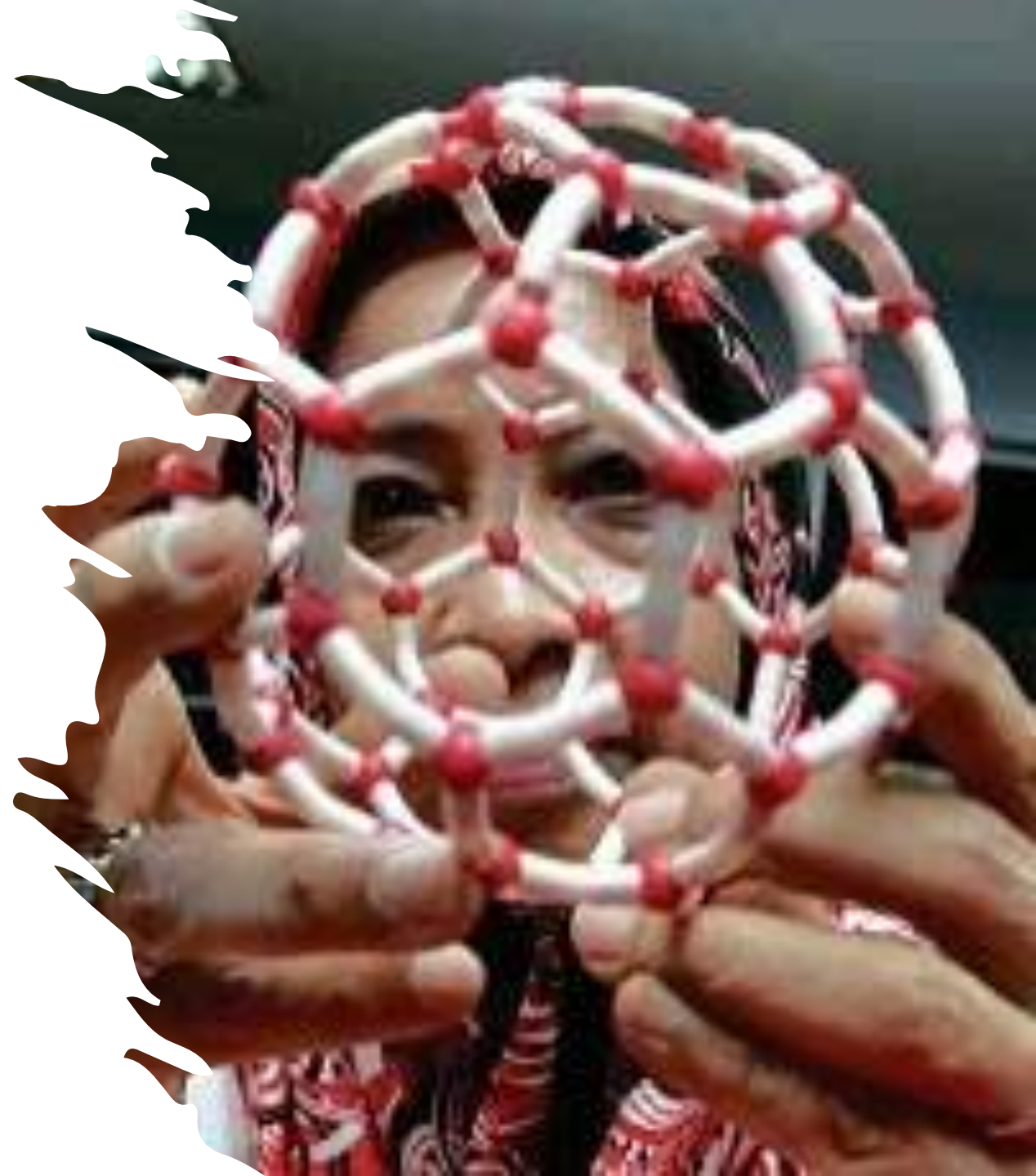


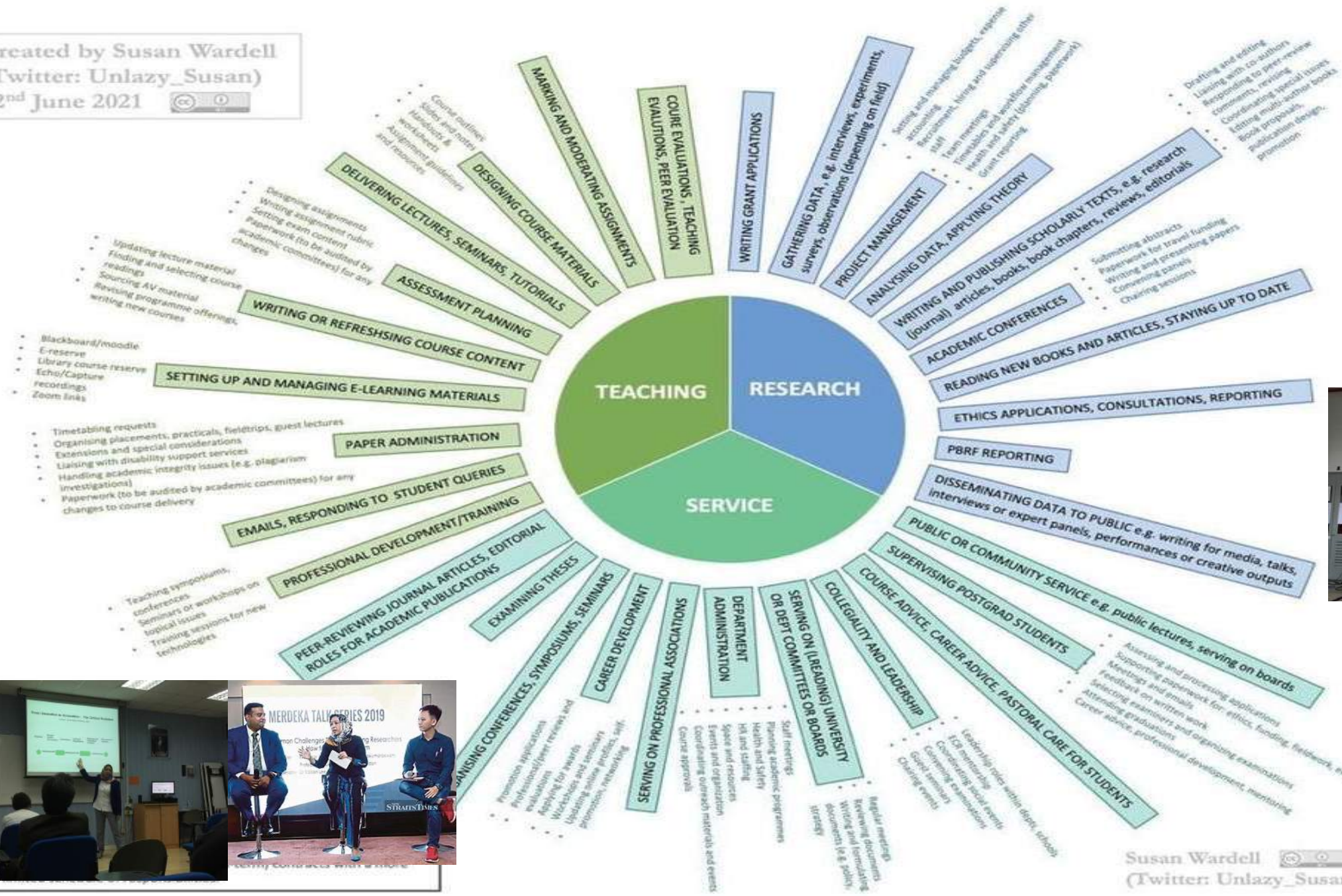
Bittersweet journey of being a sustainable researcher

Halimatun Hamdan



ACADEMIC LIFE: WHAT DOES A "LECTURER" DO?

