied to Ground Rubber Tires

**Ricky Saputra** B Eng, AMIChemE, PhD (Engineering)

Assoc Prof Dr. Rashmi Walvekar

Prof Dr. Mohammad Khalid (Sunway University)

The exponential annual increase in a large volume of solid waste produced from elastomeric materials, especially rubber tires, has caused them to be infusible, insoluble, and non-biodegradable due to their complicated three-dimensional structural linkages. As an effort to minimize and mitigate such predicament, cured natural rubber (NR), styrene-butadiene rubber (SBR), and their blend(s), which are the most common make-up composition of rubber tire, will be ultrasonically and thermally devulcanized using sustainably green solvents called deep eutectic solvents (DES). Three novel amine-based DESs, at variable molar ratios, will be prepared with various hydrogen bond acceptors/donors (HBA/HBD) and zinc salt accelerator. The influence of DES types, variable molar and mass ratios, ultrasonic frequencies, and time, as well as heating temperatures and time on NR/SBR blend(s), will be studied and optimized through response surface methodology (RSM). Optimized parameters will then be applied to devulcanize a 40-mesh ground rubber tyre (40-GRT). The recyclability of DESs and multiple cycle treatment on 40-GRT will also be evaluated. Characterization of DESs will be performed using Karl-Fischer titration (KFT), thermogravimetric analyser (TGA), differential scanning calorimetry (DSC) and Fourier transform infrared spectroscopy (FTIR). On the other hand, devulcanizates will be analysed based on Flory-Rehner equations for soluble content and degree of devulcanization. Furthermore, devulcanizates will also be evaluated by TGA, FTIR, energy dispersive X-ray (EDX), field emission scanning electron microscopy (FESEM), and Horikx correlations.

## A Hybrid Speech Processing System for Natural Language Processing

**Praveen Edward James** Ph.D. (Engineering)

Dr. Mun Hou Kit

Dr. Chockalingam Aravind

The research goal of this work is a full-fledged implementation of an FPGA based language processor for natural language processing. To enable speech-based processing, a speech recognition combination component and speech synthesis component are designed and combined with the language processor to evolve a speech processing system for Natural Language Processing (NLP).

Mel Frequency Cepstral Coefficients (MFCC) based feature vectors from the speech directly input into a Bi-directional Long Short-Term Memory Cell (LSTM) network. Dropout a regularization technique is used to minimize over-fitting and improve robustness. The language processor consists of a Vectorizer, lookup dictionary, key encoder, LSTM based training, and prediction network, and a dialogue manager, using a novel architectural framework that is influenced by a combination of model-based and process-based techniques. The processor accepts recognized text input and performs natural language processing using the LSTM network with one-pass learning and prediction. The resulting response text is converted to speech by using the Speech Application Programming Interface (SAPI) from Microsoft. The language processor has a processing time of 0.59 seconds, 5% hardware utilization, and an F1 score of 95.2%. The proposed system has a 4.17% decrease in accuracy than existing systems. The existing systems use parallel processing and high-speed cache memories to perform additional training which improves the accuracy. However, the performance of the language processor has a 36.7% decrease in processing time and a 50% decrease in hardware utilization making it suitable for embedding in low-cost electronic devices.

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## Ultrasound-assisted emulsification extraction and fractionation of natural compounds using green deep eutectic solvents

**Ameena Ali** Ph.D. (Engineering)

Dr. Chua Bee Lin

Dr. Chow Yin Hui

Process industries heavily rely on organic solvents in bulk quantities for the extraction of natural compounds as they are effective, cheap, and abundant. With the increasing demand of natural compound products by consumers, the usage of organic solvents is rising exponentially. Exposure to organic solvents can occur during manufacturing, even though their threshold values are strictly controlled by regulatory bodies. Risk assessment has shown the development of both acute and chronic diseases arising from exposure to it. Disposal of organic solvents is another major challenge as they often lead to massive environmental pollution despite having stringent regulations and policies in place. Therefore, looking into “green” solvents that are sustainable, biodegradable, and effective extractants as an alternative to organic solvents is a priority among the research community. Reported research has demonstrated deep eutectic solvents (DES) as a promising alternative to traditional solvents as they are biodegradable, have low toxicity, affordable as well as highly selective and efficient solvents for natural compounds. The current study focuses on the development of new DES using bio-renewable sources with diverse physical and chemical properties for the effective extraction of natural compounds. To take a step further, the feasibility of the developed solvents are investigated with a unique Ultrasound-assisted emulsification extraction to achieve simultaneous extraction and fractionation of hydrophilic and lipophilic fractions *via* kinetic study, modeling, and process optimisation.

## Analysis on Mechanical Strength and Intervertebral Disc Stress on Post-operated Fused Scoliotic Vertebrae

**P. Mohankumar** Ph.D. (Engineering)

Dr. Anis Suhaila Shuib

Dr. Ng Khai Ching

Dr. Shajan Koshy

Scoliosis is the abnormal curvature of the spine. In severe scoliosis, corrective surgery is performed. Corrective surgery involves whole bone or part of bone removal which is termed as osteotomy, and fusion of vertebral bones using local bone graft along with metal implants. As there is no standard procedure followed while performing the osteotomy, deciding the number of vertebrae to be fused, and application of bone graft, the mechanical strength of the fused vertebrae and its intervertebral disc stress after surgery remains unknown. Additionally, several kinds of literature after a long-term follow-up on post-operated scoliosis patients reported that most of the patients suffer from low back pain and degeneration. But the intensity of pain and degeneration was different even for the patients who had the same number of vertebrae fused at a different level of the spine. Hence, this study is conducted to find the mechanical strength of fused vertebrae and its intervertebral disc stress along with the relationship between the number of vertebral fusion and level of fusion after surgery.

## Synthesis and Optimisation of Wastewater treatment process

**Ho Jo Yee** Master of Science in Engineering

Dr. Wan Yoke Kin

Dr. Yoon Li Wan

Wastewater treatment (WWT) is a mandatory process in every manufacturing company. However, with countless WWT technologies prevailing in the market, the selection of WWT technologies is usually based on vague assumptions that result in subsidiary remittance. Material Flow Cost Accounting (MFCA) is a management tool that quantifies material flows across a production process in both physical and monetary values. As MFCA is capable to track the cost associated to each stream (hidden cost) within the process, this research aims to develop a novel MFCA-based approach primary decision-making tool in the selection of wastewater treatment technologies which meets the constraint of quality of treated effluent (e.g., biochemical oxygen demand BOD, chemical oxygen demand COD, total suspended solids TSS and oil & grease OG). A series of mathematical equations will be formulated based on a generic superstructure of a WWT plant. To illustrate the approach, a case study on a sago-based organic WWT plant has been solved in this work via an optimisation

software (LINGO). The objective function of this work is to minimise the sludge cake generation cost which will be eventually disposed of for landfill, thus, inheriting low monetary value. Also, the relationship between pollutants' removal efficiency, which is rarely studied by the researcher, has been included in this work. In the end, a novel MFCA-based approach, which able to synthesise a wastewater treatment plant (WWTP) which complies with the discharged regulation and with minimum sludge cake generation cost, will be developed in this work.

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## Stability, Thermo-Physical and Dielectric Properties of $SiO_2$-Graphene-Based Hybrid Transformer Oil

**Danial Aminin bin Zairin** Master of Science in Engineering

Dr. Rashmis Gangasa Walvekar

Dr. Chockalingam Aravind

Dr. TCSM Gupta

Transformers are electrical components that convert high incoming voltages to lower voltages. Normally, lower voltages and electricity are distributed to consumers for a wide range of applications. Naphthenic-based oil is used as a coolant in transformers by fully immersing it. However, being one of the essential components, the transformer tends to fail and one of the causes is overheating or having poor heat dissipation. One of the solutions is to synthesize naphthenic oil-based nanofluids dispersed with silicone dioxide ($SiO_2$) nanoparticles decorated on crumpled graphene particles for faster and efficient heat dissipation. This research aims to investigate the stability of nano-suspension, measures thermos-physical such as density, viscosity, thermal conductivity, and dielectric properties such as resistivity and breakdown voltage of $Si0_2$-graphene-based hybrid transformer nanofluids. The base oil for the experiments is prepared by mixing naphthenic mineral oil and palm oil methyl ester (POME). Blend oil ratio – mineral oil to POME, varies at 70:30, 80:20, and 90:10 wt.%. $Si0_2$ is decorated on the graphene through sol-gel technique by varying the pH between 10 to 12. Crumpled SiO2-graphene is synthesized by injecting aqueous graphene solution into a 1-inch diameter heated horizontal tube furnace operated between 300 and 800 °C using 1.7 MHz ultrasonic atomizer. The hybrid nanoparticles are dispersed at various concentrations into the blend oils, varying from 0.01 to 0.10 wt.%.

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## Transformative Learning in an Engineering Education Experience: Factors that Promote and Factors that Hinder

**Douglas Tong Kum Tien** Ph.D. (Engineering)

Prof Dr. Satesh Narayana Namasivayam

Dr. Logendra Stanley Ponniah

Engineers have a vital role to play in helping to overcome complex global challenges for which there are no easy answers. These include the present challenges related to energy, environment, security, health, social, and population growth issues which could threaten the sustainability of life on the planet as we know it. The complexity and scope of these challenges place ever-increasing demands on the training of engineers. To ensure that future engineers possess the requisite capability, a more holistic educational approach, one that emphasizes both the informative and transformative aspects of learning are expected to be necessary. Transformative learning differs from informative learning in that its aim is not about adding to a person's store of knowledge, but it is about facilitating changes to the person's worldview, self, epistemology, ontology, behaviour, or capacity. This study aims to investigate for the presence of transformative learning in an engineering education experience specifically at Taylor's University School of Engineering and to identify the factors that help or hinder. A qualitative study was chosen to allow for the data to emerge from the participants themselves as well as to obtain an in-depth understanding of the phenomena.

