QUADRUPLE HELIX MODEL FOR INDUSTRIAL MATHEMATICS INFRASTRUCTURES IN MALAYSIA

Zainal Abdul Aziz & Arifah Bahar

UTM Centre for Industrial & Applied Mathematics (UTM-CIAM)
Ibnu Sina Institute for Scientific & Industrial Research,
and
MYHIMS Solutions LLP, Level 3, C08
Universiti Teknologi Malaysia (UTM), 81310 Johor Bahru,
Malaysia

Outline of Presentation

- **Abstract**
- **Features**
- **Quadruple Helix Innovation Model**
- **Our "Construction & Analysis of Models"**
- **Our Dedicated Research Centres/ UTM-CIAM**
- **Our Dedicated Business Arm/ MYHIMS Solutions LLP**
- **Conclusion**

Our Prime Movers

- Emeritus Prof. Dr John Ockendon FRS, Oxford University, UK.
- Emeritus Prof. Dr Graeme Wake FRSNZ, Massey University, NZ.

Our Support Group
APMCfI founding members
(Kyushu Univ, CSIRO, ANU, Massey, UTM)

Our Support Group
(OCIAM, Oxford University)

Our Active Promoter
Distinguished Prof. Dr Masato Wakayama, Kyushu University, Japan.

Abstract

➢ In Malaysia, collaborations with industry and external parties in the realm of industrial mathematics (IM) bring benefits to applications of R&D/knowledge & innovations in industry and community at large, opportunities for talent and capacity development in academic circle & government agency and access to funding from government & industry.

➢ Applying a Quadruple Helix (QH) innovation model/framework characterises the cooperation between the four main clusters (government, industry, academia & community user/civil society) involving interaction in the forms of relation, mobility, transfer and formality to produce innovations.

➢ This talk will present our current framework to facilitate the workings of our national innovative industrial mathematics (IM) infrastructures.

Features

➢ In recent years, university-industry linkages in Malaysia have become enlarged given the rapid pace in knowledge & innovation generation as well as the escalating costs associated with R & D activities.

➢ Our IM collaborations with industry and other external parties (academia, government & civil society/users) bring various benefits such as STEM (Science, Technology, Engineering & Mathematics) teaching and skills development; access to funding and empirical data from government & industry; application of knowledge & innovation; opportunities for talent development by both students and staff; and promotion of entrepreneurship and innovations.

➢ Concurrently with the Malaysian government initiatives in promoting linkages and knowledge transfer, our efforts in creating IM partnerships and collaborations with the four clusters need to be streamlined and enhanced.

Features

➢ In order to strengthen these IM linkages, we plan to embrace the "Quadruple Helix (QH) innovation model", which refers to a model or framework describing the interaction or innovation cooperation between the four clusters, namely government, industry, academia & community user/civil society.

➢ A general definition of the QH innovation model refers to an innovation cooperation model or innovation environment in which users, private firms, universities and public authorities cooperate in order to produce innovations.

➢ These innovations can be anything that is considered useful for the partners in innovation cooperation, for example, technological, social, product, service, commercial, non-commercial, private-sector and public-sector innovations.

Features

➢ Applying this QH innovation model implies that our IM linkage between the four clusters would involve interaction in the forms of relation (involving contract research, consultancy, etc.), mobility (involving research training, modelling workshop, study group, etc.), transfer (involving copyright, patent, commercialization, etc.) and formality (involving MOU, MOA, LOI, etc.).

➢ This framework has been used to describe the inner workings of regional innovation systems. (refer e.g. R. Arnkil, et. al., Exploring Quadruple Helix – Outlining user-oriented (2010))

➢ This description suits well with our IM action plan and roadmap in strengthening, sustaining and identifying further interactive partnerships with the Malaysian industries, public authorities, universities and citizenry/community.
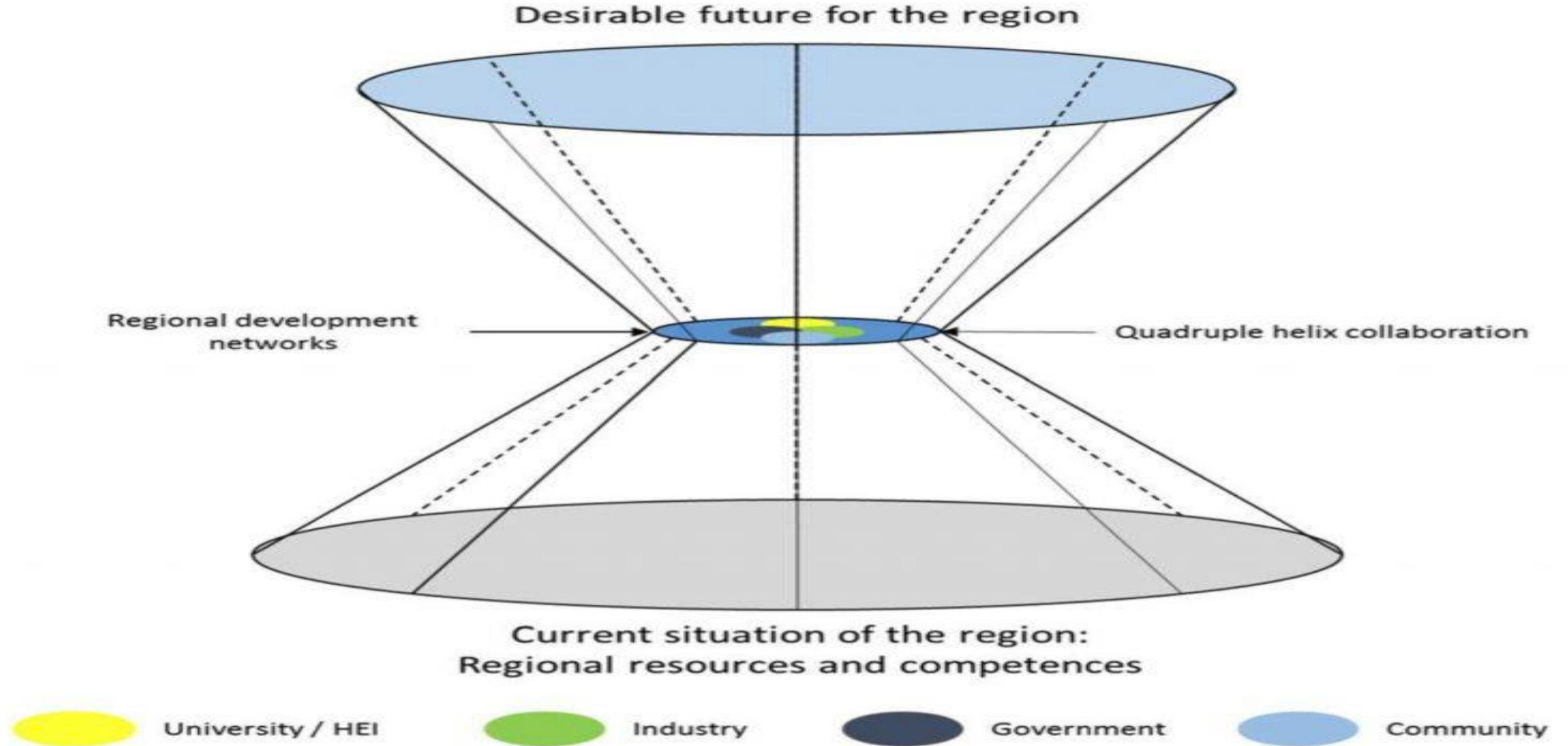
Quadruple Helix Innovation Model

Applying the quadruple helix model of open innovation in knowledge-based development.