Created by Susan Wardell
(Twitter: Unlazy_Susan)
22nd June 2021



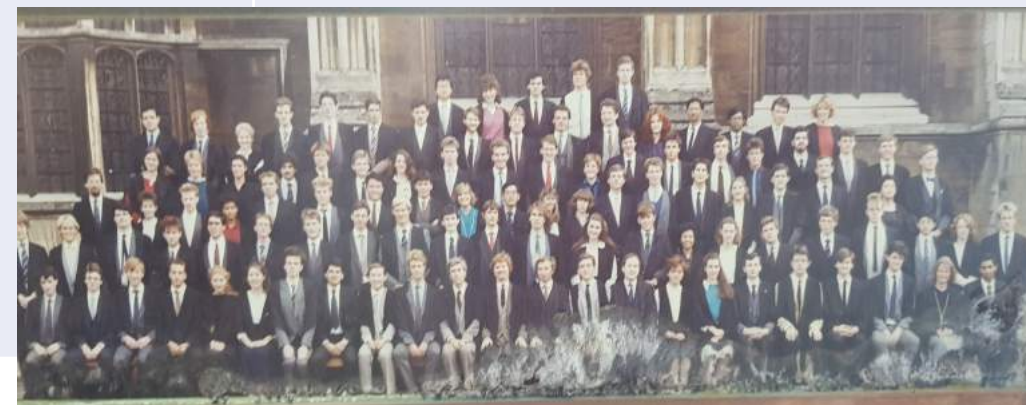
Susan Wardell
(Twitter: Unlazy_Susan)

ACADEMIC CAREER PATH



Bittersweet journey of being a sustainable researcher

YEAR	ACTIVITY	OUTPUT	Bittersweet
1981-1984	UG final year projects , terminologi kimia, planning and implementation of semester system, textbooks, laboratory and practicals, translation	<ul style="list-style-type: none"> • 3 thesis • Daftar tatanama (DBP) • Istilah Kimia (DBP) • Laboratory modules • pemeriksa kertas STPM, SPM • Implementation of Semester System 	<ul style="list-style-type: none"> • First batch of Lecturers with PG degrees, • Semester System • Threat – Women (<5%), • US Graduate, • Language switch • Young, ambitious, enthusiastic - volunteer
1985-1989	PhD Research – University of Cambridge <ul style="list-style-type: none"> ➤ Studies of zeolite catalysts by MAS-NMR, quadrupole nutation and solid NMR techniques ➤ Characterization of zeolites by XRD, FTIR, ion exchange and adsorption 	<ul style="list-style-type: none"> • PhD Dissertation • 11 Journal publications (First Author) • New knowledge (Solid state materials) • Novel research (Quadrupole Nutation Solid-State NMR) • University of Cambridge alumni • Leadership and networking 	<ul style="list-style-type: none"> • First woman PG at Peterhouse Cambridge • Adopting R&D culture – basic knowledge, independence, time management • Practical, perserverence, communication, peer relation/recognition, supervision, maintaining standards and quality



What is



Research is the careful search or inquiry for; endeavor to discover new facts, procedures, methods and techniques by the scientific study of a subject, course of critical investigations

Research is a technical effort directed towards the discovery of new scientific facts

Research is

- ❖ Subjective
- ❖ Inspirational
- ❖ Often irrational
- ❖ Creative
- ❖ Dynamic



Research is not

- ❖ Information gathering
- ❖ Movement of facts from one location to another
- ❖ Retrieving information
- ❖ Advertising catchwords

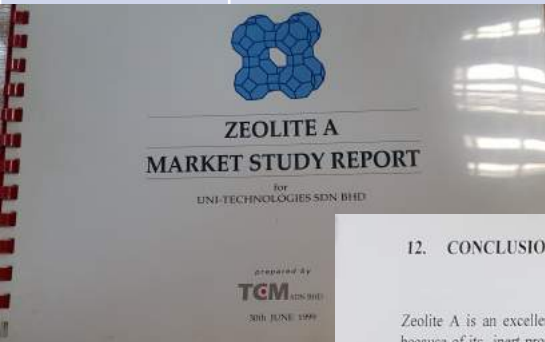




Research produces scientific knowledge,
not products and processes

Research results through development and
innovation creates new products and processes



Why do research?

- **Finding answers**
- **Conclusions from data**
- **Adding of new knowledge**
- **Improve understanding**

YEAR	ACTIVITY	OUTPUT	Bittersweet
1991-1995	<p>UTM Research and Development Grant (Leader 1991-1995 RM 140,000.00</p> <p><i>Synthesis of zeolites and derivatives as catalysts (TRL1-3)</i></p> <p>IRPA RM-6 Research Grant (Leader 1992-1995) RM 100,000.0</p> <p><i>Scale-up Synthesis of zeolites from rice husk (TRL 4-5)</i></p>	<ul style="list-style-type: none"> Focus area established Establishing niche 1 patent (SIRIM) 1 PhD and 1 MS student 4 technical books 15 Journal publications 	<p>Research attachment (Post-doc) Spain and Cambridge</p> <p>First books published by DBP to be written and typeset by authors</p> <p>Petronas Inventors Award (1993)</p>
			
	<p>12. CONCLUSION</p> <p>Zeolite A is an excellent material with a very wide range of application. It is a choice material because of its inert properties and environment friendliness. The increased production and demand for Zeolite results in many research towards the synthesis of Zeolite.</p> <p>One of the main problems encountered in the synthesis of Zeolite is the availability of pure silica suitable for producing Zeolite. An alternative source of pure silica was needed for the Zeolite industry to develop in Malaysia.</p> <p>The use of rice husk to extract silica for the synthesis of Zeolite is indeed a very novel approach. The efforts of the researchers, headed by Prof. Dr. Halimaton Hamdan must be commended. The novelty of this application resulted in a patent being filed. Initial study by the researchers have that the silica from rice husk is very effective for the production of Zeolite.</p>		

Types of research

Basic/Fundamental

- Contributes to building knowledge in the various disciplines
- Offensive, risky and unpredictable

Applied

- Contributes to solving problem existing currently in the work setting
- Defensive, highly competitive

Experimental Development

- Contributes to using knowledge acquired from applied research with the aim of improving the efficiency or capacity of a new material, equipment, system or process

YEAR	ACTIVITY	OUTPUT	Bittersweet
1996-2000	<p>IRPA RM-7 Research Grant RM326,000</p> <p><i>Synthesis and Characterization of Mesoporous MCM-41 materials</i></p> <p>IDB Development Grant (RM200,000,000) – <i>Equipments and facilities development of IIS to focus on nanotechnology</i></p>	<ul style="list-style-type: none">Development of IIS(UTM,1999) Konsep Asas Kimia dan Penyelesaian Masalah(SPACE UTM, 1999) Modul SSK 1003 Kimia Asas(SPACE UTM, 1999) Modul SSK 1801 Amali Kimia Asas(HH, 1998) Kimia asas Sains dan Kejuruteraan(DBP, 1996) Kimia untuk Jurutera dan Ahli Teknologi38 journal publications2 patents2 PhD studentsYouth Science CampsExcellent Scientist Program	<ul style="list-style-type: none">First woman professor in UTMVisiting Scholar (Cambridge)First textbook to be written, edited, typeset, published by author (5 cycles - 5000 copies)First On-line LectureDirector of IIS – to become a world class scientific research institute (Nanotechnology)Developed IIS research facilitiesYouth Science Camp PINTARExcellent Scientist Program

Tiga tokoh terima Anugerah Khas Pingat Emas

TIGA tokoh wanita cemerlang yang menerima nama pada peringkat antarabangsa dalam bidang sains dan teknologi diberi Anugerah Khas Pingat Emas oleh Pergerakan Wanita Umno semalam.