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## Compatibility of fuel delivery metals with water in the biodiesel-diesel fuel blend

**Nursyahirah Insyirah Binti Arshad** Master of Science in Engineering

Dr. Rashmi Gangasa Walvekar

Dr. Chow Yin Hui

This is the world's first work which is to characterize the corrosion behaviour of water in the biodiesel-diesel fuel blend. This is important in the attempt to adopt water in biodiesel-diesel fuel blend for the use which has shown a potential reduction in harmful diesel engine exhaust emission. The first aim of this project is the formulation of water in the biodiesel-diesel fuel blend. Biodiesel-diesel consist of 15vol% of biodiesel fuel with 85vol% of diesel fuel would be used as the fuel with various concentration of water. The second aim is metal corrosion due to exposure to water in the biodiesel-diesel fuel blend. Lastly, the corrosion of the metal will be calculated based on mass loss using the equation from ASTM G1. As an expected result, free water formation due to the demulsification of water in biodiesel-diesel fuel blend accelerated metal corrosion is expected to occur. This would result in significantly early fuel delivery materials failure which could culminate in installing the engine during engine operation. By doping a suitable corrosion inhibitor, the corrosion rate of metal due to water in the biodiesel-diesel fuel blend could be minimized. There are many significant objectives to be gained from this project: to obtain more knowledge and understanding of corrosion in diesel-biodiesel water and to identify components incompatible in the fuel delivery system when using water in diesel emulsion fuel. Besides, the adoption of emulsified diesel fuel for use in diesel engines would reduce exhaust gas emission which contributes to the decline of air quality.

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## Two-Stage Sintering and Mechanical Properties of Transition Metal Oxide Doped Alumina-Zirconia Composites

**Teow Hsien Loong** Ph.D. (Engineering)

Dr. Sivakumar Sivanesan

Yttria-Tetragonal Zirconia Polycrystals ceramics (Y-TZP) have been extensively studied for their high-performance application due to its excellent mechanical properties such as high fracture toughness, high bending strength, and good wear resistance. Alumina ceramics ($Al_2O_3$) on the other hand, exhibit low fracture toughness, and low bending strength. Research has shown that the mechanical properties of alumina ceramics can be improved through the incorporation of zirconia ($ZrO_2$). Much research has been done on alumina-zirconia composites but most of the research was focused on improving its mechanical properties through a sintering schedule. The effect of transition metal dopants on alumina-zirconia composites are not widely investigated. This research aims to investigate the effect of various sintering schedule and transition metal oxide dopants on the mechanical properties of alumina-zirconia composites and to develop an alumina-zirconia composite system using transition metal oxide as sintering additives that complies to international industrial standards.

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## Hydrodynamics CFD Simulation of Blood Flow to Predict Risk of Rupture in Brain Vessels

**Md Al Amin Sheikh** Master of Science in Engineering

Dr. Anis Suhaila Binti Shuib

Mr. Mohd Hardie

Hidayat Bin Mohyi

An aneurysm is a thin or week spot in a blood vessel that deigns to fill up with blood. The consequences are often a leaking or burst vessel that can cause haemorrhage as it spills blood into the surrounding tissues. However, not all the aneurysm ruptures, there is an estimation of about 40 to 80 percent of patients do not rupture during an aneurysm in their lifespan. Being diagnosed with a small aneurysm 5mm or less means an up to 80% chance of it never rupturing. However, there are almost 500,000 deaths worldwide each year by a brain aneurysm. Currently, the survival rate for those with a ruptured brain aneurysm is about 60%. Two-thirds of those who survive a ruptured brain aneurysm will face morbidity. However, the development of an aneurysm is occurred by the artery wall thinning and it's often different to diagnose before it ruptures and leads to several fatal diseases including brain damage. As a result, it becomes an imperative need to predict the risk of aneurysm rupture. In this research, the relationship between wall shear stress, blood cell distribution, and aneurysm rupture are investigated. The hydrodynamics understanding of the correlations will helps the medical practitioner to decide proper treatment for a brain aneurysm patient to prevent it from rupture.

## Novel Eutectic Salt-Based Hybrid Anofluids to Improve the Efficiency of PV/T System

**Mahesh Vaka** Ph.D. (Engineering)

Dr. Rashmi Gangasa Walvekar

Dr Emy Marlina Binti Samsudin

Undisputedly, photovoltaics (PV) is regarded as one of the most reliable and competitive energy production alternatives due to a massive decline in prices. In the coming years, it is predicted that PV will lead the renewable electricity capacity growth by surpassing 550 GW. However, the efficiency of the enormous amount of PV modules being produced and installed remains unsatisfactory due to overheating. Technology that is based on cooling the PV modules using efficient coolants, popularly known as photovoltaic-thermal (PV/T) is a promising solution but the inherent thermal conductivity of the conventional coolants being used makes it less attractive. A breakthrough was made when nanoparticles were successfully dispersed in coolants that led to the anomalous enhancement of its thermal conductivity. In recent years, hybrid nanofluids, which is a dispersion of two or more different materials with nano-meter size particles into the base fluid has helped augment heat transfer through PV panels. However, the impact of hybrid nanofluids on PV/T efficiency is unclear under the purview of the ongoing extensive design and developments. Therefore, in this paper, we aim to provide a clear perspective on the role of hybrid-nanofluids on PV/T efficiency through a possible 10 big questions on this subject.

## Modelling Mixed Traffic Flow on Urban Roads & Evaluation of Safety Standards

**M.Bhargav Naidu** Ph.D. (Engineering)

Dr Sivakumar Sivanesan

The area of traffic flow modeling and analysis that bridges civil engineering, computer science, and mathematics has gained great momentum in the urban areas due to the increase in vehicular population causing traffic congestion and an increase in accidents. The presence of heterogeneous traffic amplifies the problem of traffic congestion and accidents, increasing the number of conflicts especially at the merging and diverging sections of road intersections and roundabouts. Shockwaves in traffic congestion are one of the major safety concerns because of a sudden change in velocity and density of traffic flow that drivers experience, as they pass through a shockwave, can often accidents. The past traffic safety analysis was conducted using different statistical approaches observing accident data. The major drawback of statistical models is that they fail to consider driver behaviour. This research focuses on constructing a two-dimensional fluid dynamic model to simulate the merging and diverging traffic flow at different intersections. Analyse the flow under heterogeneous traffic conditions in urban areas followed by microscopic evaluation of shockwave, and evaluate its formation and propagation in traffic congestion. Evaluation of traffic safety at the microscopic level

using Visual Simulation (VISSIM) by implementing the Traffic Conflict Technique (TCT). Predicting an accident before it happens, providing deep insight into accident analysis.

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## Vienna Rectifier: A New Type of Converter for Electric Vehicles Charging Stations

**Gowthamraj Rajendran** Ph.D. (Engineering)

Dr. Chockalingam Aravind Vaithilingam

Dr. Hoon Yap

In recent years, electric vehicles (EVs) are becoming more popular than conventional fuel-driven vehicles, because of the emission norms amendments done. However, one of the key challenges in EVs is charging the batteries. During the charging and discharging cycle, the current harmonics are injected into the battery or to the grid by the power converters. The input current harmonics from the power converters can affect the charging station performance thereby affecting the overall performance of the grid. In conventional rectifiers, the total harmonic distortion (THD) of the input current is 30%. To improve the overall performance of the system, the Vienna rectifier with a power factor correction (PFC) controller is proposed which is a combination of the three-phase diode bridge rectifier and a boost converter. The proposed PFC controller with Vienna rectifier, THD is expected to reduce less than 5% to meet the IEE standards. The closed-loop control technique in the PFC controller uses the proportional-integral controller to balance the output voltage thereby improving the power factor of the source and also reduces the input current THD of the Vienna rectifier. The Vienna rectifier is simulated using MATLAB/ Simulink and its performance is analysed.

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## Multiple Human Activity Recognition Using Commercial Wi-Fi Devices

**Hasmath Farhana** Ph.D. (Engineering)

Dr. Hafisoh Ahmad

Dr. Phang Swee King

We are living in a digital era, where all data is digitalized for making people's lives better than ever before. Advancement in the IoT (Internet of Things) arena is sensing for human activity tracking, identifying, and recognizing human behaviour. Human Activity Recognition (HAR) has attracted a lot of research, especially in the fields which require human-machine interaction in some form or other. Several of the IoT protocols were deployed for HAR and monitoring applications. Amongst the available protocols, cellular is widely used in outdoor applications. Alternatively, for indoor environments, Wi-Fi protocol is widely used as it is economical compared to other IoT protocols. It does not require any special infrastructure and it can be made feasible with the ready availability of commercial Wi-Fi devices deployed in almost all places. This research deals with improving the classification accuracy of action recognition by identifying the essential features using a novel feature

extraction technique. Later the extracted features will be analysed using a classification algorithm for estimating the improvements in the prediction accuracy of activities.

## Sulfonated Polyether Ether Ketone-Sulfonated Polybenzimidazole (SPEEK-SPBI)/Graphene Oxide (GO) Proton Exchange Membrane For Fuel Cell Application

**Raja Rafidah Raja Sulaiman** Master of Science in Engineering

Dr. Rashmi Gangasa Walvekar

Dr. Pang Ming Meng

Dr. Wong Wai Yin

Proton-conducting hydrogen fuel cell generates electricity without releasing any harmful pollutants into the environment; therefore it is regarded as one of the promising technologies for clean and efficient power generation. Its function relies on the solid polymer electrolyte membrane with proton conductive ability. The commercial Nafion membrane is limited to its high cost and loss in conductivity under high operating temperatures (above 80$^{o}$C) due to dehydration. Alternative lower-cost sulfonated hydrocarbon membranes offer better water uptake and retention, which is key in maintaining sufficient proton conductivity at elevated temperatures. Additionally, the use of graphene oxide (GO) nanoparticles as fillers for the proton exchange membrane has been studied in recent years and was found to positively improve the membrane's dimensional stability. This study aims to synthesise and investigate the properties of a proton exchange membrane based on sulfonated polyether ether ketone (SPEEK) crosslinked with sulfonated polybenzimidazole (SPBI) reinforced by GO. The combined effect of crosslinking between two different polymers and the addition of nanofillers could potentially bring about a physically stable membrane with high water retention and improved proton conductivity that can be suitable for application in hydrogen fuel cells.