The quadruple helix model adds the element of citizenry/community.

QH Innovation Model

The use of QH model possibly can aid understanding and help ensure that our actions have a sound theoretical basis. This model of open innovation has the potential to assist with our IM process/infrastructure/service when linked to knowledge management, particularly in regards to:

- Evidence-based knowledge management, where there is significant support between the four helices of the quadruple helix model (academia, industry, government, community) and the four sources of evidence (scientific literature, practitioners, organisation, stakeholders).

- Knowledge management for development, where there is a noticeable attempt towards knowledge co-creation involving multiple stakeholders and a crossing of the boundaries between STEM scientists and society.

Double-Coin Model of Knowledge-Based Regional Development (source: Kolehmainen et al. 2016). Quadruple helix, innovation and the knowledge-based development: lessons from remote, rural and less-favoured regions. Journal of the Knowledge Economy, 7(1), 23-42

October 30, 2015

Mathematics in Industry around the World

By Hilary Ockendon

The Mathematics in Industry minisymposia panel at ICIAM 2015: (left to right) the late Yongji Tan (Fudan University), Zhijie Cai (Fudan University), Liqiang Lu (Fudan University), Huaxiong Huang (York University, Toronto), Shige Peng (Shadong University), Graeme Wake (Massey University, Auckland), and Hilary Ockendon (University of Oxford).

The 8th International Congress for Industrial and Applied Mathematics (ICIAM 2015), was well represented by sessions on applied mathematics, but sadly, only 19 out of the 651 minisymposia at the meeting held in Beijing in August were designated as 'industrial.' Among these, a series called "'Industrial Mathematics around the World," organized by the late Professor Yongji Tan (Fudan University) and Dr Yichao Zhu (Hong Kong University of Science and Technology), brought to light how different countries address industrial mathematics.

The talks in these minisymposia described how organized Mathematics in Industry started in Europe nearly 50 years ago and has since spread to all parts of the world. The overall trend, although not

participants, 80 percent of whom were students.

• The Universiti Teknologi Malaysia- Centre of Industrial and Applied Mathematics has been working since 2011 to boost industrial mathematics in Malaysia. It is anticipated that it will become a national hub, one part of which will operate similarly to the Smith Institute.

• In Japan, the Institute of Mathematics for Industry in Kyushu University hosted a national forum in October. This is part of the recently-formed Asia-Pacific Consortium for Mathematics for Industry, which provides support for neighboring countries on the Pacific

Rim and is similar to the European Consortium for Mathematics in Industry (ECMI) model in Europe.
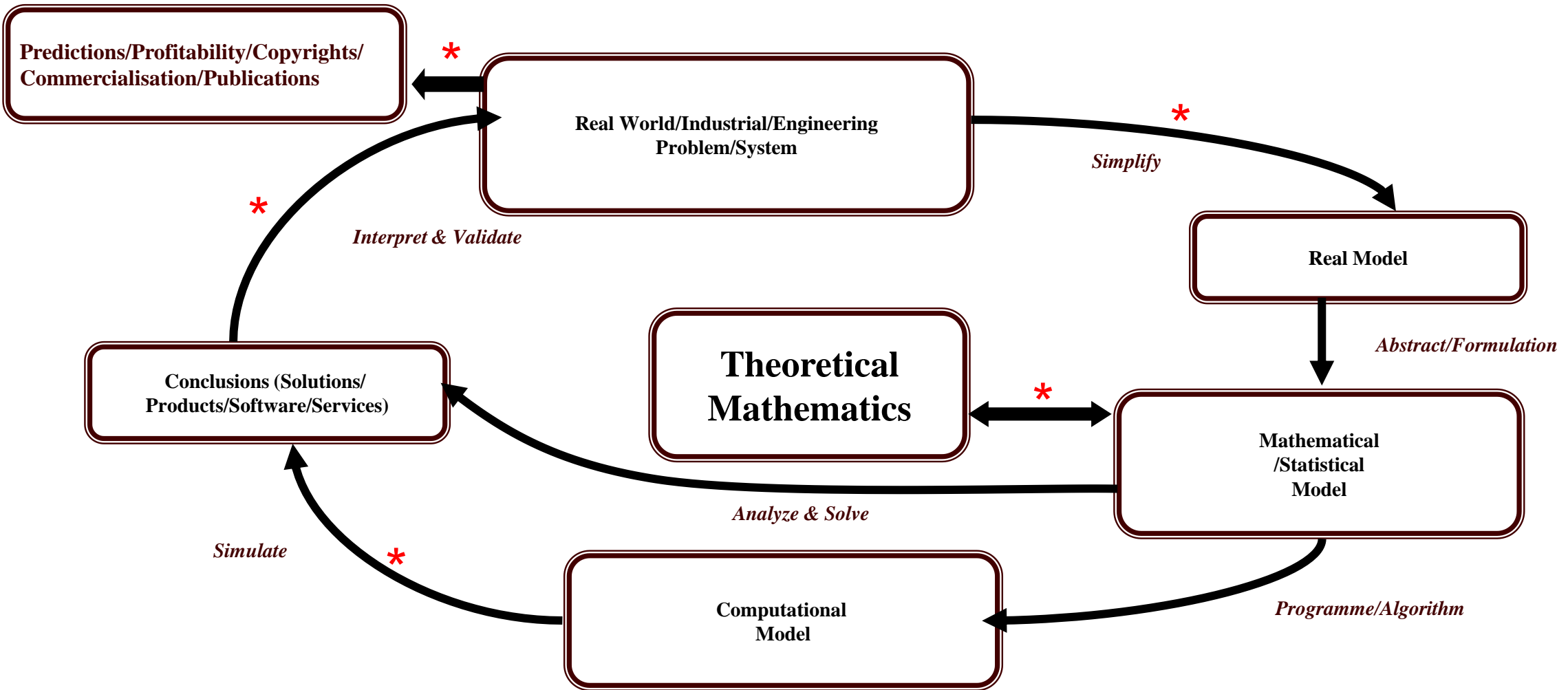
Industrial Mathematics around the World