Anugerah khas itu diperkenalkan buat pertama kali tahun ini bagi menghormati tokoh yang berjaya memajukan wanita dalam bidang pendidikan dan penyelidikan.

Tokoh berkenaan ialah Timbalan Naib Canselor (Penyelidikan dan Inovasi) Institut Penyelidikan Perubatan Molekul, Universiti Sains Malaysia (USM), Prof Dr Asma Ismail; Penasarah Fakulti Kimia Universiti Teknologi Malaysia (UTM), Prof Dr Halimatun Hamdan dan Ketua Pengarah Suruhanjaya Sosial dan Ekonomi Pertubuhan Bangsa-Bangsa Bersatu Asia Pasifik (Unesep), Dr Salmah Zakaria.

Dr Asma ialah pakar molekular biokimia kesihatan yang

... akan bersempitan. Beliau telah menulis beberapa buku dan artikel dalam jurnal antarabangsa.

KIMIA UNTUK JURUTERA DAN AHLI TEKNOLOGI

Halimatun Hamdan
Hanim Awab
Mohd Nazlan Mohd Muhid

KIMIA
asas Sains dan Kejuruteraan

Halimatun Hamdan
Hanim Awab
Mohd Nazlan Mohd Muhid

Profesor wanita pertama di UTM

Profesor Datuk Dr. Halimatun Hamdan menyuntik inspirasi dalam kalangan warga muda untuk mendalami bidang sains dengan meneroka teknologi nano dan menghasilkan Maerogel.

KEMAKMURAN belian dalam bidang teknologi nano di negara ini semakin meningkat apabila satu anjakan paradigma telah berlaku. Halimatun Hamdan, berketurunan Melayu (Sarawak Malaysia) daripada keluarga ilmu sains pada tameng, menggariskan kepengalaman sebanyak 30 tahun.

Beliau ini mengumpul nilai kemahiran dan kebolehan untuk menghadapi masa depan yang lebih maju.

Profesor wanita pertama di UTM ini juga telah menulis beberapa buku dan artikel dalam jurnal antarabangsa.

Pengiktirafan ... lesen penting kepada penyelidik

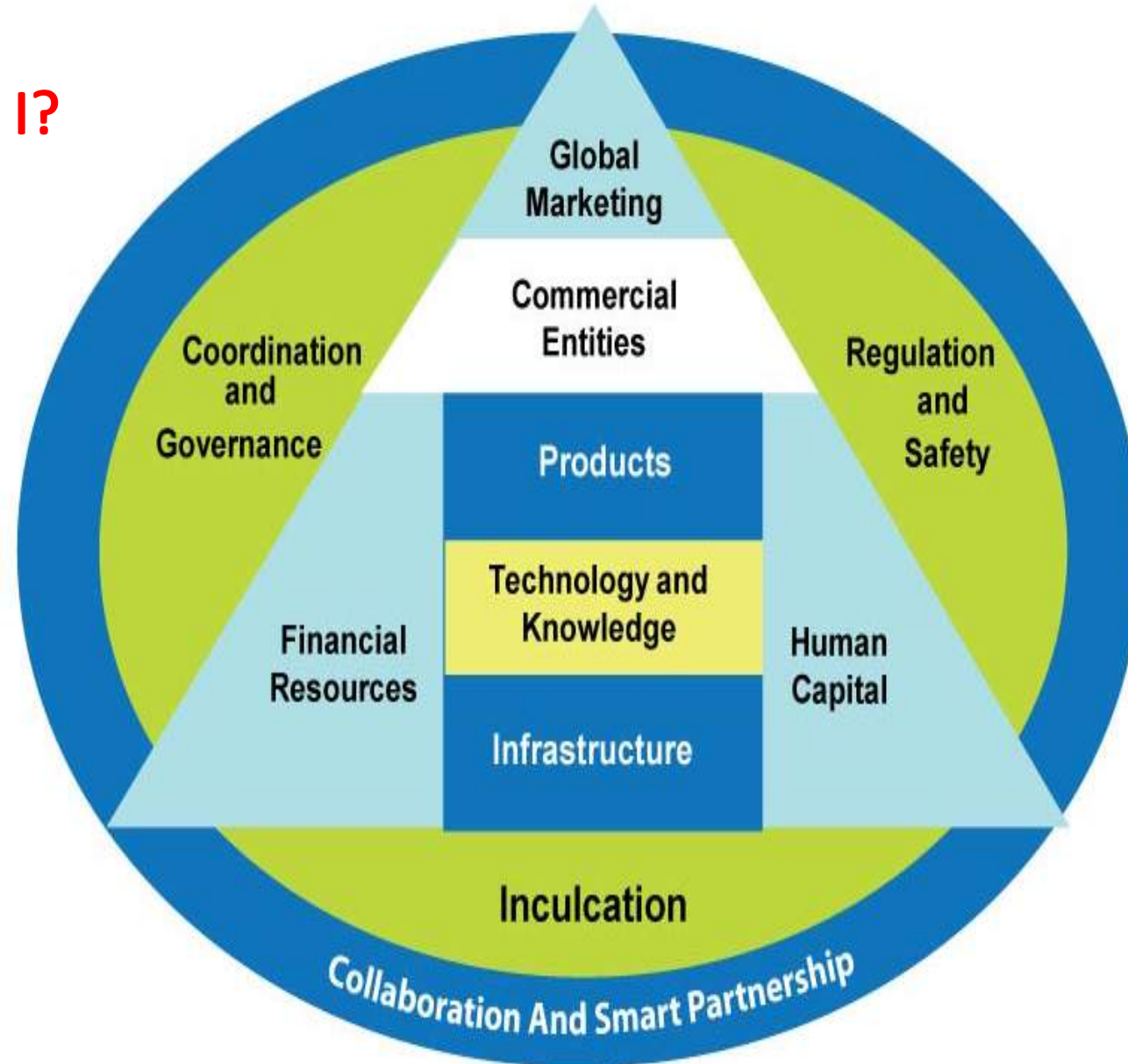
MUKADIMAH

Pengetahuan, adalah faktor utama yang mendorong kemajuan teknologi. Oleh itu, penting untuk memastikan bahawa pengetahuan yang dimiliki oleh penyelidik-peneliti dapat dimanfaatkan untuk kemajuan negara.