## Enhancement of Structural and Acoustical Properties of 3D-Printed Natural Fibre Composite

**Vignesh Sekar** PhD (Engineering)

Assoc Prof Dr. Mohammad Hosseini Fouladi

Prof Dr. Satesh Narayana Namasivayam

Malaysia is among the countries which have shown enormously good numbers in terms of oil palm plantation which makes Malaysia one of the leading producers of palm oil as well. This scenario might show a huge profit in the economy of the country. But, on the other hand, huge volumes of biomass are being dumped on landfills during the production of oil by the palm oil industries causing

environmental issues. Disposing of this biomass from land is made as one of the forced moves in the conversion process of making a useful product that is less than the production volume. Out of the conversion process of biomass into a useful product, Oil Palm Empty Fruit Bunch (OPEFB) is one of the major constituents of the biomass produced from oil palm still underuse. Many techniques are in practice to convert EFB into low-value products like pellets and papers but making them into a valuable product is challenging. This research takes up the challenge by converting the fibres shredded from an OPEFB into a valuable product rather than being disposed of. This research intends to develop an acoustic absorption panel using fibres shredded from OPEFB.

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## Completion Detection Scheme for Asynchronous Digital Circuits

**Pallavi Srivastava** Ph.D. (Engineering)

Assoc Prof Dr. Edwin Chung Chin Yau

The Asynchronous Circuit Design is again in demand since it helps overcome the shortcomings faced in technology scaling due to the presence of a global clock. The handshaking signal replaces the clock signal in an asynchronous circuit for error-free data transmission and reception. One of the primary challenges in designing such circuits is to detect whether the data is valid or not. As the addition is the key arithmetic operation in a digital system, various completion detection methods are present to check the data validity of a variety of adders which can give an accurate result at higher speed, consume less power and improve the overall performance of a digital system. This study aims to propose a completion detection scheme for asynchronous floating-point adders using bundled data method. It will eliminate the need for complex completion detection circuitry required for dual-rail protocol, which will reduce the power consumption as well as increase the speed of operation.

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## Extraction of Bioactive Pure Compound from *Crataegus monogyna,* Ensuring its Stability Through Encapsulation to Treat Cardiovascular Disease

**Haripriya Ravikumar** Ph.D. (Engineering)

Dr. Chua Bee Lin

Dr. Chow Yin Hui

Dr. Mah Sian Hui

Natural products such as medicinal plants and herbs have been of great importance in the treatment of diseases from ancient times due to antioxidant property and negligible adverse effects. One such herb is *Crataegus monogyna* commonly called Hawthorn, which has innumerable antioxidant bioactive compounds and promising activity toward treating cardiovascular diseases. Cardiovascular diseases have become a threat due to an alarming increase in mortality and morbidity rates

worldwide. Thus, this study aims to identify plant parts of *Crataegus-monogyna*, a solvent type which provides the highest antioxidant activity through Ultrasound-Assisted Extraction. Also, to isolate the pure compound which is the highest contributor of antioxidant activity, and to optimise the conditions using RSM (Response Surface Methodology) to investigate the stability of the targeted compound using the microencapsulation technique and its role in treating cardiovascular disease.

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## A Bio-Inspired Design of Wings to Optimise the Aerodynamic Performance of Small UAVs

**Shahrooz Eftekhari** Ph.D. (Engineering)

Dr. Abdulkareem Shafiq

Assoc Prof Dr. Mohammad Hosseini

The biology of the living organs and creatures in nature has been significantly inspiring for the advancement of aeronautical and aerospace sciences. Notable inspirations are taken from nature by mimicking the biological characteristics of flying birds and insects such as eagles, dragonflies, etc. to design new wings and optimize the aerodynamic performance of fighter jets, commercial aircraft, wind turbine blades, and Unmanned Aerial Vehicles (UAVs) among many. Aerodynamic performance enhancement of small UAVs has taken significant advantage from the bio-inspired design of wings due to similar flight conditions of birds with Micro Air Vehicles (MAVs) and Mini Unmanned Aerial Vehicles (MUAVs). The recent drastic increase in civil applications of small UAVs has motivated researchers and industries to continuously investigate and optimise the aerodynamic performance of such vehicles and enhance their practical capacity by increasing the flight endurance as well as the stability. This research investigates the application of a bio-inspired wing design with serrations to enhance the aerodynamic performance of small UAVs. Different bird wing configurations are studied to identify the effects of wing parameters on the aerodynamic performance. A compromise of the investigated parameters is used to design an innovative wing configuration with optimised aerodynamic performance, which enhances the endurance and stability of small UAVs. Numerical simulations and wind tunnel experiments are used to conduct the investigations.

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## Production and Characterisation of Polhydorxyalkanoate Biopolymers derived from Crude Glycerol

**Nguyen Huynh Thao Thy** Ph.D. (Engineering)

Dr. Yoon LiWan

Dr. Chow Yin Hui

Prof. Adeline Chua Seak May

The use of conventional plastics synthesised by petroleum substances is known to cause serious pollution and waste management issues. It is crucial to make an eco-friendlier plastic using being biodegradable and biocompatible, such as bioplastics. Among them, polyhydrolyalkanoates (PHA) has become a branch of the bioplastic research focusing on studying its characteristics, applications, and developing sustainable production and extraction processes. PHA production using mixed microbial cultures (MMC) is a three-step process that can convert renewable carbon sources into value-added PHA bioplastics. In the MMC-PHA process, it is important to obtain a strong MMC in the enrichment stage because it will lead to a high performance of producing PHA in the accumulation stage. However, the MMC obtained from the enrichment showed low performance in terms of PHA productivity or production rate and organic loading rate in the accumulation stage as reported in most studies. This is a hindering factor for the commercialisation of PHA in the market. Therefore, this study aims to develop an efficient MMC-PHA production using crude glycerol, to perform process optimisation, and PHA characterisation.

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## Optimal Design of Power System Stabilizer to Enhance the Transient Stability of Power System Integrated Wind Energy

**Ahmad Adel Alsakati** Ph.D. (Engineering)

Assoc Prof Dr. Chockalingam Aravind Vaithilingam

Dr. Khaled Homsi

The growing expansion of wind energy in the electrical networks transforms the distribution system and changes it to an active system with multiple technical effects on load flow, power quality, and power system stability. These effects may have positive, negative, or neutral influences on the performance of electrical networks depending on the structure of the network and different types of wind turbines. Power system stability is the ability of a system to recover a state of operating balance after a disturbance. The disturbances can be mitigated with the use of a power system stabilizer (PSS). PSS provides auxiliary damping to the oscillations through stabilizing signal to control the generator's excitation. Optimized design for PSS will provide better performance in terms of the settling time and damping influence when oscillations occur in the networks. This research implements a new type of algorithm for PSS tuning parameters to enhance the transient stability of the power system integrated wind energy. The new design of the PSS will be applied to a real electrical network to enhance transient stability with high penetration of the Doubly-Fed Induction Generator (DFIG).

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## Development of Chitosan/Alginate/Graphene Oxide Membrane Module for Decentralized Greywater Recycling

**Sathishkumar A/L Nalatambi** Master of Science in Engineering

Dr. Oh Kai Siang

Dr. Yoon Li Wan

Malaysia has experienced a rapid development accompanied by environmental degradation at various scales. Despite high rainfalls, a significant amount of freshwater supply was sacrificed to cater to the needs of rapid urbanization and population growth in Malaysia. Under such circumstances, Malaysia and countries with limited water resources should place an immense priority on freshwater management and sanitation measures. Greywater recycling has been identified as a sustainable option for substitution of freshwater for non-potable activities. 67% of potable water in Malaysia is used for domestic usage in which 43% of it ends up as GW, representing 97.18 L/person/day. Henceforth, this research aims to the synthesis of composite biopolymeric membrane alongside biocides component for GW treatment under a decentralized system. Chitosan (CS), Alginate (AL), and Graphene Oxide (GO) will be incorporated for the synthesis of the membrane module. A combination of CS/AL CS/GO and CS/AL/GO membrane will be synthesized and characterized based on physical, chemical, and molecular structure. The optimum membrane from each combination will be subjected to a filtration unit for greywater treatment. The treated greywater is expected to meet the greywater reuse standard of BOD5< 20 mg/L, turbidity <5 NTU, and non-detectable level of coliform bacteria and *E.coli*.

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## Correlating the Displacement current to Output power for Variable Charge Density Generators

**Ramsundar Sivasubramanian** Ph.D. (Engineering)

Assoc. Prof. Dr. Chockalingam Aravind Vaithilingam

The progressive miniaturization of electronics and their ever-increasing role in daily life have served as the incentive for the development of compact, rugged, sustainable, and green power sources. The need for self-powered, green, and sustainable power supplies for sensing, detection, and data handling is ever rising with the increasing prevalence of the Internet of Things (IoT), smart networks, and big data infrastructure applications. Variable charge density contact-based generators that function by the capacitive effect of mechanical to electrical energy conversion are among the most feasible solutions proposed to satisfy these power supply requirements. Particularly the generation of electricity from ambient energy harvesting based on piezoelectric, triboelectric, and pyroelectric principles by applying nanotechnology is very promising. The high surface area, tunable physical, and chemical properties of nanoscale structures promise greater efficiency for technologies that can capture, convert and store different forms of energy like thermal, radiant, electrical, chemical, and mechanical energies. This research aims to develop a numerical model of a variable charge density generator system and derive the relation between the output power and the displacement current and then subsequently to validate the relation by the fabrication of a nanostructured surface module integrated into a solar array.