Hilary Ockendon
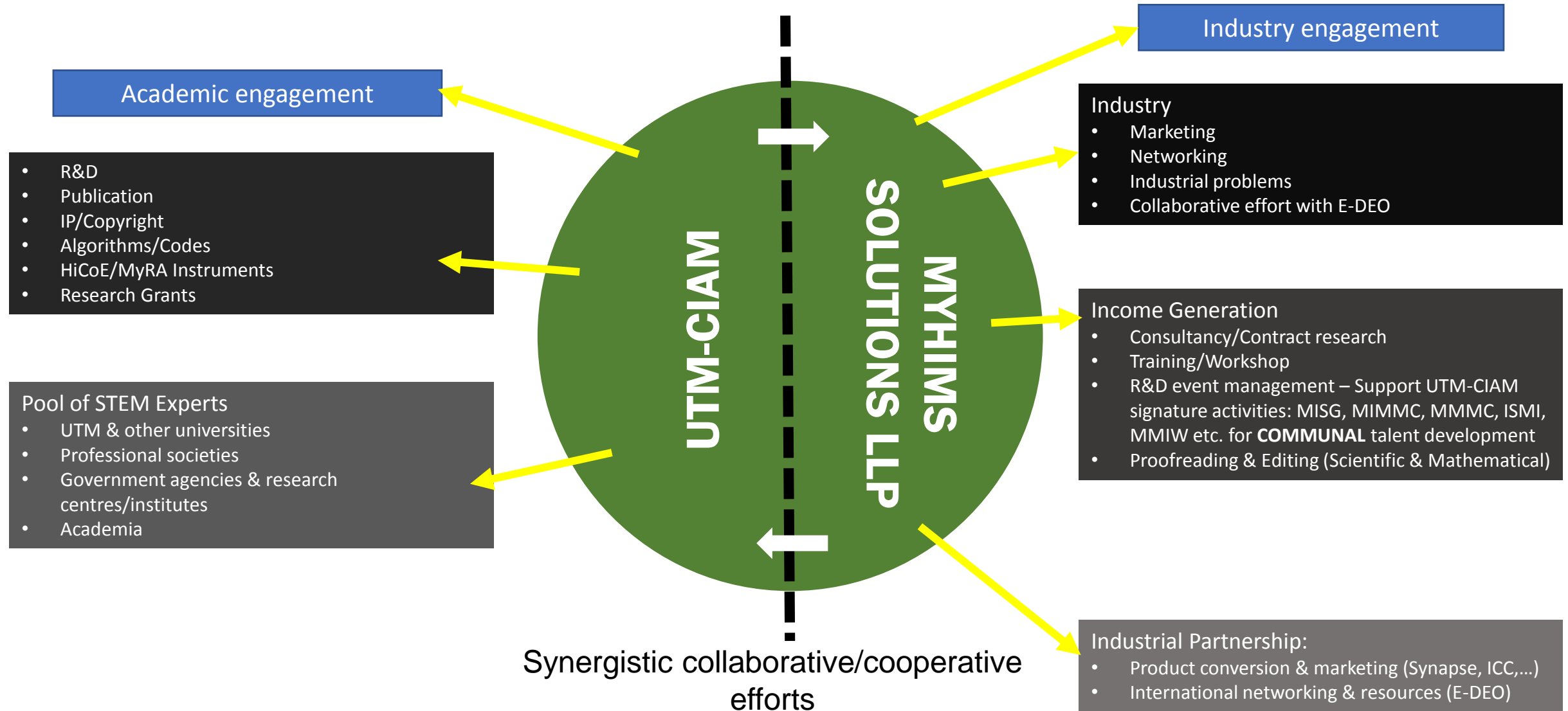### OCIAM
3 December, 2018

- MACSI, Ireland, 2006 –
  - funded by government
  - Limerick is centre of an Irish network

- UTM-CIAM, Malaysia, 2011 –
  - model based on OCIAM
  - has set up a company to work with industry
  - network across SE Asia

- IMI Kyushu University, Japan, 2014 –
  - strong government/university support
  - emphasis on using pure maths for industrial problems
  - founded APCMfI

Our "Construction and Analysis of Models"

Predictions/Profitability/Copyrights/Commercialisation/Publications

Real World/Industrial/Engineering Problem/System

Simplify

Real Model

Abstract/Formulation

Interpret & Validate

Conclusions (Solutions/Products/Software/Services)

Theoretical Mathematics

Mathematical/Statistical Model

Analyze & Solve

Simulate

Computational Model

Programme/Algorithm

* *Knowledge Transfer Mechanism*

We propose a Quadruple Helix Innovation Model: Academia, Industry, Government & Community/Users

UTM-CIAM

MYHIMS SOLUTIONS LLP

Synergistic collaborative/cooperative efforts

Academic engagement

- R&D
- Publication
- IP/Copyright
- Algorithms/Codes
- HiCoE/MyRA Instruments
- Research Grants

Pool of STEM Experts
- UTM & other universities
- Professional societies
- Government agencies & research centres/institutes
- Academia

Industry engagement

Industry
- Marketing
- Networking
- Industrial problems
- Collaborative effort with E-DEO

Income Generation
- Consultancy/Contract research
- Training/Workshop
- R&D event management – Support UTM-CIAM signature activities: MISG, MIMMC, MMMC, ISMI, MMIW etc. for **COMMUNAL** talent development
- Proofreading & Editing (Scientific & Mathematical)

Industrial Partnership:
- Product conversion & marketing (Synapse, ICC,…)
- International networking & resources (E-DEO)

Our Dedicated Centre:

Centre for Industrial and Applied Mathematics

www.ciam.utm.my

+607-5532355

UTM Centre for Industrial and Applied Mathematics

utmciam@utm.my

Why we are **established?**

Specifically Malaysia and generally for developing countries, the use of advanced mathematical knowledge in businesses, companies and organizations for their services, product developments or even running of the company itself especially for SME is still not evident. We hope to change this, especially in this globally connected, fast-paced world.

UTM-CIAM activities are targeted towards empowering industrial mathematics & statistics as tools for problem solving, innovation and commercialization. Our activities include industry related research, capacity building and industrial customized software development programs

Main objectives in setting up of UTM-CIAM

➢ Capacity building in advanced research areas of industrial & applied mathematics.

➢ Intensify research & development (R & D) on collaborative industrial & applied mathematics with fields related to engineering and technology.