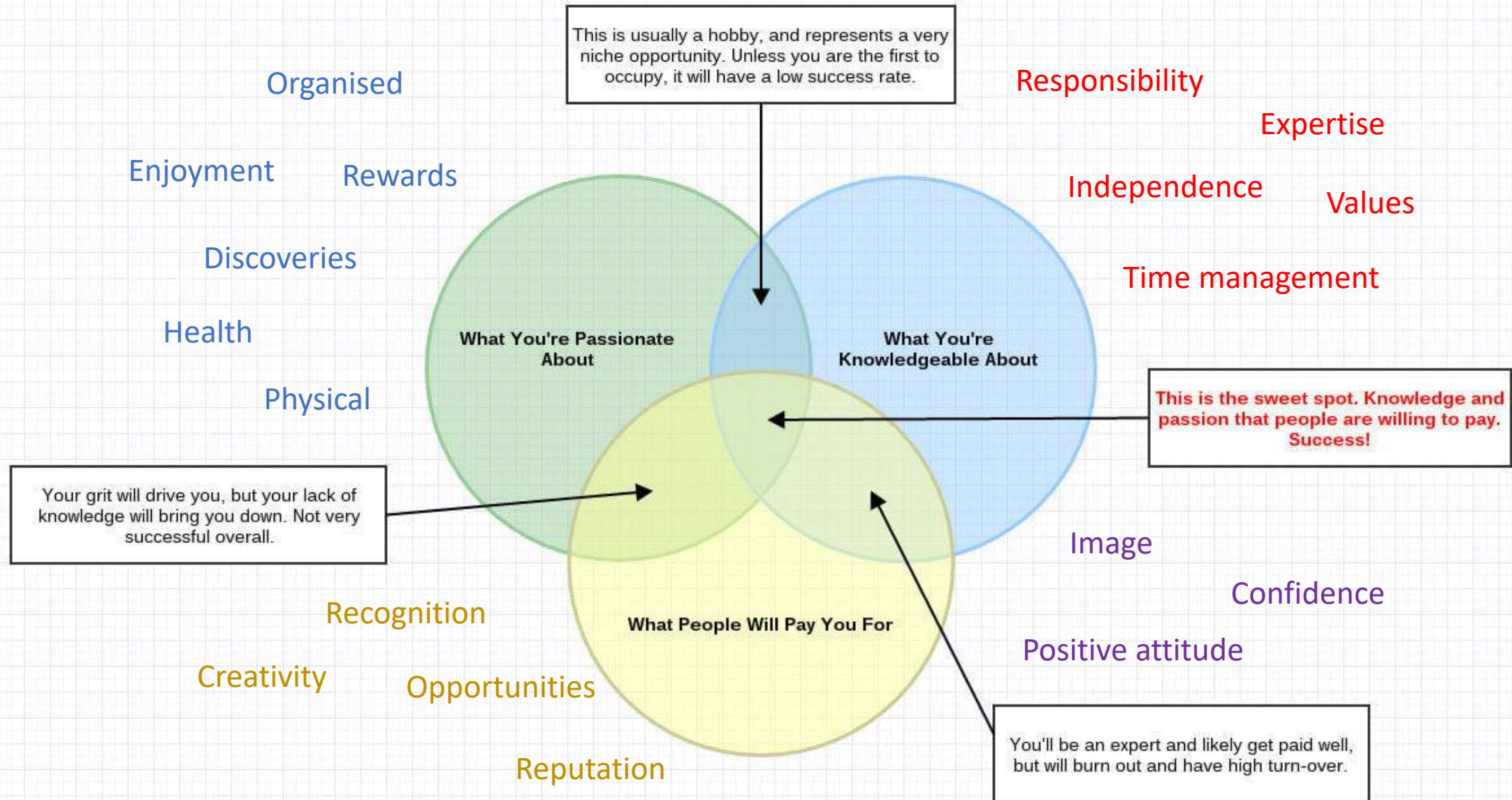
Halimatun Hamdan, seorang penyelidik yang berprestasi, telah menerima pengiktirafan sebagai salah satu tokoh wanita cemerlang dalam bidang sains dan teknologi.

SUSTAINABLE INNOVATION ECOSYSTEM

Where am I?

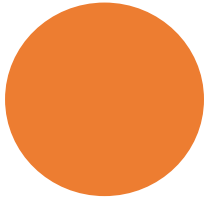


SELF-EVALUATION AND PERSONAL MOTIVATION



Change Leadership

Energizes and alerts groups to the need for specific changes in the way things are done. It involves taking responsibility to champion the change effort through building and maintaining support and commitment.



YEAR	ACTIVITY	OUTPUT	Bittersweet
2001-2005	<ul style="list-style-type: none"> IRPA SR RM-8 Research Grant RM11,290,000.00 Title: Development of Zeolites and Derivatives as Catalysts in the Synthesis of Specialty Fine Chemicals <i>Project 1: Post-Laboratory Production of Amorphous Silica and Synthetic Zeolites (A, Y, P, ZSM-5, beta and MCM-41) from Rice Husk (RM5,200,000.00)</i> <i>Project 2: Silica Aerogel from Rice Husk (RM 900,000.00)</i> FELDA Research Grant (2001-2003) RM80,000.00 Title: <i>Silica aeroglass from rice husk</i> 	<ul style="list-style-type: none"> 26 First Class Graduates - Excellent Scientist Program Director of IIS – A full pledge research institute Fellow of ASM Research Group (Leader) National research program Leader 6 Scientists (Mentees) 5 PhD, 10 MS 4 patents 34 journal publications 	<ul style="list-style-type: none"> Founding comm of ANF 2003- OIC Summit -10 most influential women Presented Chemical Sciences Malaysia to Nobel Laureate (Ahmad Zuweil) Established Zeolite and Microporous Materials Laboratory Director E-SciNano RA Lead SR Grant Professor B (2003)
	 	<ul style="list-style-type: none"> Halimaton Hamdan, Design and Molecular Engineering of Nanostructured Zeolites and Mesomorphous Materials – Advancing through the Pores, 2003, Penerbit UTM Halimaton Hamdan, Kecemerlangan Menerusi Kreativiti Transformasi dan Cabaran, A. Z. Idrus (Ed), Bah. V: Pengurusan Kreativiti, Penerbit UTM, 201-208, 2001. Pendidikan Nobel Laureate: Masa hadapan kelas pertama Universiti Teknologi Malaysia  	 

YEAR	ACTIVITY	OUTPUT	Bittersweet
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2006-2010	<p>Technofund (Project Director - 2007- 2009) RM6,400,000.00 - RM690,000.00 <i>Title: Exploratory pilot plant for the manufacturing of Maerogel from organic cereal waste</i></p> <p>Science Fund (2007-2009) RM 211,244.00 <i>Title: Nanobiosensor Based on Enzyme Encapsulated Silica Aerogel</i></p> <p>FRGS (2007- 2009) RM160,000.00 <i>Title: Amphiphilic Nano Composite Proton Conducting Membrane</i></p> <p>FRGS (2007- 2009) RM111,000.00 <i>Title: Nanoenabled Drug Delivery System</i></p> <p>Scientific Advancement Grant Allocation (SAGA) (2005- 2007) RM207,326.00 <i>Title: Chiral Mesoporous Solid Catalyst for Acid Catalyzed Enantioselective Reaction Prepared by Chiral Auxiliary Stamping Technique</i></p>	<ul style="list-style-type: none"> Spin-off Company (GKSB) Zeolite Laboratory UTM (20 researchers) Launching of Malaysia Nanotechnology Initiatives 2006 29 Journals publications 3 PhD, 8 MS 	<ul style="list-style-type: none"> Anugerah Harta Intelek Negara (2006) Founding member of ANF (Singapore) Established NanoMalaysia Program World Invention Award Glass Oberlisk BIS2007 (Overall, Industry and Natural Resources) IFIA Cup Women Inventor Award 2008 Maerogel- Product of the Year (2009) – Clean Energy Circle UK Future Potential Product – Power of Science Miraikan, Japan (2007) Lindau Nobel Laureate Convention 2006 Merdeka Award (2009) Director of NND (2010-2012)
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What are research impacts?