## Influence of manganese on the sintering properties of ceria-stabilized tetragonal zirconia

**Ananthan Soosai** Ph.D. (Engineering)

Dr. Siva Kumar Sivanesan

The ceria-zirconia is a developed alternative to the yttria-zirconia because of its better performance in a moist environment. Its cheaper and wider range of solubility in zirconia and better mechanical properties. Two tetragonal phases give additional improvement for the mechanical properties through the crack deflection method but the limited sintering properties even with hot isostatic pressing to fully densify the poor sinterable material was not suitable because the transformation of $Ce^{+4}$ to $Ce^{+3}$ will causes the structure of zirconia change from tetragonal (t) to monoclinic (m) transformation. The aim of the studies is to find the effectiveness of additives such as $MnO_2$ for the sintering of ceria-zirconia according to the pressureless process. To preserve good mechanical properties the material must contain almost all of them in the tetragonal phase and the density must be as close as possible to the theoretical density to avoid any defects leads to crack initiation. Despite outstanding properties of zirconia ceramics, there is a drawback especially ceria-zirconia which undergoes an aging phenomenon that causes loss of strength and generation of microcracking in the presents of water. This happens typically from room temperature up to 400$^{o}$C. The water in the atmosphere especially triggers the transformation from the tetragonal phase to the stable monoclinic phase. This happens due to water molecule absorbs into zirconia grain replacing oxygen vacancies and spread the surface and roughness builds up which degrade the strength, fracture toughness, density, young modulus, and the list continues.

## Development of Hydroxyapatite Zirconia composite for biomedical application.

**Suresh s/o Muniandy** Ph.D. (Engineering)

Dr. Siva Kumar Sivanesan

Hydroxyapatite, HA has an excellent resemblance to the mineral component of human bones and teeth. This makes HA one of the most suitable minerals as an implant for defects associated with bones. Furthermore, HA is also very biocompatible, osteoconduction, and capable of making direct bonds with tissues. Unfortunately, HA cannot be largely used for biomedical applications due to its poor mechanical properties such as low fracture toughness and mechanical strength. One way to overcome this is to mix HA ceramic with other ceramic that exhibits high mechanical property and fracture toughness. Ongoing research shows Zirconia, $ZrO_2$ based ceramics exhibits these properties and since it is bio-inert, $ZnO_2$ makes a perfect choice. HA-$ZrO_2$ composites show similar bioactivity and structural properties of human bones. This research aims to find the optimum weight of $ZrO_2$ in

HA-$ZrO_2$ which gives excellent structural properties. This can be useful for biomedical applications especially in promoting osteointegration.

## Landslide Monitoring based on Optical Time Domain Reflectometry

**Merlin Asha Manoah Johnson** Ph.D. (Engineering)

Dr. Mun Hou Kit

Landslide monitoring is significant for a maintainable living environment where one can comprehend the mechanism of it and can receive preventive measures. In the previous decade, observing technologies have been an extraordinary subject of enthusiasm inside the engineering networks. Most of the time, they used either an array of FBG sensors in series form or Brillouin Optical Time Domain Analysis/Reflectometry (BOTDA/R). FBG detectors produce point sense, only where the sensor exists while the BOTDA/R has advantages as it provides distributed sensing everywhere throughout the optical fiber length. However, the later one is more expensive and is progressively conservative for extremely monitoring long length/distance. So to overcome this, OTDR is implemented, it is more efficient and economical to monitor disasters. It has also been utilized in the media transmission industry for flaw area estimation in optical cables. OTDR can be executed with much lower cost that appeared differently to Brillouin optical time area investigation/reflectometry (BOTDA/R) with tolerably practically identical exhibitions. In this research, the deliberate distributed field-monitoring test of the proposed D-shaped optical fiber using OTDR is designed. The proposed sensor will be able to detect distributed pressure in real-time and would be more cost-effective in terms of detection ability. This system can be applied to distance sensing and will be able to detect and communicate cautioning messages to prevent or reduce the impact of the disaster.

## Microchannel based D-Shaped Photonic Crystal Fiber Biosensor: A Theoretical Analysis

**Firoz Haider** Master of Science in Engineering

Dr. Wei Jen Chew

Assoc. Prof. Dr. Ghafour Amouzad Mahdiraji

Since the last few decades, the photonic crystal fiber (PCF) based surface plasmon resonance (SPR) is getting more interest due to easy launching light through the fiber, small size, design flexibility, and high sensing ability. The D-shaped PCF based SPR sensing technique is the most promising approach in terms of high sensing response and fabrication. However, we take a systematic approach to investigate the various parameters that influence the sensor performance where we study the localization, optical properties, shape, and thickness of the metal components. Finally, a

miniaturized, simple D-shaped PCF based SPR biosensor is proposed for refractive index sensing in the visible to mid-infrared (mid-IR) region. A microchannel is incorporated to increase the sensitivity of the sensor by forming the interaction between core and cladding. A thin Titanium di-oxide (TiO2) layer is used as an adhesive layer to strongly attach the plasmonic gold (Au) layer with a silica fiber surface. TiO2 also helps to tune the operating sensor wavelength from visible to mid-IR (550–3000 nm wavelength). The guiding performance of the proposed sensor will be investigated by the finite element method (FEM). Initial results show that the proposed sensor has a maximum wavelength and amplitude sensitivity of 130,000 nm/RIU and 1088 RIU-1 respectively, in the sensing range of 1.33 to 1.44 refractive index (RI). To the best of our knowledge, this is the highest wavelength sensitivity among the reported PCF SPR sensors. Moreover, we anticipate that we will get a better result by optimizing the design parameters of the sensor.

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## Biodegradation of Natural Rubber Waste: Process Optimization and Characterisation studies

**Harika Chittella** PhD (Engineering)

Dr Yoon Li Wan

Dr Lai Zee Wei

Dr. Suganti Ramarad

The rubber glove industry has tremendously grown to meet the world's rising healthcare demands. Subsequently, the demand for protective products of healthcare such as gloves, condoms, and latex threads, etc. has also increased. Disposal medical gloves are made of different polymers including natural rubber latex, nitrile rubber, polyvinyl chloride, and neoprene. The general rubber degradation methods, mechanical and chemical have their shortcomings by high cost and highly toxic nature. Many researchers have reported the use of microorganisms to biodegrade the natural rubber, whereby a few bacterial species have been identified to degrade the rubber in the past two decades. Studies on the enzymes responsible for the biodegradation has been done, and their biochemical mechanism is ongoing research. Rubber biodegradation is a slow process due to its water-insoluble nature which sometimes may take weeks or even months. The present study is to employ a novel bacterium, *Klebsiella aerogenes* capable of producing two different enzymes, which can biodegrade the rubber. This research also studies the pre-treatment of rubber before biodegradation which may significantly improve the rubber biodegradation and the characterisation of the biodegraded rubber will be carried out by FTIR and SEM analysis to determine the extent of biodegradation. Optimisation of the temperature, time, and pH of the experiment and ANOVA analysis for any significant changes will be conducted in the study.

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## Intelligent Control Strategy for Stand-alone Solar Photovoltaic Based Peripatetaic Based Peripatetic Electric Vehicle Rapid Charging Stations

**Kameswara Satya Prakash Oruganti** Ph.D. (Engineering)

Dr. Chockalingam Aravind Vaithilingam

Dr. Agileswari Ramasamy, Universiti Tenaga Nasional

Electric vehicles (EVs) are creating a paradigm shift in the transportation sector by reducing air pollution caused mainly due to the vehicles. All major countries are developing various policies to enhance the adaption of EVs. In this situation, penetration of more EVs can cause significant stress on the local grids along with an increase in investment for expanding the distribution grid. In Europe, for a 100 % electric mobility scenario, it requires 15% of present total energy production. In Colorado, 5 % of EV penetration leads to overloading of 4 % in distribution transformers. In the UK by 2035, charging 10 million EVs during the evening will increase the peak demand by 3 GW. To overcome the above issues, the foremost and viable solution is adapting renewable energy-based EV charging stations. In this work, preliminary feasibility and design studies will be carried out to develop solar photovoltaic based peripatetic electric vehicle rapid charging stations, followed by the development of a novel intelligent controller to carry out the various communication and power flow between charging station and EVs.

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## A Prescriptive Analytical Logic Model along with the Analytic Hierarchy Process for Analysing Enterprise Level of Software Application Error

**Wong, Hoo Meng** Ph.D. (Computer Science)

Assoc Prof Dr. Sagaya Sabestinal Amalathas

Dr. Sanath Sukumaran

The longer duration of conducting software application analysis activity to identify the root cause would impact and prolong the total time taken to resolve software application error. The proposed prescriptive logic model consists of the proposed algorithm delivers a conceptual guide to provide and to contribute a detailed guideline to build an independent software plug-in as a component that is sitting at the logic tier to analyse especially the enterprise level of software application error. This proposed logic model will be having a similar human-like intelligence and judgment as it incorporates the Analytic Hierarchy Process (AHP) into the proposed logic model for decision making. Indeed, the target of this research is to deliver the proposed prescriptive logic model and the contribution is to shorten the total time spent on root cause analysis activity, which leads to improving the speed of restoration of the software application service back to the users who are on the critical business operation that is highly depending on the Information Technology (IT) as the enabler.

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## Wellness Monitoring and Emergency Reporting System for the Elderly

**Li Jie** Master in Computer Science

Dr. Goh Wei Wei

Dr. Noor Zaman

After decades of development, the concept of the Internet of Things (IoT)and its application strengthens various types of interactions between users and devices over the Internet. As IoT technologies mature in different industries, their corresponding applications have radically changed the data communication approaches as well as people's lifestyles in many different ways.