➢Advance multidisciplinary R & D by strengthening the collaborative research, modelling and formulation of optimal & innovative solutions for the local industry.

➢Promote practical & innovative applications of industrial and applied mathematics in industry to generate high quality applied research output.

MAIN ACTIVITIES

- ✓ MISG, ISMI, MMIW, MMMC & MIMMC
- ✓ UTM staff, MSc & PhD and postdoctoral training
- ✓ University – Industry Collaboration/Linkage
- ✓ Research & Contract Grants Procurement
- ✓ Consultancy services
- ✓ Empowering Human Capital through STEM teachings & researchs
- ✓ Publications & managing journal MATEMATIKA: Malaysian Journal of Industrial & Applied Mathematics
- ✓ IP (Intellectual Property) development

In cooperation with

Oxford Centre for Industrial and Applied Mathematics (OCIAM)

Smith Institute for Industrial Mathematics and Engineering, UK
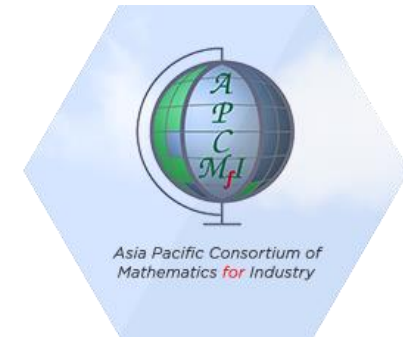
Member of The Asia Pacific Consortium of Mathematics for Industry (APCMfI)

Staff of UTM-CIAM

Expertise

Industrial & Applied Mathematics → Operational Research → Numerical & Computational Research → Statistics

What we **do?**
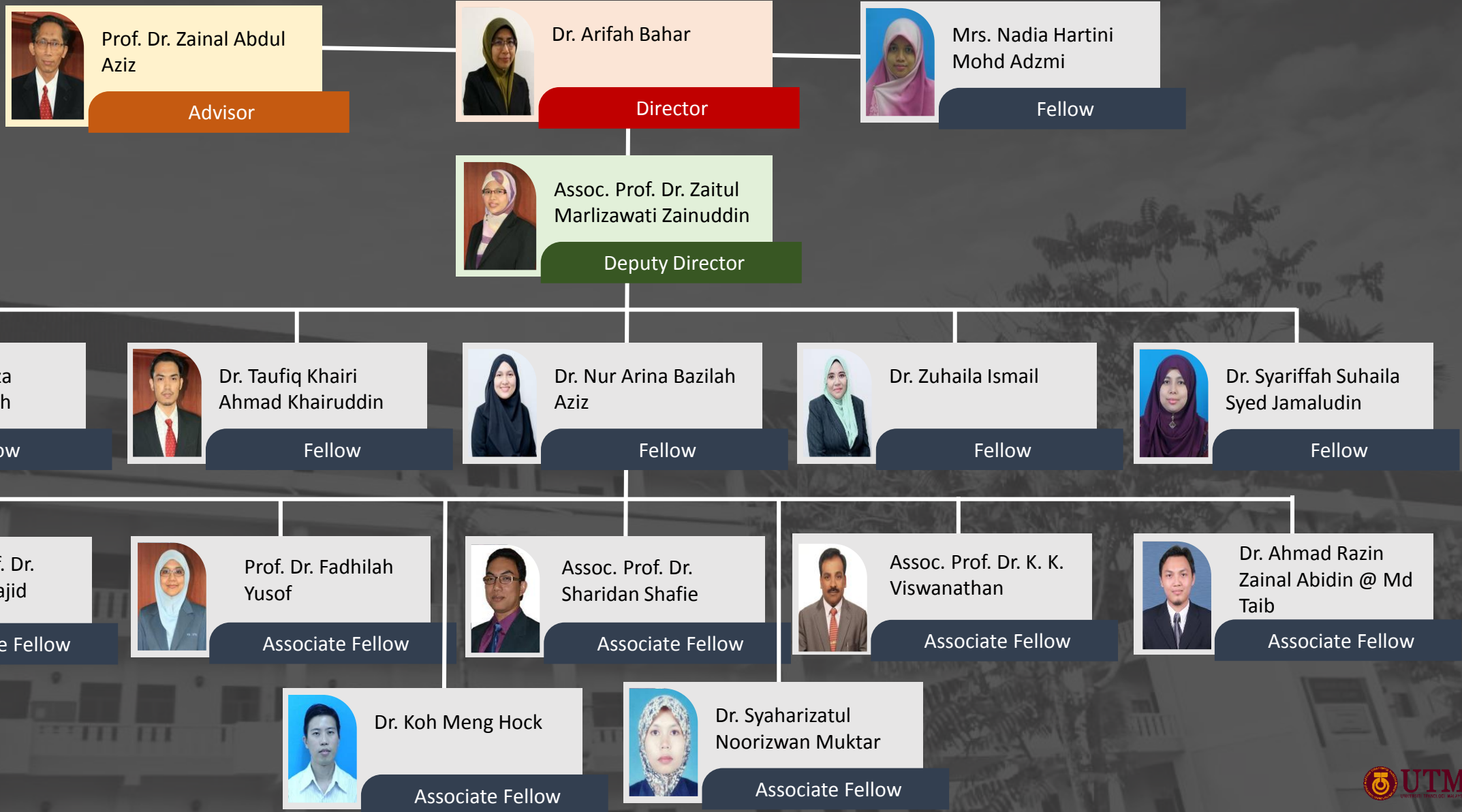
Fundamental Researches

What we **do?**

Industrial Customized Software

EPMB EP MANUFACTURING BHD

Optimal Stock Level and Inventory Policy

The challenge
High production downtime that is caused by the stock runs out for sub-components required in the production lines due to the failure of suppliers to deliver components on time.

The solution
Improving inventory system and production plan using mathematical models and a prototype system in determining the optimal production quantity and allocation of resources.

The benefit
Improve the inventory system and decision making for production planning.

CIAM
UTM Centre for Industrial and Applied Mathematics | http://ciam.utm.my

IISJ Institut Inovasi Strategik Johor

Optimisation System for Production of Chicken Products

The challenge
Growing demand for halal chicken products.

The solution
Chicken Production Optimizer (CPO) software.

The benefit
Improved decision making to ensure optimal production of chicken products.

CIAM
UTM Centre for Industrial and Applied Mathematics | http://ciam.utm.my

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

What we do?