- Real change in the real world.
- “impact” means demonstrable and beneficial change in behaviours, beliefs and practices.
- controversial and fast developing areas – likely to comprise a mix of quantitative indicators and qualitative reviews.
- Researchers will need to develop new skills and capabilities to demonstrate ability to create impact.



YEAR	ACTIVITY	OUTPUT	Bittersweet
2011-2014	<p>Nanotechnology Directorate (MOSTI) 2010-2012 RM20,000,000</p> <p>Residence Scientist Grant (2011- 2013) RM200,000.00</p> <p><i>Title: Nanodelivery System of Antioxidant</i></p> 	<ul style="list-style-type: none"> NanoMalaysia Bhd 20 NanoFund and 5 Nano COE NanoLab >20 public lectures on Nanotechnology 18 journal publications 20 patents granted Developed UniMy (IPTS) 	<ul style="list-style-type: none"> National Nanotechnology Initiatives National Science Council (2010-2013) National ST Human Capital Roadmap Exec Comm. ANF Zeolite & NanoStructured Materials Laboratory UTM Malaysia Nanotechnology Conference VC UNIMY (2012-2014) Formulation of NanoMITe TRSM

YEAR	ACTIVITY	OUTPUT	Bittersweet
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2015-2021	<p>TNBR Research Contract (2016) RM341,000.00 <i>Title: The development of a prototype device using nanomaterial to increase dissolution of CO₂ gas in marine microalgae culture</i></p> <p>NanoMITe-LRGS (Program Chair and Project Leader 2015-2020) RM25,000,000.00 <i>Project Title: Second Generation Catalytic Conversion of Palm Oil EFB to jet fuel (RM1,900,000.0)</i></p>	<ul style="list-style-type: none"> • 32 publications • 2 PhD, 1 MS • Science Outlook 15 and 17 • Pilot plant • Technology Transfer • 1 patent • NanoMITe Global Research Consortium 	<ul style="list-style-type: none"> • Contract Professor • Chair NanoMITe • Chair Yayasan My-Prihatin • National Science Council (2014-2017) • Merdeka Award Board Of Trustees (2021-2023) • Chairman Governing Board ISTIC (2019-2021) • Renewable Silica Technology (RENSIL)
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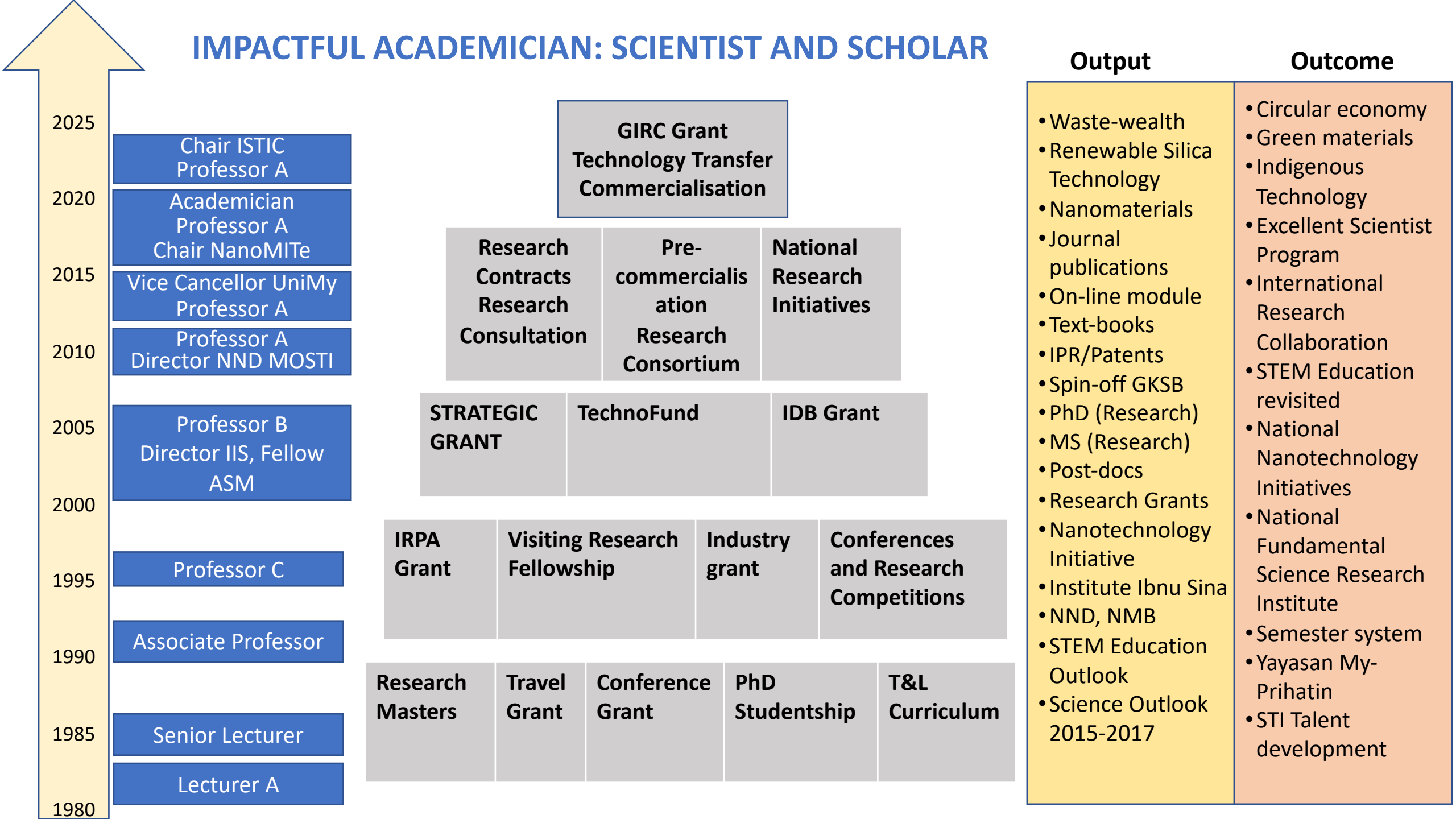
CONTINUOUS SELF-IMPROVEMENT - SUSTAINABILITY



1. Knowledge + Experience = Expertise
2. Productivity = Get more done
3. Efficiency = Quality/Excellence
4. Organisation = Management
5. Influence = Mentee, followers, leadership
6. Reputation = Branding, Mentor, followers, promotion
7. Celebrity Status = Renown, Communication, Public and Community
8. Career minded
9. Vision and Mission
10. Personality
11. Attitude
12. Image