At the same time, the increase of an ageing population has been observed in many countries, however, the phenomenon of an ageing society has been greatly inspired innovation of IoT solutions for elderly people in their independent living[4][5]. Thus, people realize Ambient Assisted Living (AAL) with device-based techniques can contribute to the elderly by providing applicable solutions to the difficulties from which they are suffering.

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## Anomaly Detection Model for IoT Sensor Network

**Redhwan Al-Amri** Ph.D. (Computer Science)

Dr. Ibrahim Abaker

Assoc Prof Dr. Raja Kumar

Heterogeneous Internet of Things (IoT) devices are a source of a large amount of different information such as light, temperature, humidity, etc. With the increased reliance on IoT devices and their services, the capability to detect malfunction devices (false positive) among the vast number of devices is becoming more challenging. There is a lack in this matter as the anomaly detection was oriented toward intrusions and malicious activities detection within IoT networks. At the same time, traditional anomaly detection approaches are not suitable for delay-sensitive IoT applications since these approaches are significantly impacted by latency and energy consumption issues. In this study, we propose an IoT device malfunction detection system based on machine learning techniques. The proposed model will be using principal component analysis (PCA) and linear discriminate analysis (LDA) of the dimension-reduction method to spate the high dimensional dataset to a lower one with lesser features. Next, utilizing Naïve Bayes and Certainty Factor version of K-Nearest Neighbour will be employed to identify anomalies in the behaviour of IoT devices' data streams.

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## A Framework for Profiling Potential Computing Graduates

**Hemalatha Ramalingam** Ph.D. (Computer Science)

Dr. Thulasyammal Ramiah Pillai

Dr. Ibrahim Abaker Targio Hashem

To gain a sustainable competitive advantage, organizations need to screen talented prospective employees possessing the relevant skills to fit the job. Soft skills take up 25% of the skills required to do the job and to be a great team player hence screening candidates for soft skills is one of the top areas recruiters want to learn more about. Traditional methods used in assessing soft skills have limited support on their predictive validity for high stakes selection hence Situational Judgement Test (SJT) as a multi-dimensional measurement method with high predictive and incremental validity has been gaining prominence. Adding to that, gamification, the application of game-design elements to non-game systems are being used significantly in business to assess the relevant soft skills of candidates. With interactivity, motivation, and engagement as its main driver, this technique has assessed potential employee's soft skills more specific and identifiable. This research aims to explore the effectiveness of the gamification method as a stimulus mechanism to administer selected SJT of a specific IT job role measuring identifiable soft skills with evident objective measures in place. A benchmark of comparison will be made with the traditional selection measures administered.

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## Criminal Network Community Detection Using Graphical Analytic Methods

**Theyvaa S.Krishnan** Master in Computer Science

Assoc Prof Dr. Azween Abdullah

Dr. Noor Zaman Jhanjhi

Social network analysis focuses on investigating the connection between social actors and obtaining useful insights. It involves various techniques and methods, including determining the isomorphism among (sub)graphs. In this study, we have presented new knowledge by providing the working mechanisms, features, different application areas, and mechanism states of various algorithms used for methods of community detection and isomorphic methods based on graph analysis focussing on criminal networks analysis, which has attracted quite many researchers as network analysis gained its popularity among professionals and researchers. The concept of community was vividly discussed as well as the algorithms for detecting communities within a network. This study enables us to study and examine different structures of the graph from a new perspective by applying community detection and isomorphic methods for greater insights into the criminal network. Thus, it becomes obvious through this study that more research activity is necessary and expected to increase this research area.

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## Leveraging Deep Reinforcement Learning For Criminal Network Hidden Link Prediction

**Lim Teng Soon** Ph.D. (Computer Science)

Assoc Prof Dr. Azween Abdullah

Dr. Noor Zaman Jhanjhi

Criminal network analysis (CNA) which involves the use of graph theory models in the investigations of organised crimes (e.g. narcotics trafficking, terrorism, armed robbery, fraud, etc) has been getting attention among law enforcement agencies globally as a powerful tool in the gathering of analytic intelligence for the identification of entities (both individuals or organisations) and their associated parties in syndicated criminal activities. Most of the methodologies and techniques based on graph mining used in CNA has been adopted and adapted from the field of Social Network Analysis (SNA). However, CNA poses its additional challenges in comparison to SNA due to the nature of criminal networks which tends to operate in a covertly and stealthy manner to evade law enforcement. These characteristics of criminal networks result in the collection of criminal activities data that tends to be incomplete and inconsistent which is topologically reflected in the criminal network in the form of missing nodes (actors) and links (relationships). In this respect, SNA models provide the mathematical models, algorithm computation, and metrics for the identification of possible interaction, connection, association, and the relationship between the nodes in the network which enables CNA to predict the possible hidden links between the entities of the criminal network. Analytical models rely on machine learning techniques to improve the performance of the model in terms of predictive accuracy and computational power. The challenge of obtaining a large enough dataset in the domain of criminal networks is a significant problem due to the stealthy and covert nature of their activities compared to social networks. Therefore, current breakthroughs in the construction of ML models trained with dataset generated through self-simulation by leveraging deep reinforcement learning (DRL) may overcome this constraint. Taking into consideration recent developments in Deep Reinforcement Learning (DRL) techniques and the availability of the Graphical Processing Unit (GPU), the primary objective of this research is to develop a Criminal Network Link Prediction Model based on SNA link prediction metrics. To model the dynamic nature of evolving criminal networks over time, metadata (i.e. environment attributes such as criminal records, education level, age, and police station proximity) is also factored in the development of the model. The proposed model developed with the fusion of metadata (i.e. environment attributes such as criminal records, education level, age, and police station proximity) is expected to contribute towards higher precision in predicting links as it is reflective of real-life scenarios in organised crimes. The performance of this model is then evaluated against classical supervised machine learning models such as Gradient Boosting Machine (GBM), Random Forest (RF), and Support Vector Machine (SVM).

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## Spatial Data Analysis for Coastal Erosion and Flood Mitigation

**Lim Eng Lye** Ph.D. (Computer Science)

Dr. Sophea Prum

Prof Patrice Francois Boursier

Floods are among the most devastating natural hazards in the world, widely distributed leading to significant economic and social damages than any other natural phenomenon. This research hopes to use data-driven methods to investigate and to analyze the relevancy of the factors on floods. The integration of data extracted through the Geographical Information System (GIS) and Remote

Sensing (RS) with other datasets provide tremendous potential for identification, monitoring, and assessment. This study aims to propose a model for spatial data analysis for a flood. The outcomes of the research hope to provide assistant to policymakers, planners, and developers in planning the optimal development of an area while simultaneously preserving the environment.

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## Bone Age Measurement Based on Dental Radiography Using Learning Techniques

**Fatemeh Sharifonnasab** Ph.D. (Computer Science)

Dr. Mohsen Marjani

Dr. Ibrahim Abaker Targio Hashem

Bone age measurement is a method for evaluating the level of skeletal maturity to estimate the actual age of a person. Usually performed manually by comparing an X-ray image of a left hand-wrist or dental with an atlas that contains a collection of images of known persons in the clinical procedure. The manual methods are based on analysing special regions of the images of the hand bones or dental bones of the images. Both approaches are prone to observation variability, time-consuming, and a decision made on bone age is subjective. As a result, there is a pressing need to develop a model for accurate bone age measurement. This research aims to develop a model for accurate bone age measurement using images of the dental. Our research uses a new image processing technique that involves generating the histogram of the X-ray images. This approach overcomes the image classification problem, and it also overcomes problems when conducting bone age measurement on people who have dental defects or even growth abnormalities in the dental bone. A dataset collected from the faculty of dentistry at the University of Malaya Medical Centre (UMMC), and the images used for the implementation of the bone age for the development of the bone age model. The model will be developed based on the analysis, design, development, implementation, and evaluation of machine learning technique.

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## Using Social Media Data to Estimate the Impact and Level of Disasters

**Nicholas Lau** Master in Computer Science

Dr Tan Ee Xion

Dr Dini Oktarina Dwi Handayani

In the past 20 years, natural disasters over the globe have cost over $2.9 trillion in damages and the lives of 1.3 million people. To successfully coordinate what are often complex disaster relief efforts, disaster response organizations — including government agencies and humanitarian groups — first require real-time information at their fingertips to assess the damage from areas affected by natural disasters. Damage assessment is a critical first step to creating an effective disaster response strategy. Using abundantly available social media data and machine learning, first responders will be able to

adopt a nimble, fact-based approach to disaster preparation and recovery with less required manpower and in less time. This research aims to develop methods to use social media data in conjunction with machine learning, computer vision, natural language processing, and geographical information systems to determine the degree of disaster damage in a given area during and right after a natural disaster. This will decrease the time required for first responders to assess the damage which will allow successive disaster response actions such as disaster relief operations to be taken earlier.

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## A Predictive Model for Smart Decision In Oil Palm Plantation

**Kusai Mosbah Esseid** Ph.D. (Computer Science)

Assoc Prof Dr. Sagaya Amalathas

Dr. Ibrahim Abaker Targio Hashem

Palm oil in Malaysia is known as the main economic income for the nation. The performance in the Malaysia palm oil industry can directly affect the national economy and government income. Palm oil has become an ingredient in the making of margarine, candles, soaps, domestic frying oil, and snack foods. The main unsolved problem in Malaysia's palm oil industry is the shortage of labour. Moreover, traditional agricultural production regulation methods are time-consuming. This research aims to design and develop a model predictive control to be used for smart decision making in an oil palm plantation, such as the tree health, oil content, and predict and make the best decision for site-specific harvesting at the optimum maturity stage for oil palm FFB and make the best decision for site-specific harvesting at optimum maturity stage for oil palm FFB. This predictive model will overcome losses due to uncollected loose fruit and only a ripe fruit bunch will be harvested. Determination of correct harvesting time of the oil palm fruit bunch maximizes the oil extraction rate. Besides that, it's to encounter the labour shortage in the oil palm industry by providing some level of automation.