Signature Activities

 Mathematics in Industry Study Group (MISG)

 International Seminar on Mathematics in Industry (ISMI)

 Malaysian Mathematics in Industry Workshop (MMIW)

 Malaysia Mathematical Modelling Camp (MMMC)

 Malaysia Industrial Mathematical Modelling Camp (MIMMC)

 Young Talent Consultancy Camp (YTC)

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

Mathematics in Industry Study Group Malaysia (MISG)

2011 — 4 Industrial partners, 6 Problems

Optimal Placement of Security Cameras in In-door Spaces

Efficient Reasoning in Conceptual Graph Knowledge Representation Model

River Pollution Problem in Iskandar Malaysia Region

Industrial Problems

Cardiological Problem

Fouling in Heat Exchangers of Refineries

Oil Refinery Water Supply

UTM
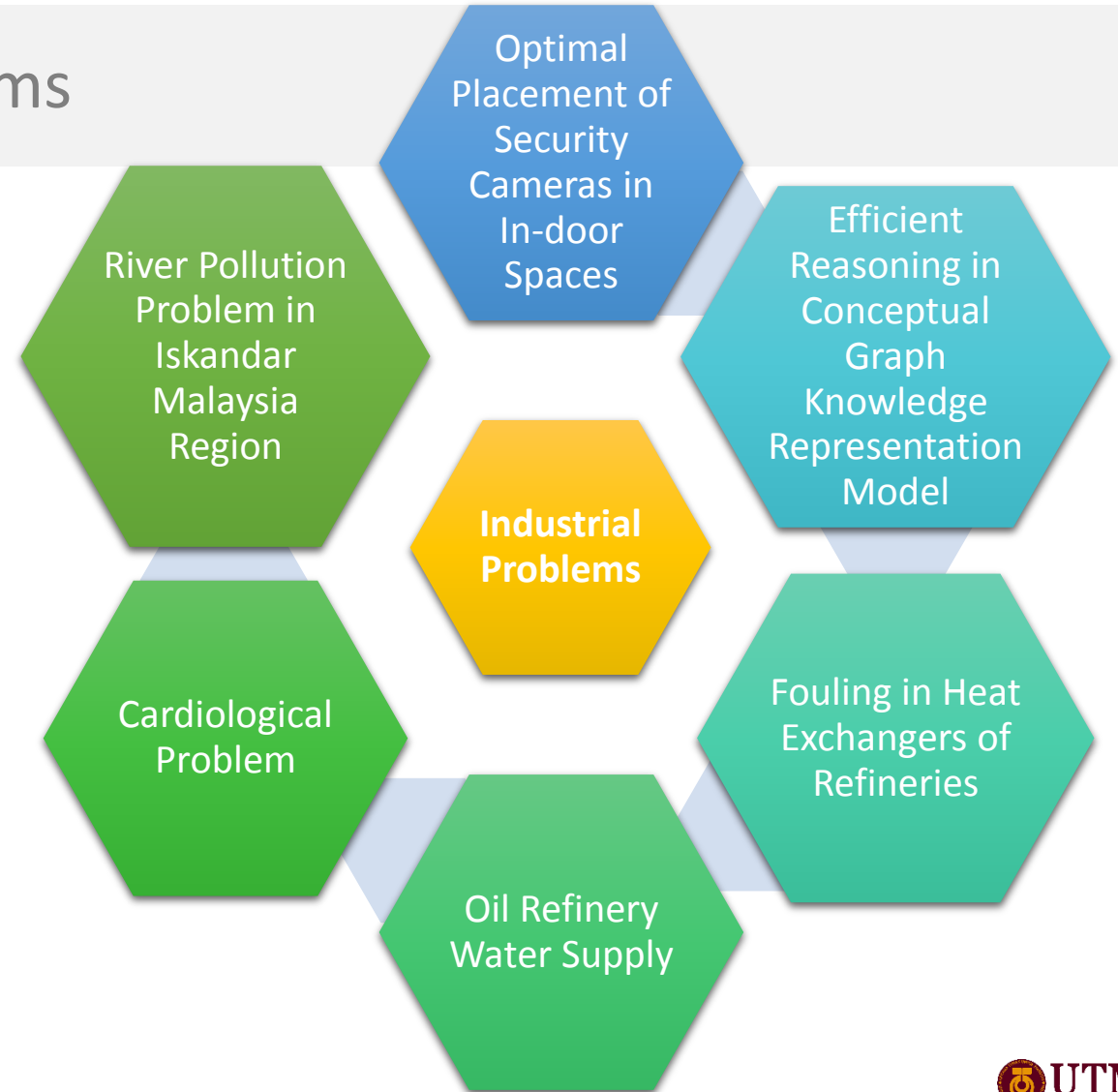
Mathematics in Industry Study Group Malaysia (MISG)

6 Industrial partners, 6 Problems

2014

Mathematical Modelling and Optimization for Biological-based Treatment of Oxidation Pond

River Pollution Attenuation in Aquifers Using River Bank Infiltration Technique

Cost Effective Minimum Water and Energy Networks for The Industries

Industrial Problems

Development of early warning system for rice blast and brown planthopper (BPH), pest and disease of rice

Green Propulsion Regenerative Electromagnetic Suspension System (GPRESS)

Coronary Bifurcation-Effect of Stent on Blood Flow

KPJ HEALTHCARE

PROSPECT
PROCESS SYSTEMS ENGINEERING CENTRE
engineering sustainability

NAHRIM

PROTON

MARDI
INSTITUT PENYELIDIKAN DAN KEMAJUAN PERTANIAN MALAYSIA

J-Biotech

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

Mathematics in Industry Study Group Malaysia (MISG)