IMPACTFUL ACADEMICIAN: SCIENTIST AND SCHOLAR



Pyramid of Success

**Competitive
Greatness**

Poise

Confidence

Condition

Skill

Team Spirit

Self-Control

Alertness

Initiative

Intentness

Industrious

Friendship

Loyalty

Cooperation

Enthusiasm



Impactful Research Legacy


- **Specialize and focus** -Stick to what you are good at, research and build on it, overcome restriction and persevere limitations and wield wonders
- **A change leader** and **create critical mass**
- **Relevance** – “trendy and demand driven
- **Optimist** about the potential of science and technology to improve society and safely expand the economy.
- **Advocate**
- Communication
- Quality and Sustainability



Difficult Phases

- Financing research
- Funding for Intellectual Property protection
- Funding development work
- Funding pre-commercialization
- Managing successful commercialization

Only some inventions lead to
successful product



Changes are what make life interesting
Bringing them is what makes

Joshua J. Martin

Commercialisation Value Chain

IDEATION

TRL 1-2



R&D

TRL 3-4



TESTING

TRL 5-6



MVP

TRL 6-7

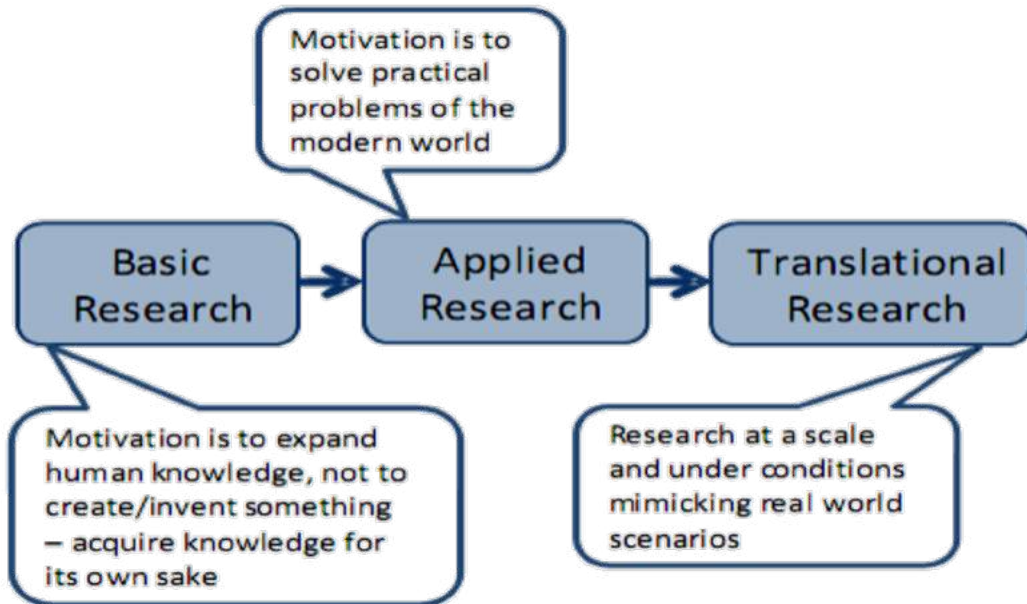


SCALE

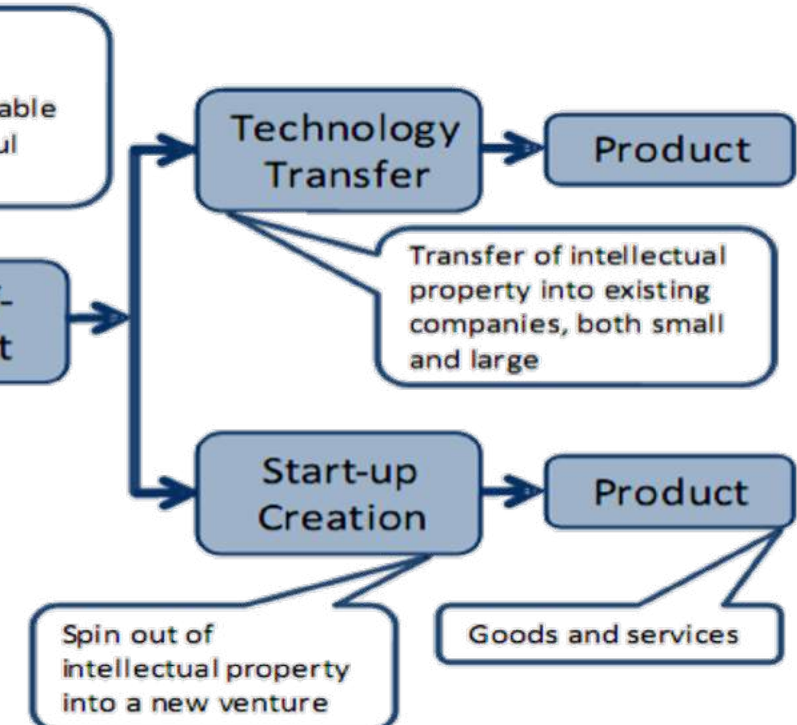
TRL 8-9



RESEARCH AND DEVELOPMENT



COMMERCIALISATION



Challenges of deriving commercially viable product from research

- The process is high-risk (there is lots of uncertainty about the outcome), long-term, multi-stage and complex
 - Research and Development
 - Engineering to a prototype
 - Raising capital
 - Manufacturing
 - Marketing
- Protecting and developing a marketable product is often much more expensive than initial research
- You have to deal with a funding gap at the early engineering and commercialization stage





RenSil



**Renewable Silica Technology:
Next-Gen Green Nanomaterial**

THE VISION

Imagine a world where...

- 1 billions of people have access to heating/cooling at a fraction of current energy consumption and cost
- 2 multiple industries are able to adopt efficient and cheap nanomaterials from environmental friendly and renewable resources
- 3 Aerospace and transportation industries can cut its costs by half for energy dependent technology developments

...and this is all made possible by a
Malaysian solution...a green one





The Problem

Major market barrier:

- High production cost
- Corrosive chemicals/raw materials
- Limited supply and expensive raw materials