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## A Secure Model of Blockchain In the Internet of Things Application

**Kwan Kok Foong** Ph.D. (Computer Science)

Dr. Ibrahim Abaker Targio Hashem

In recent years, the Internet of Things (IoT) has emerged as a new computing paradigm, in which a continuum of devices and objects are interconnected with a variety of communication solutions such as Bluetooth, wifi, zig-bee, and gsm, to name just a few. A typical IoT deployment contains heterogeneous devices with embedded sensors interconnected through a network, an application layer, and gateways. Devices in an IoT system are uniquely identifiable and are mostly characterized by low power, and limited memory and processing capability. The wireless networks are deployed not only to connect IoT devices to the outside world for the remote provision of data and services to

IoT users but also to encryption and decryption of data exchanged between the sensors. However, the deployment of wireless networks for encryption and decryption in an IoT environment is the main cause of communication overhead. Although the communication overhead of an IoT system can be significantly reduced by using IoT gateway or proxy architecture, the computational resources that are required remain high. The research aims to propose a multi-objective secure model of blockchain for IoT networks to overcome the issue of computational resources when encrypting and decrypting the data exchanged between sensors and gateway devices. The proposed model is evaluated and compared to existing IoT security models using time and energy consumption.

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## GIS Satellite Image Processing Using Machine Learning Algorithm

**Kang Xiaoxi** Master in Computer Science

Dr. Dini Oktarina Dwi Handayani

Professor Dr Chong Pei Pei

The geographic information system (GIS) is used for capturing, analysing, storing, manipulating, managing, and presenting spatial or geographic data. GIS is a very important tool that can be used to understand and manage the environment it can be used in agriculture, disaster management, telecom, and network planning, transportation management, urban development, and so on. Spatial data is one of the sources that are mainly used for GIS and it means that data that contains the location, size, and shape of an object on earth such as building, road, mountain, lake, etc. The satellite image is one of the spatial data which has a rich and structured source of information for us to detect objects to determine the details of the geographic information. The satellite sensor provides digital raster images that can apply Digital Image Processing (DIP). Many of the GIS such as Esri are manually to do the extraction and segmentation, although some of GIS are doing the auto extraction system accuracy and efficiency is not very high. To improve the accuracy and efficacy I am proposing a GIS extract from the satellite image by using the machine learning algorithm to improve efficiency and accuracy.

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## Political Profiling Using Social Network Analysis

**Muhammad Bilal** Ph.D. (Computer Science)

Dr Mohsen Marjani

Dr. Ibrahim Abaker Targio Hashem

Social media has taken an important place in the routine life of people. Users from all over the world are sharing interests, emotions, and other information that leads to the generation of huge volumes of user-generated data. This data contains rich and useful information related to trends, patterns, and interests of individuals. Based on the information shared over social media networks reliable

future predictions can be made. This study aims to propose a model for political profiling using social network analysis. The results will be useful for political parties to the device the plans for interacting and influencing voters. This study also gives the insight of network size, interaction patterns, and most influential political party over social media. These social media insights will be used to infer the probability of winning seats by each political party in the multi-party electoral system.

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## Predictive Spatial Model for Cardiovascular Effects of Outdoor Air Pollution

**Raja Sher Afgun Usmani** Ph.D. (Computer Science)

Dr. Ibrahim Abaker Targio Hashem

Dr Thulasyammal a/p Ramiah Pillai

The increasing availability of environmental and health data has led to an explosion in the number of spatial (geo-tagged) datasets available for analysis. These datasets come with a complexity that renders it difficult to rely on traditional epidemiological or environmental health models. There is a lack of models that can handle the size and complexity of spatial datasets and foresee the cardiovascular effects of outdoor air pollution. In this research we will propose a Predictive Spatial model called the GSAR model, to predict the cardiovascular effects of outdoor air pollution. The GSAR-based analysis will allow solving complex location-oriented problems. The GSAR-based analysis goes beyond mere mapping to help in studying the characteristics of places and the relationships between them. The superiority of the GSAR model can be seen in the case of air pollution and its cardiovascular effects. GSAR model can be used to make pinpoint analysis and prediction of the cardiovascular effects of outdoor air pollution that can help in raising public awareness as well as deriving the policies to minimize these harmful effects.

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## A Trusted Framework for Decision Making of an Event in Fog Computing

**Poornima Mahadevappa** Ph.D. (Computer Science)

Assoc Prof Dr. Raja Kumar Murugesan

Professor Dr. David Asirvatham

Fog computing is the extension of both cloud and mobile computing. Each node in fog computing is dependent on other nodes to provide a meaningful service. If one node fails to mitigate the other node in latency-sensitive application, it creates a serious threat that leads to trust crisis. Fog nodes handle the first set of data pre-processing in IoT and have the required resource to implement full hardware root of trust. This trust is extended to all the processes and the application running on them and then to the cloud. Without a hardware root of trust, various attack scenarios can compromise the software infrastructures of the Fog, allowing hackers to gain a foothold. Hierarchical data preprocess is considered to support decision making. The systems with a stringent response

time would perform the most important part of the decision-making process in the fog nodes. The main aim of this study is to obtain pre-processed data to assist decision making with stringent response time and to guarantee that these decisions are done from the trusted nodes.

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## A Trust-Based Secure Routing Protocol for Defense Against RPL Rank and Blackhole Attacks in IoT Applications

**Syeda Mariam Muzammal** Ph.D. (Computer Science)

Assoc Prof Dr. Raja Kumar Murugesan

Dr. Dini Oktarina Dwi Handayani

With large scale generation and exchange of data between IoT devices and limited security to protect data communication, it becomes easy for attackers to compromise data routes. In IoT networks, IPv6 Routing Protocol for Low Power and Lossy Networks (RPL) is the de facto routing protocol. However, it is prone to diverse attacks like other routing protocols and offers limited protection against several RPL-specific and WSN-inherited attacks. For example, Rank and Blackhole attacks are popular among routing attacks in IoT applications. Both have a severe impact on device-to-device (D2D) communication and network topology. Additionally, IoT devices are limited in memory, processing, and power to operate properly using current security solutions. Hence, there is a need for a novel security mechanism that is compatible and practically applicable in diverse IoT scenarios to provide adequate security to devices and data communicated. This research work proposes a trust-based routing protocol for secured routing in IoT. The solution will be able to secure IoT networks by identification of attacks and isolation of malicious nodes. The secure routing protocol will be based on a trust-based approach embedded in RPL. The research aims to provide security with scalability, mobility, and better network performance.

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## User Centred Design Of Internet of things to Assist Elderly In An Ambient Assisted Living

**Karsten Phua Cheng Kai** Master in Computer Science

Dr. Goh Wei Wei

Dr. Mohsen Marjani

Malaysia is moving toward an ageing population (ages 65 and above) by the year 2021. As people begin to grow older, they begin to lose the ability to do the same things that they were able to when they were younger. Basic tasks like cooking and cleaning, which were once part of a manageable daily routine are now too difficult to perform. Despite this, many elderlies choose to live independently in their own home. The Internet of things (IoT) is one of the ways that can support the elderly in their

daily lives and increase their comfort and safety at home. With the help of technologies, the elderly will be able to live independently without the help of others. This study aims to achieve and provide an independent and quality life for the elderly who live alone by investigating the state-of-art literature related to IoT solutions and devices that are suitable for the elderly and to propose an IOT based device/required application to assist the elderly in ambient living.

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## Tacit Knowledge Elicitation Recommender Engine for Knowledge Intensive Systems

**Casper G K Simon** Master in Computer Science

Dr. Sanath Sukumaran

Dr. Noor Zaman Jhanjhi

Knowledge management systems (KM System) today play an integral part as the drive to capture knowledge that resides in the minds of subject matter experts (SMEs) are crucial to an organisations survival. Furthermore, this knowledge is acquired through experience which could be beneficial to new joiners or junior staff. Despite the advancement of KM systems out there, there is little to no quality control over knowledge creation. There is a saying, garbage in garbage out which if no control is in place, therefore knowledge created is not usable for users to access or learn from it. This study aims to investigate the issues plaguing KM systems in particular with knowledge creation in terms of knowledge quality and to infuse elements of the current advancement in technology today to solve the pressing matter which currently plagues KM systems today.

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## Predicting Respiratory Mortality Based on Traffic-Relate Air Pollution

**Abdullahi Akibu Mahmoud** Ph.D. Compuer Science

Dr. Ibrahim Abaker Targio Hashem

Dr. Thulasyammal A/P Ramiah Pillai

Dr. Mohsen Marjani

At present more than half the world's population lives in urban areas and is expected to increase to nearly 60% in 2030. In urban areas, there are increases in motor vehicles on the roads that lead to traffic congestion and produce emissions of air pollution that have an impact on human health such as respiratory and cardiovascular morbidity and mortality. Traffic-Related Air pollution (TRAP) is one of the biggest threats to human health and the environment. The Health Effects Institute (HEI) estimates that living within 1,640 ft (500 m) of a highway or major roadway constitutes an area "highly affected" by traffic-related air pollution. The purpose of this study is to propose a model to predict the impact of traffic-related air pollution on humans residing near roads where no air quality monitoring stations have been installed. This study will enable the authorities to implement the most

appropriate policies and strategies to minimize the effects of traffic-related air pollution on the citizens.