2015 — 7 Industrial partners, 7 Problems
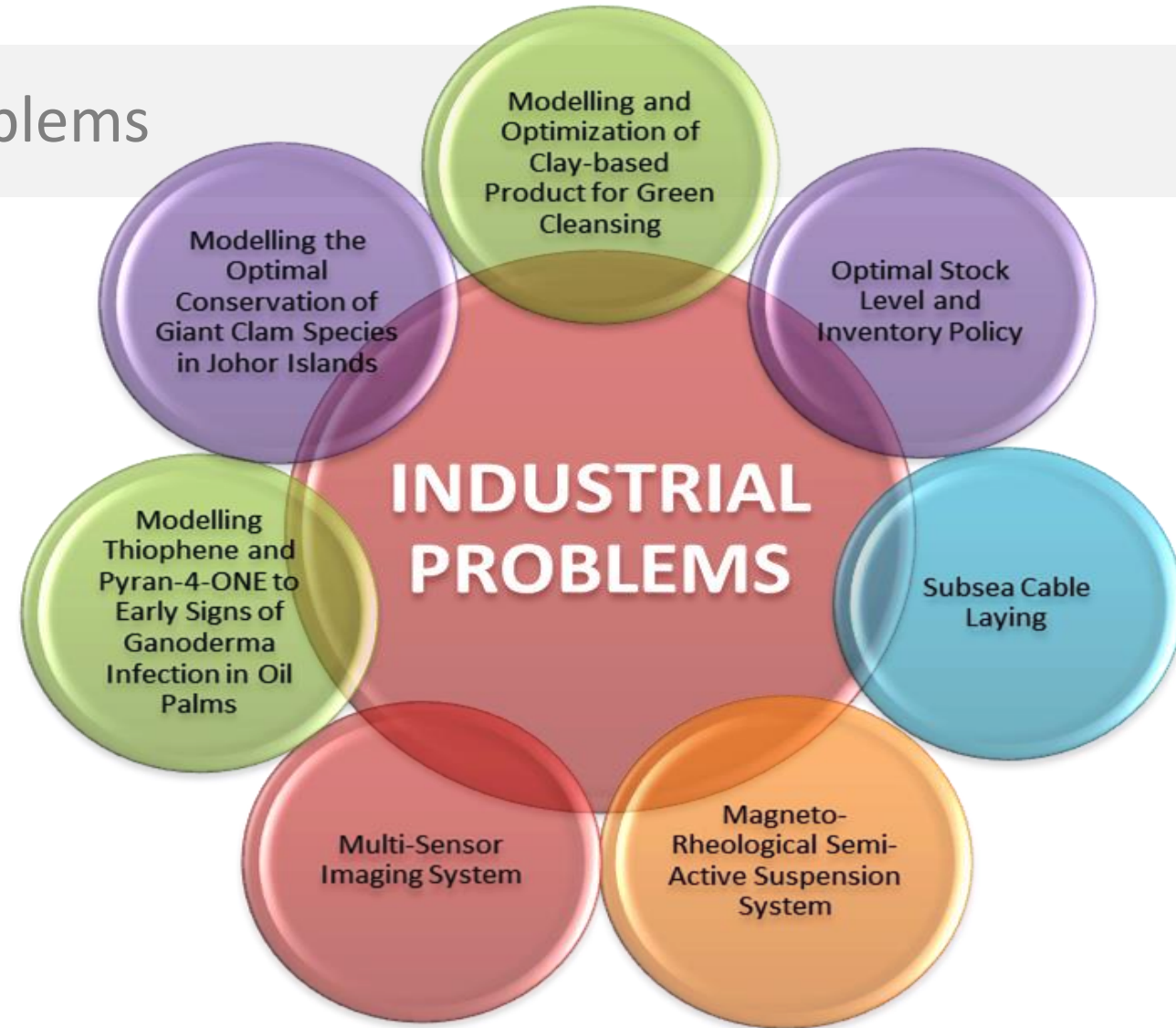
International Seminar on Mathematics in Industry (ISMI)

27th – 28th November

2013

2017

2018

- A platform for mathematical scientists and industry practitioners to **share their experiences in handling real industrial problem** through mathematical ideas and tools.
- **Strengthening collaborations** among mathematicians from around the world.
- **Promote and support the use of mathematical models in industry** for a sustainable environment and optimal allocation of resources.

International Seminar on Mathematics in Industry (ISMI)

1st – 2nd August

Introducing **Malaysian Mathematics in Industry Workshop (MMIW2017)**, a special engagement session with industry practitioners/researchers where participants are given the opportunity to work on industrial problems shared by industries using diverse mathematical approaches.

UTM

Malaysian Mathematics in Industry Workshop (MMIW) 2017

J-Biotech
Johor Biotechnology & Biodiversity Corporation

Analysis of the seagrass ability to grow in the Johor coastal area

PHOTO LASER GRAMMETRY
Digital

- How to apply K-Nearest Neighbor (KNN) and K-Dimension Partioning/indexing (K-DTree) method for the processing of 3D point clouds data using Matlab software? How to use these two methods to speed up the processing time for big dataset of 3D point clouds data?

- How to apply Principal Component Analysis (PCA) in analyzing the geometrical component of the 3D point clouds data? How to produce the Matric A of the point clouds dataset using PCA?

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

International Seminar on Mathematics in Industry (ISMI)

4th – 6th September

Joint conference with Institut Teknologi Sepuluh Nopember, Surabaya Indonesia, called International Seminar on Mathematics in Industry & International Conference on Theoretical and Applied Statistics **(ISMI-ICTAS18),** with **MMIW2018**

Malaysian Mathematics in Industry Workshop (MMIW) 2018

PERUNDING IRZI SDN BHD
CONSULTING ENGINEER & PROJECT MANAGER

Telemong River Bifurcation for Flood Mitigation

MATHCRAFT SOLUTIONS

Time versus Gain Analysis for Crude Palm Oil Trading

iFACTORS

Cable Installation Analysis in Deep Water Environment

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

Malaysia Mathematical Modelling Camp (MMMC)

2015 30th March – 2nd April

- **hands-on experience** of mathematical modelling under the guidance of an experienced instructor

- broad range of **problem-solving skills**, such as mathematical modelling & analysis, scientific computation & critical assessment of solutions

- enhances the **social networks and cooperation** among participants

Student & Staff Attachment

15th October – 14th November | **2015**

- Student and staff attachment at **Mathematical Institute, University of Oxford**
- Research discussion with experts
- Exposure to the student and staff on how to work, learning environment and networking

Malaysia Industrial Mathematical Modelling Challenge (MIMMC)

2015 | 11th November

2019

Problem 1: Canned Pineapples

Problem 2: Surface Water Pollution

Problem 3: Hydro-Electric Power Generation

- MIMMC is a **group-based competition.**
- Offers the experiences and challenges that **enhanced the participants' intellectual capabilities, knowledge and skills** in solving real world problem through mathematical modeling.
- This competition is open to all **local undergraduates** at any Malaysian university or tertiary institution.

Malaysia Industrial Mathematical Modelling Challenge (MIMMC)

2015

2019   18th March

Problem 1:

Crude Palm Oil Futures: To Buy or Not?

Problem 2:

Analysis of The Seagrass Ability to Grow in the Johor Coastal Area

Problem 3:

River Bifurcation

Young Talent Consultancy Camp (YTC CAMP)

1st – 2nd November

2016

- a camp that **trains young talents to become technology translators** who are able to mediate between academicians and industrial practitioners.

- give more exposure to the mathematicians on how to consult the industries by **understanding the industries business needs** and know what business decisions might be on their desk that we can help them with.

- identify how to **apply mathematical sciences that would add value to their business.**

UTM

What's **next?**

UTM-CIAM engages industries and has a lot of activities involving capacity building and problem solving with industries and communities, and these require substantial financial support and with the current scenario of economic slow down, this is thus unsustainable.

Moving forward, to maintain UTM-CIAM and its important & impactful signature activities, we require ways to generate finance and aggressive marketing of UTM-CIAM's expertise & "products".