NOT SUSTAINABLE

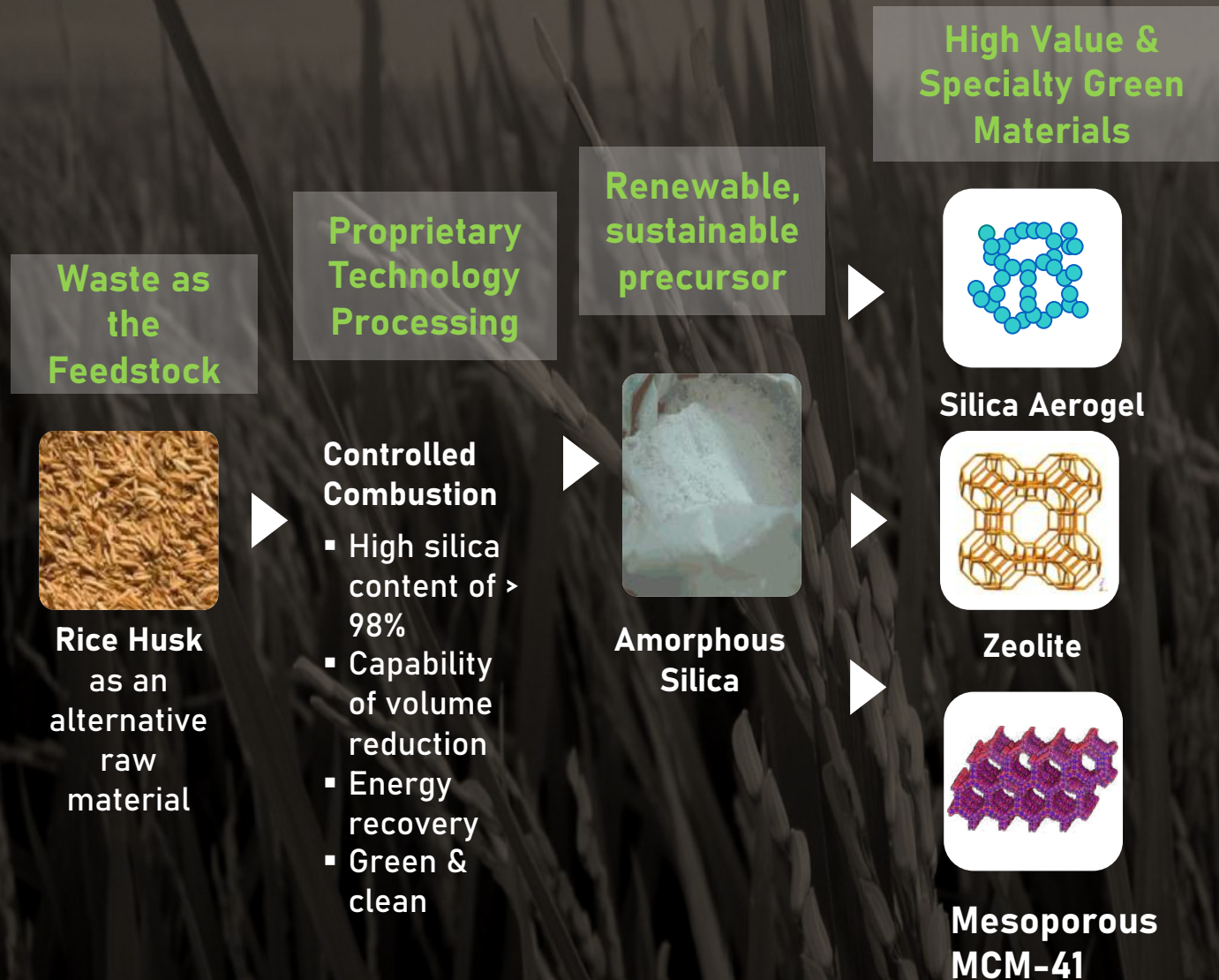
The insulation and catalyst industry is heavily reliant on non-sustainable raw material sources, corrosive chemicals and safety concerns of manufacturing facilities



NOT AFFORDABLE

Emergent high-tech material (i.e. silica aerogel and nanocatalyst) have not been used widely due to its ridiculously high chemical & production costs

THE SOLUTION – Renewable, Sustainable, Circular Economy



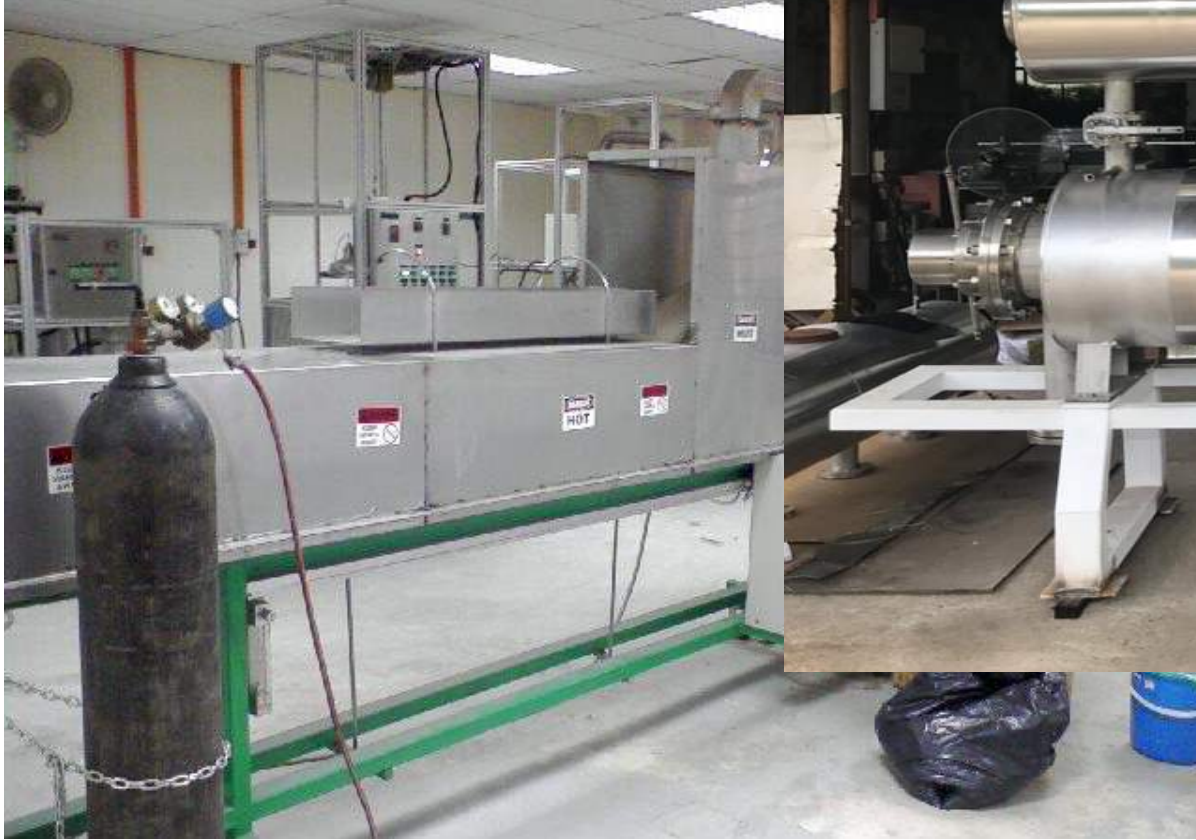
RenSil

Renewable Silica

Green Renewable Amorphous Silica from Rice Husk for Silica-based Nanomaterials

- Cheap
- Non-toxic
- Environmentally Friendly
- Waste Management

RenSil Pyrolyser System



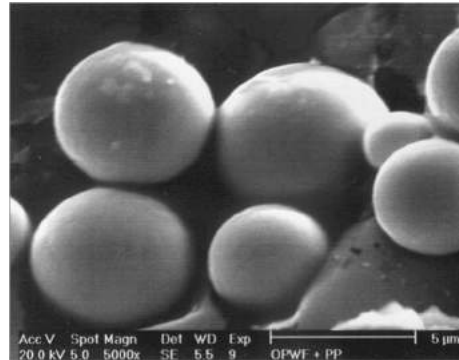
Post-Lab Prototype



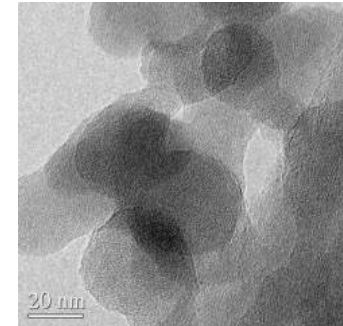
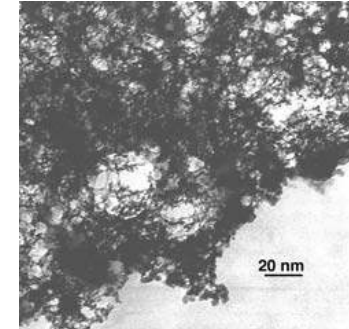
Pre-Com Prototype