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## A Security Framework for Cyber-Physical Systems (CPS)

**Navid Ali Khan** Ph.D. Computer Science

Dr. Sarfraz Nawaz Brohi

Dr. Noor Zaman Jhanjhi

With recent advancements in the Internet of Things (IoT), we have seen the exponential growth of cyber-physical systems (CPS). The impact can be seen in almost every aspect of daily life. For example, transportation, electric power grids, home security, and health-care devices, etc. Most of the systems are deployed in critical infrastructures such as health and life support equipment, and other aspects which are important in our daily life. Due to their rapid growth and usage, they are becoming an ideal target for attackers against vulnerabilities and other severe threats which can cause huge losses. To test the vulnerabilities. This study aims to propose a security framework for cyber-physical systems against potential vulnerabilities such as Dos attack, GPS spoofing, eavesdrop attack, etc.

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## A Framework to Identify Attention Deficit in Adults based on EEG Neurofeedback Training

**Eshrak Alaros** Master in Compuer Science

Dr. Dini Oktarina Dwi Handayani

Dr. Mohsen Marjani

Attention deficit training (ADT), which specifically focuses on non-pharmacologic therapies such as neurofeedback interventions still does not give guidelines in helping the AD groups. Adults lose their attention level nowadays due to challenges of the contemporary life. In modern life like in Malaysia, it was reported in 20 I 6, Almost 4.2% of adults have attention deficit symptoms. They are not getting treatment, due to that, many adults lose their skills in work, education, and other normal activity. Studies on attention deficit training for adults, which specifically focus on neurofeedback interventions are still scarce. Although there have been many studies on neurofeedback, there is still a space for substantial evolution, especially concerning the elaboration of new and more complete training protocols that may be capable of maximizing this potential. This study aims to create frameworks to determine the best outcome based on the current methods and extracted features. The research methodology consists of two major phases, which are Analysis of the Problems, Design

& Development. Building a framework for training the human brain in Adults with Attention Deficit is expected to give good feedback to society.

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## First Impression Recognition Using Capsule Convolutional Neural Network in Short Video Sequences

**I Made Artha Agastya** Ph.D. Compuer Science

Dr. Dini Oktarina Dwi Handayani

To be able to automatically predict personality traits in a short time is important in the screening process because the screening process takes a lot of time and involves many psychology experts to be done. The main problem of automatic personality recognition is the complexity of personality information in short video sequences. In the video sequences, there are two types of modalities, visual and audio. To tackle the problems, we proposed a novel deep-learning-based technique which is the Modified Capsule convolutional neural network (Mod-CCNN) or Modified Capsule Networks (Mod-CapsNet). We chose CCNN as a base algorithm because it has a strong aptitude to overcome the complexity problem and break through the current state of the art accuracy. We do not only propose new methods, but we propose a new model for the fusion strategy to support the new method. Also, the fusion strategy is essential to combine both visual and audio features.

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## A Framework for Graphical Visualization of Criminal Networks Using Predictive Modelling and Analytics

**Adeyemo, Victor Elijah** Master in Computer Science

Assoc Prof Dr. Azween Abdullah

Dr. Noor Zaman Jhanjhi

The criminal network is not a recent societal component, it dates back ages, where it is known that people who tend to commit crime do so not in isolation. It is known that crimes committed by a criminal network, no matter the size, are being executed by a cohort of people who possess different but complementing skills, attributes, or resources including but not limited to charisma leadership role, violence, aggression, money, special skills, etc. The analysis of crime, crime pattern identification, discovering influencer member(s) of a criminal network, identification of information disseminators within a criminal network group, discovering latent relationships between criminal network members, predicting crime rate, identification of key factors to (a particular) crime, understanding the behavior of criminal network members, etc. are all viable areas of research covered by crime and or criminal network analysis. Thus, this research work plunges into criminal network analysis using some social network analysis and some predictive modeling techniques to develop a framework whose results will be visualized graphically.

## Travel Behaviour Modelling Using Social Media for Urban Congestion Control

**Aman Sharma** Ph.D. Computer Science

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Dr. Mohsen Marjani

This research is about deploying Travel Behaviour Modelling to ease the congestion problem in big cities. Generally, traffic congestions are affected by at least three main factors like a natural disaster, human being, and transport vehicles. The human factor is deemed to be the most significant cause for congestion which is due to improper traffic management, unawareness, carelessness, and indiscipline. Vehicles are also the major factor for congestion due to indiscipline, unawareness, and traffic management. Therefore, the congestion problem is related to human behavior in which either directly or indirectly contributed to the congestion problem. Based on the above-mentioned events and causes, we conclude that the congestion problem exists mainly due to human misbehavior, in terms of lacking awareness, carelessness, indiscipline, improper planning of road construction, improper time management, and improper staff management. Many methods had been proposed to ease the congestion problems, but they do not get rid of the problem completely. This is simply because the congestion problem is a systemic type of problem that cannot be solved by a simple straight solution. The hard problem cannot be solved by a simple engineering approach, but this soft problem requires a systemic approach. Our systemic approach uses modeling on travel behaviour to analyse the state of traffic and offers an immediate solution to travelers and traffic administrators. This is possible by deploying the theory of Queuing to measure the level of congestion at a particular time and its magnitude. By having prior knowledge of travelers' behaviour, the traffic administrator can devise a better policy to cope with such bad behaviour.

## AI-Based Model for Facial Expression Recognition

**Anantha Krishnan Raman Fesabas** Master in Computer Science

Prof Dr. David Asirvatham

Professor Dr. Jean-Pierre Marie Poulain

Facial expression is one of the most important features of human expression recognition. It is the facial change in response to a person's internal emotional state, intentions, or social communication. These facial emotions are used in the process of non-verbal communication. There are 6 basic expression states: neutral, joy, surprise, anger, sadness, fear, and disgust. Facial expression recognition (FER) can be useful for companies to improve their customer service and be used by educators to improve the e-learning method. Furthermore, FER can be used as an additional tool for

Social Sciences to enhance the survey. This study looks into the different FER methods and will be proposing an AI-based model to improve FER accuracy.

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## A Theoretical Framework to Build Trust and Prevent Fake News in Social Media Using Blockchain

**Tee Wee Jing** Ph.D. Computer Science

Assoc Prof Dr. Raja Kumar Murugesan

Dr. Ibrahim Abaker Targio Hashem

Fake news detection and prevention on social media have recently become an emerging interdisciplinary area that needs tremendous attention and solutions. Social media is a double-edged sword. The problem statement is fake news detection and prevention on state-of-the-art social media presents unique challenges that make existing algorithms used in current news media not effective. This research area has a tremendous real-world political, economic, and social impact. With an increasing appetite for verifiable truth on the Internet, emerging blockchain technology combines with powerful AI algorithms can step in to provide the new ecosystem of information on major social platforms to rebuild a more trustable, reliable, transparent, distributed, and secure fundamental fabrics of our modern society. Next-generation social media built on blockchain will ensure a decentralized system that relies on the wisdom of the crowd and returns the power to the people to provide them with high quality and verifiable news. As a result, this research can create a high impact in protecting democracy and civil liberties in our modern society.

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## Development of Pre-Encryption Detection Algorithm for the Early Detection of Crypto-Ransomware

**Kok Sim Hoong** Ph.D. Computer Science

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Dr. Noor Zaman Jhanjhi

Ransomware has been considered as the biggest threat in cybersecurity that uses encryption technology to prohibit its victim from accessing his/her resources. To gain access again, the victim is required to pay the demanded ransom. Therefore, this study aims to build an early detection system using a pre-encryption detection algorithm (PEDA). Early detection is important to prevent a ransomware attack from causing serious and often irreversible damage, more specifically at the pre-encryption stage. Once the victim is aware of the presence of crypto-ransomware, valuable data and files can be back-up to another location, and then an attempt can be made to clean the ransomware with minimum risk. PEDA

consists of two phases, in PEDA-Phase-I, the trained learning algorithm (LA) can detect both known and unknown crypto-ransomware but takes more processing time and may have a high false-positive rate (FPR). If the prediction is a crypto-ransomware, PEDA would generate a signature of the ransomware, and store it in the signature repository, which is in Phase-II. In PEDA-Phase-II, the signature repository allows the detection of crypto-ransomware at a much earlier stage, which is at the pre-execution stage through the signature matching method. However, this method can only detect known crypto-ransomware, although very rigid, it is accurate and fast. The two phases in PEDA formed two layers of early detection for crypto-ransomware to ensure zero files lost to the user and prevent ransomware from achieving its objective.

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## A Model to detect Anomalies in Signalling Network using Ensemble Algorithms

**Rafia Afzal** Ph.D. Computer Science

Assoc Prof Dr. Raja Kumar Murugesan

Dr. Dini Oktarina Dwi Handayani

The telecommunication and mobile communication networks use the Signalling System No. 7 (SS7), which acts as a backbone of these networks, for communication purposes. Moreover, simultaneously it helps in managing bills for operators and much more. By exploiting mobile networks signaling security flaws like lack of subscriber actual location check, inability to verify a subscriber's belonging to the network, SMS home routing configuration flaws, and lack of message filtering attackers can impose threats such as like subscriber/network information disclosure, traffic interception, fraud, tracking location and denial of service both on either subscriber level or network level which in turn could lead to reputational and financial risks for the operator and significant financial losses, privacy violation, and availability disruption to subscribers. Subscribers, as well as operators, will endure in danger due to prevailing signaling attacks especially the privacy and security of users is at high stake because of location tracking, SMS/call interceptions, eavesdropping, and frauds. Signaling network attacks are very common now. Intelligent defensive monitoring is required to identify, track, with a faster response to these intimidations.

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## Cervical Cancer Detection Using Deep Learning approaches

**Nina Youneszade** Master in Computer Science

Dr. Mohsen Marjani

Cancer arises in the body when the cells of a specific organ start to grow abnormally. Cervical cancer ranks as the fourth most common type of cancer worldwide in women aged 15–44 years. Cervical

cancer is the main death cause in women around the world globe It becomes the second well-known disease among women after breast cancer with more than 700 mortality daily and estimated by 2030 to be 400,000 annually which 90% occurred will occur in developing countries.