Further consultation with OCIAM & Smith Institute, UK, for a sustainable model, we have decided to set up UTM-CIAM's dedicated business arm - MYHIMS Solutions LLP and proposed a synergy based on the Quadruple Helix Innovation Model.

Our Dedicated Business Arm

MYHIMS SOLUTIONS PLT

Industrial Mathematics & Statistics Solutions Provider

📞 *+6011-11227016*

✉ *myhims.solutions@gmail.com*

🌐 *http://myhims.my*

WHAT IS MYHIMS SOLUTIONS LLP?

Industrial Mathematics & Statistics Solutions Provider

MYHIMS Solutions LLP is simply a dedicated business arm of UTM-CIAM.

MYHIMS Solutions LLP is a Limited Liability Partnership (LLP) company that offers industrial mathematics and statistics consultancy services via national network of experts in solving industrial problems

Staff of MYHIMS Solutions PLT

![MYHIMS SOLUTIONS PLT logo]

MYHIMS SOLUTIONS PLT

LLP0015092-LGN

INDUSTRIAL MATHEMATICS & STATISTICS SOLUTIONS PROVIDER

BRIDGING THE GAP

ACADEMIA + GOVERNMENT + INDUSTRY + COMMUNITY
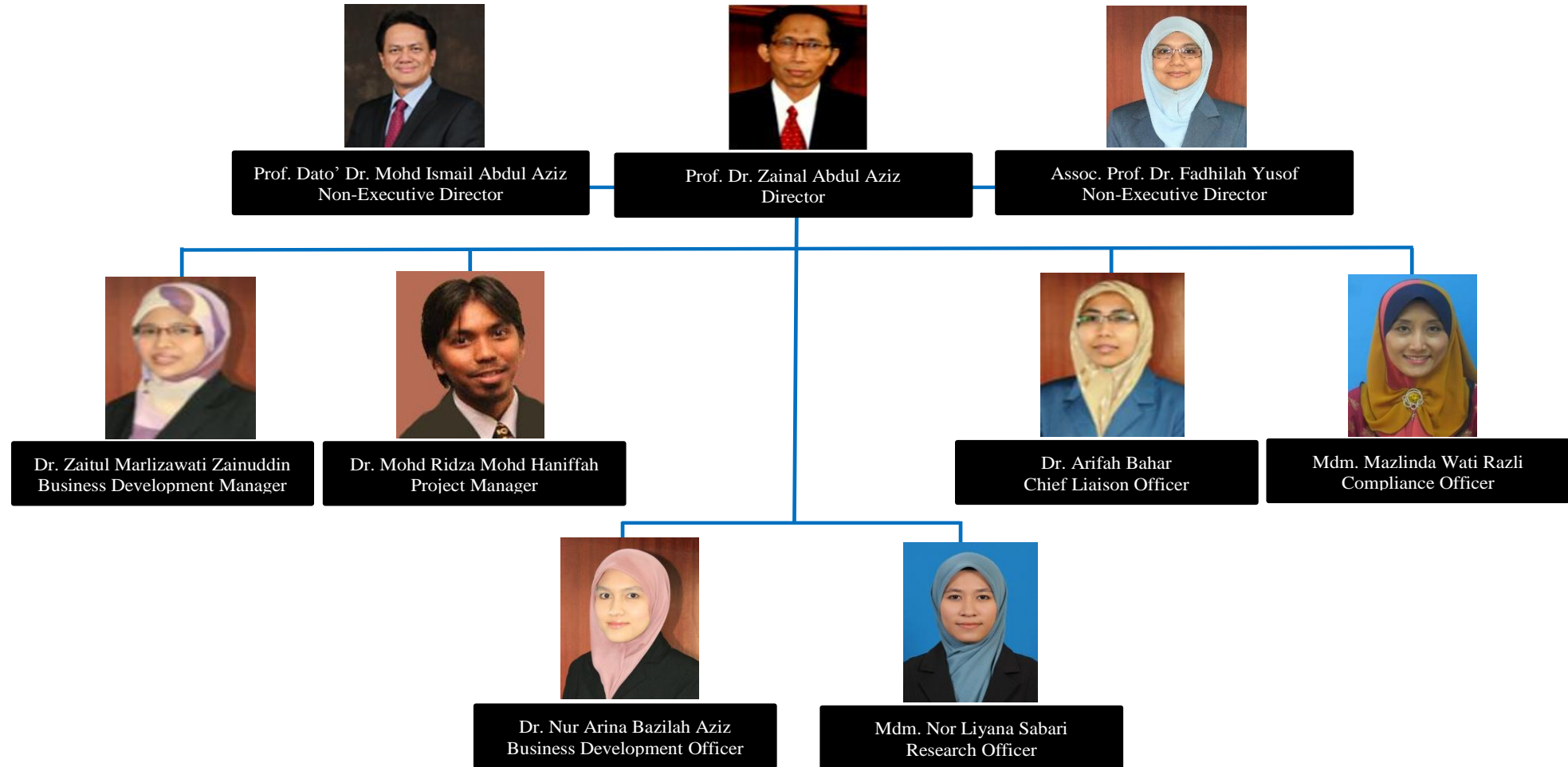
enhance your business today, tomorrow and for years to come

[QR code]

CALL US
011-11227016

MYHIMS SOLUTIONS PLT,
Level 3, C08, UTM-CIAM
Universiti Teknologi Malaysia
myhims.solutions@gmail.com
ciam.utm.my/myhims-solutions-plt

ABOUT US

MYHIMS Solutions PLT is a Limited Liability Partnership (LLP) company that offers industrial mathematics and statistics consultancy services via national network of experts in solving industrial problems.

EXPERTISE

- Engineering & Industrial Mathematics
- Operations Research
- Numerical & Computational Methods
- Data Analysis & Statistical Modelling
- Geospatial Analysis

SERVICES

- Industrial Mathematics & Statistics Solutions Provider
  - ➤ Mathematical Modelling
  - ➤ System Validation & Optimisation
  - ➤ Industrial Process Enhancement
  - ➤ Data Analysis
  - ➤ Decision Support
- Event Management
- STEM Talent Development

OUR EXPERTISE

Engineering & Industrial Mathematics

Operations Research

Numerical & Computational Methods

Data Analysis & Statistical Modelling

Geospatial Analysis

OUR SERVICES

Industrial Mathematics & Statistics Solutions Provider

Mathematical Modelling, System Validation & Optimization, Industrial Process Enhancement, Data Analysis, Decision Support

Educational Event Management

Seminar, Conference, Training Workshop

STEM Talent Development

MISG, MMIW, MIMMC, YTC Camp, MMMC, Training and Workshop

TIMELINE

Dec 2016

Establishment of MYHIMS pro-tem committee

Nov 2017

- Approval from UTM authorities to establish MYHIMS
- Appointment of compliance officer

Feb 2018

MYHIMS has been registered as Limited Liability Partnership

Present

- Website development for MYHIMS (in progress)
- Set up proofreading and Editing Unit (done)

Industry Engagement

Apr 2018

Critical Thinking & Problem Solving Assessment Consultation for Universiti Teknologi PETRONAS (done)

Jan 2019

- Smart Entrepreneurship Training for SME Corporation (in progress)
- Cable Installation Analysis in Deep Water Environment for IFACTORS Sdn Bhd (done)

Present

- Telemong River Bifurcation for Flood Mitigation for Perunding IRZI Sdn Bhd (done)
- Automated Crude Palm Oil Futures (FCPO) for Mathcraft Solutions (in progress)
- Airport Delay Prediction using Weather Impact Index (in progress)
- Commercialize products from software development activities
  - Attendance Management System (in progress)
  - Optimal Stock Level & Inventory System (in progress)
  - Chicken Optimizer System (in progress)

Academic Engagement

Sept 2018

Event Management: International Seminar on Mathematics in Industry & International Conference for Theoretical and Applied Statistics ISMI-ICTAS18 (done)
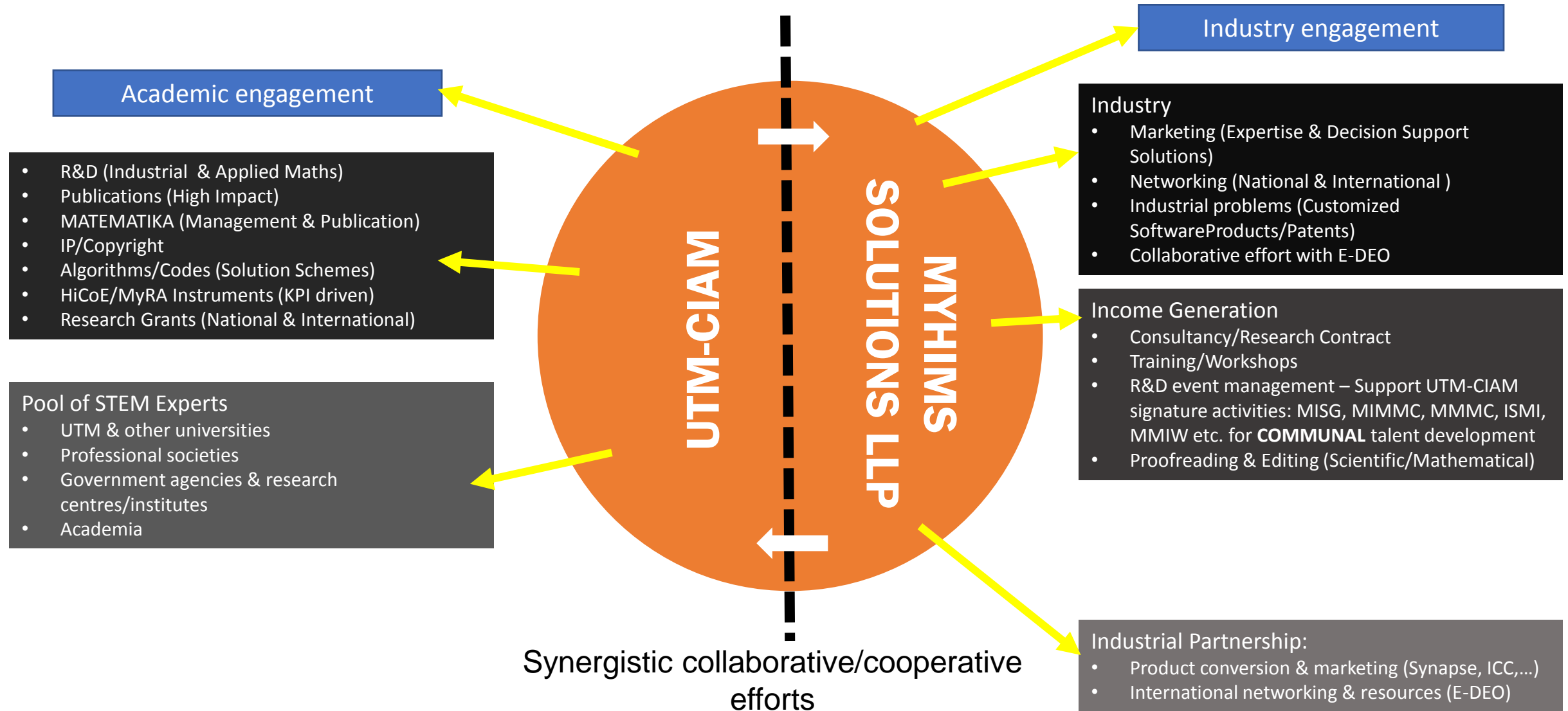
March 2019

Consultation work for Malaysia Industrial Mathematical Modelling Challenge 2019 (done)

Present

Event management: What Can You Do With MATLAB Programming Workshop (done)

CONCLUSION - To practice a Quadruple Helix Innovation Model: Academia, Industry, Government & Community/Users

Academic engagement

Industry engagement

UTM-CIAM

MYHIMS SOLUTIONS LLP

- R&D (Industrial & Applied Maths)
- Publications (High Impact)
- MATEMATIKA (Management & Publication)
- IP/Copyright
- Algorithms/Codes (Solution Schemes)
- HiCoE/MyRA Instruments (KPI driven)
- Research Grants (National & International)

Pool of STEM Experts
- UTM & other universities
- Professional societies
- Government agencies & research centres/institutes
- Academia

Industry
- Marketing (Expertise & Decision Support Solutions)
- Networking (National & International)
- Industrial problems (Customized SoftwareProducts/Patents)
- Collaborative effort with E-DEO

Income Generation
- Consultancy/Research Contract
- Training/Workshops
- R&D event management – Support UTM-CIAM signature activities: MISG, MIMMC, MMMC, ISMI, MMIW etc. for **COMMUNAL** talent development
- Proofreading & Editing (Scientific/Mathematical)

Synergistic collaborative/cooperative efforts

Industrial Partnership:
- Product conversion & marketing (Synapse, ICC,…)
- International networking & resources (E-DEO)

Our Possible Forward-Looking Options (ICIAM2019 Valencia)

- **Zainal, MYHIMS Solutions LLP**
- **Dr Arifah Bahar, Director Of UTM-CIAM**

- **Professor Aderito Araujo, Coimbra University, Portugal (President of ECMI)**
- **Professor Deitmar Homberg, Weirstrass Institute for Applied Analysis & Stochastics, Germany (Past President ECMI)**

Terima Kasih/Thank You/Gracias

وسلم