According to recommendations of the World Health Organization, there are currently three types of cervical cancer/lesion screening methods, including human papillomavirus (HPV) testing, Pap smear testing, and vinegar-based colposcopy. The first two methods are relatively complex and expensive, especially for patients in developing countries. Even in the first two methods, colposcopy is still a necessary step in the biopsy. Therefore, colposcopy is a necessary and most effective tool for cervical cancer screening. Deep learning is widely used in medical image processing and made great achievements, including classification, detection, segmentation, and registration. Most of the processed image data are medical images such as MRI, CT, and ultrasound images. The multilayer neural network perception mechanism of deep learning can learn more abstract features in images and is expected to solve or improve the problems of traditional medical CAD systems such as a colposcopy. The goal for this research is to increase sensitivity, specificity and minimize expenses to improve the quality and accuracy of images for detection and classification, and segmentation cervical cancer in early-stage to save more lives with using Deep Learning methods.

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## A holistic multiple similarity metrics method for matching geospatial data using multisource background knowledge

**Sohaib Al-Yadumi** Ph.D. Computer Science

Dr. Tan Ee Xion

Prof. Dr. Patrice Boursier

Geographic information systems (GIS) interact with a vast number of geospatial big data sources with direct and indirect applications to drive more precise and more informed decisions. Geospatial multi-source databases are needed in particular for effective disaster risk management. A significant portion of data is considered as spatial data due to ubiquitous technologies such as satellite images, the internet of things (IoT), social networks, location-based data, and volunteered geographic information (VGI). However, giving a unified view over heterogeneous and disparate spatial big datasets is a difficult task. Geospatial matching issues live on the kernel of spatial data integration. The existing manual matching between geospatial data sources is impracticable and inefficient. Adding to that, all these methods more often not reusable, require human involvement in some form, and the impacts of unbalanced information ignored in geospatial datasets matching. Hence, the aim of this research to propose a novel holistic matching method for geospatial datasets using multiple source background knowledge that will meet the requirements of unbalanced information and provide acceptable accuracy. The results of the matching will be evaluated in terms of performance and accuracy with existing methods.

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## A Load Balancing Algorithm for The Optimization of Cloud Computing Applications

**Dalia Abdulkareem Shafiq Al-Obaidi** Master in Computer Science

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Cloud Computing (CC) is a fast-growing service that makes use of pay per use model. The technology provides various services in terms of storage, deployment, web services, etc. however the expand of these services and the tremendous increase of user demand has resulted in many challenges to keep up the performance in line with Quality of Service measurement and Service Level Agreement document provided by Cloud Service Providers to enterprises. This expansion resulted in challenges such as load balancing, for example, overloading situation of VM, task migration should occur to free the resources and transfer tasks to a less utilized VM. Besides that, the user's requirements became hard to fulfill in terms of response time and deadline regarding task scheduling. To address the challenges mentioned above, this research proposes an optimized algorithm with the use of Machine Learning Classification technique based on deadline constraints. The main objective of the proposed algorithm is to optimize server resources by considering the priority of different users' tasks and avoid overloading situations. Furthermore, the proposed algorithm will be evaluated using simulation tools. The results will test the performance of the algorithm with the currently existing solutions. As an outcome, the algorithm is expected to schedule tasks dynamically and reduce response time for the tasks' execution.

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## Predictive Model Using Graph Traversal Based Algorithm To Identify The Right Influencer In Instagram

**Kristo Radion Purba** Ph.D. Computer Science

Prof Dr. David Asirvatham

Assoc Prof Dr. Raja Kumar Murugesan

An influencer is an impactful content creator on social media. Influencing has become a new way to advertise, and by using these, brands can get significantly more engagement compared to traditional marketing channels. Currently, many companies are having a limited budget for advertising, and existing systems are either still not fully automated, or not very accurate due to lack of additional factors, i.e. topic similarity with followers and outsiders, sentiments, and non-authentic followers. For business users, picking the right influencer means to maximize influence and minimize cost. We hypothesize that influence will be optimal if an influencer has the same topic preference with the followers, and topic similarity can easily reach outsiders as well. Sentiments are also proven to be impactful on the engagement level, as well as fake followers. In this research, we will build a framework that focuses on building a heuristic graph traversal algorithm, as well as using these factors to determine the right influencer in a topic, on Instagram. Other methods will be used to support, such as unsupervised sentiment analysis, hybrid Fuzzy logic and genetic algorithm for non-authentic account classifier, a bag of words, and cosine similarity for topic similarity. The framework will be applied to the Instagram influencers dataset. We aim to further improve the accuracy of influencer detection compared to previous research.

## Perceptions of different stakeholders in conservation approaches of heritage buildings at Royal Klang Town, Selangor

**Gooi Liang Jun Ph.D.** (Architecture)

Dr. Camelia Kusumo

Prof. Johanes Widodo

It is known that conservation of heritage buildings at most non-UNESCO historic towns in Malaysia remained dormant and indifferent despite constant concerns being expressed from conservationists and different stakeholders. The challenge attributes to the lack of contextualised theory, vary conservation guidelines and approaches put forward by local authority and professional bodies, which were adopted by different stakeholders who share different perspectives and priorities. Although the National Heritage Act 2005 and conservation guidelines from municipal councils have been set, different organisation and stakeholders partake in conservation projects uphold a different set of values and approaches regarding conserving heritage buildings. This research seeks to explore the theoretical implication of heritage buildings conservation in Malaysia, Royal Klang Town as the case-study. It is aimed that the theory developed could explain the dormant scenario in heritage conservation and improve existing conservation approaches for historic towns in Malaysia. It will be done through understanding the existing conservation theories and legal provisions in preserving heritage buildings in Klang, by analysing conservation approaches of different stakeholders and identifying the perception of different stakeholders toward conservation. The grounded theory method is adopted as the tool for data collection and analysis since its data analytic techniques applied for both primary and secondary data can yield in-depth information required and construct an all-rounded theory for the study.

## Innovative Procurement for Prefabricated Prefinished Volumetric Construction (PPVC) in Malaysia Context

**Leong Boon Tik** Ph.D. (Architecture)

Dr. Kam Kenn Jhun

Assoc Prof Dr. Veronica Ng

In Malaysia, the population of Malaysia rose from 28.6 million in 2010 to 32.4 million in 2018, recording 3.8 million growth in 8 years. The total household in Malaysia increased from 6.9 million to 7.5 million from 2009 to 2016, a growth of 600,000 households. There is a demand for housing, especially affordable housing in Malaysia. Given the effort of reducing foreign workers, the construction industry has to catch up with the productivity at the same time maintaining the cost and the quality of the construction of affordable houses to fulfill the demand for affordable housing.

Prefabricated Prefinished Volumetric Construction (PPVC) is a construction method whereby free-standing volumetric modules complete with finishes for walls, floors, and ceilings are constructed and assembled. It is described as "Lego-like" construction that provides benefits as follows: 1) Improved productivity, 2) reduction of on-site manpower, 3) better construction environment, 4) improved quality control. An efficient project procurement method will ensure the project achieves the project golden triangle, namely time, cost, and quality. There is yet a procurement method for PPVC in Malaysia. This research aims to review and propose an innovative project delivery method to optimize the benefits of PPVC.

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## Identifying Creative and Strategic Tools for Social Innovation in Interior Design Practice

**Mohd Redzwan Hisham b. Bidin** PhD in Design Management

Dr. Noorhayati Saad

Assoc Prof Dr. Edwin Chung

The subject of this paper is to identify strategic and creative tools for social innovation in interior design practice to contribute to a change in how interior design professionals can contribute to society. Interior design has always focused on the look and feel of the design. The need to unfold the clients' brief and translate the requirements usually requires the process of design from ideation to reality. The growing complexity and interconnectedness of our global society also have challenged the effectiveness of traditional Interior Design education systems. A new model needs to teach young designers how to explore, engage and create; and this style should include a constant creation of knowledge and empowering individuals to participate, communicate and innovate compared to the traditional approach which was to apply the basic skills learned in school to a specific task. Propagating the young minds to value innovation; they need to be ambitious and concern - characteristics to drive innovation. In the process of change, an innovative attitude needs to be implanted between education and the profession. Interior design projects must be redefined to allow unique ideation takes place through a humanistic approach. This should be centered on emotional interaction rather than mere sociology concern like the style and trendsetting which should be experienced and sensed rather than noticed. Interior design projects should not only be for commercialization but also looking into educating society driven responsibilities as great space can change people's lives. Therefore, to encourage innovative ideas among interior architecture and design students; this research will focus to identify various creative and strategic thinking methods from a wide and diverse spectrum of disciplines. This will serve as a crucial reference to encourage innovative-driven-projects ideas.

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## Quantifying Haptic Responses to Improve Vehicle Sales Volume of Proton Cars

**Azlan Othman** Ph.D. in Design Management

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Dr. Ahmad Majdi Abdul Rani

The automotive sector in Malaysia is in a vibrant stage where consumers have a substantial amount of choices, in the form of brands, to choose from to satisfy their wants. Perusahaan Otomobil Nasional Sdn. Bhd. (PROTON) in particular, is at the forefront of this phenomenon as it has always been identified as the industrialisation leader for Malaysia's development master plan. Haptic research is one such area that is in the realm of R&D but still in its infancy, especially in Malaysia. However, it plays an important role in lifting the brand perception and quality appearance of a product. the use of haptic feedback is the inherent physical interaction between the car and driver, as the user perceives a direct physical relationship with the product. There isn't a lot of studies done on haptics research specifically within the realm of automotive interiors related to touch & feel. This is even more obvious when it comes to the act of measuring such feedback. This naturally opens the opportunity to realise a new body of knowledge where the quantification of responses can benefit the larger industry. The main purpose of this study is to identify a method to quantify haptic responses within PROTON car interiors in the effort to improve its product quality through a systematic approach.

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# Research Students


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