RenSil Aerogel

- Cheaper alternative precursor
 - Novel technology
 - Simpler preparation technique
- ❑ Dramatic cost reduction in the manufacture of aerogel



Silica aerogel from rice husk is a nanostructured material with high specific surface area, high porosity, low dielectric constant, low density and outstanding heat insulation properties



Properties:

Apparent density	0.03 g/cm ³
Int. Surface area	600-900 m ² /g
Mean Pore Diameter	20-30 nm
Particle Diameter	5 mm
Thermal tolerance	to 500 C, mp>1200C
Thermal conductivity	0.01 - 0.09 Wm ⁻¹ K ⁻¹

US PATENT US7897648 – 2011
AUSTRALIAN PATENT AU2004287759 (B2) - 2009
EUROPEAN PATENT EP1689676 (A4) - 2009
MALAYSIAN PATENT MY130071-A (Granted 2007)

Technology Benchmarking

Competition

Estimated Pricing of Major Global Aerogel Manufacturers

Manufacturers	Raw materials	Price/kg (USD)
Silica Aerogel Pieces and Chunks by Marketch International, Inc.	Chemicals	500
Aspen Aerogel Inc (USA)		>800
BASF SE (Germany)		>500
Svenska Aerogel Holding AB (Sweden)		>500
JIOS Aerogel Corp (Korea)		800
Silica aerogel (Nanotech Co., Ltd.)		700
Aerogel Particles by Zhengzhou Joda Technology CO., LTD. (China)		400-700
RenSil Aerogel	Rice husk ash	<500

RenSil Aerogel Competitive Advantages:

- Lower manufacturing costs
- Local production efficiency
- Indigenous technological innovation
- Eco-friendly green safe and organic based product
- Sustainable and waste-free products

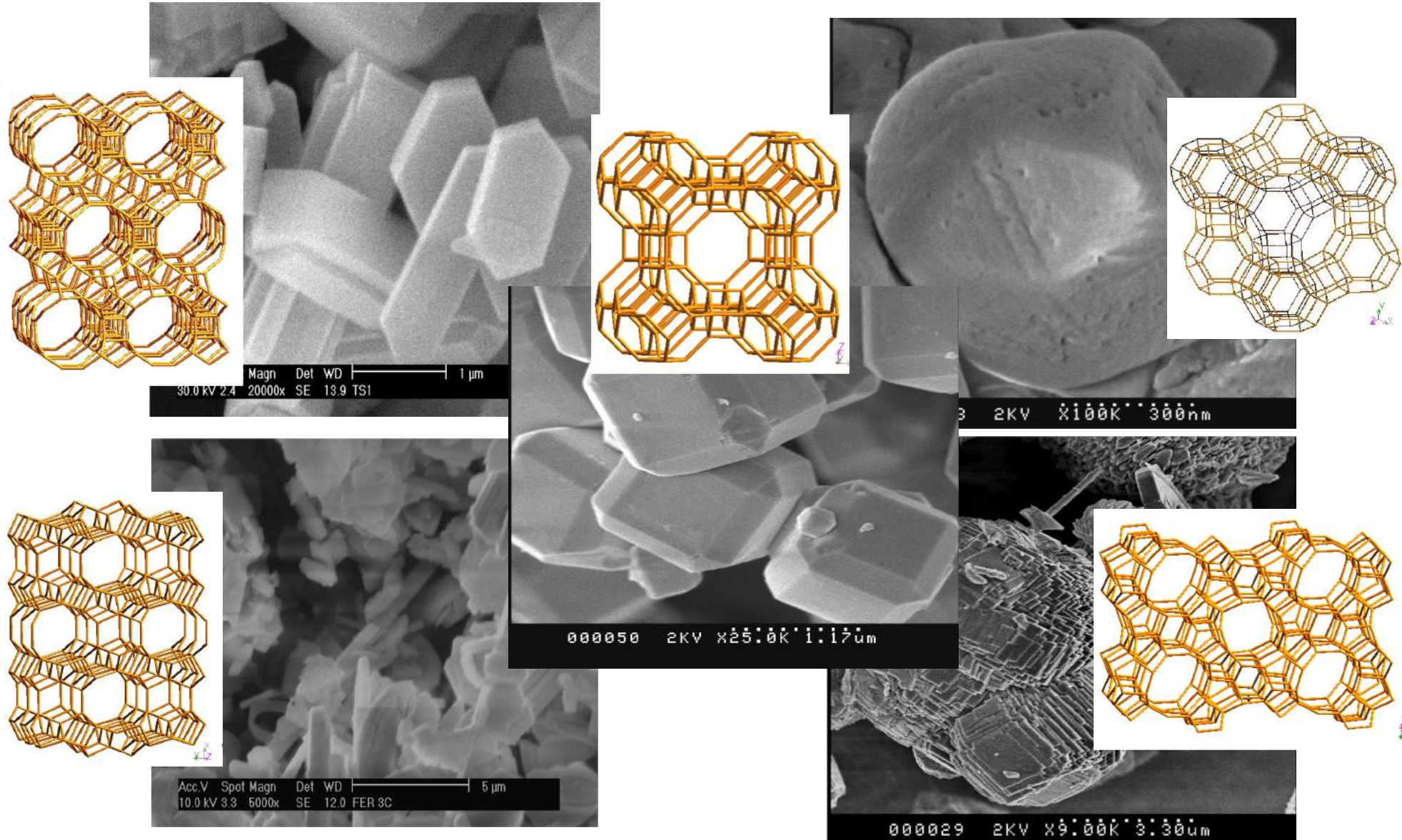


The pioneer for Malaysia, competing at a global stage

"Although aerogel is priced at a premium, the material has a wide range of applications. Commercialization of a new aerogel production technology, which uses rice husk as raw material, is expected to change the market dynamics by lowering prices. Vendors are investing heavily to find new production methods and aerogel variants for diverse applications,"

Swapnil Tejveer Sharma,
Lead plastics, polymers, and elastomers analyst, Technavio.

SEM of various crystalline zeolites synthesised from rice husk showing distinct morphologies



Zeolites for water and wastewater treatment

- Water softening agent
- “Builder” in detergent formula
- Ammonia removal
- Heavy metal ($d > 5 \text{ g cm}^{-3}$) removal
- Radioactive species removal
- Inorganic anions (nitrates, phosphates, arsenates etc) removal
- Organic compounds (eg. benzene, toluene) removal
- Dyes removal
- Humic substances in soil removal
- Microorganism capturing
- Permeable reactive barrier
- Oxygen concentrator
- Sea water desalination

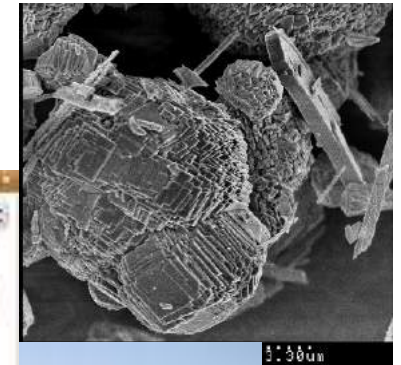


Heterogeneous Zeolite Catalysts

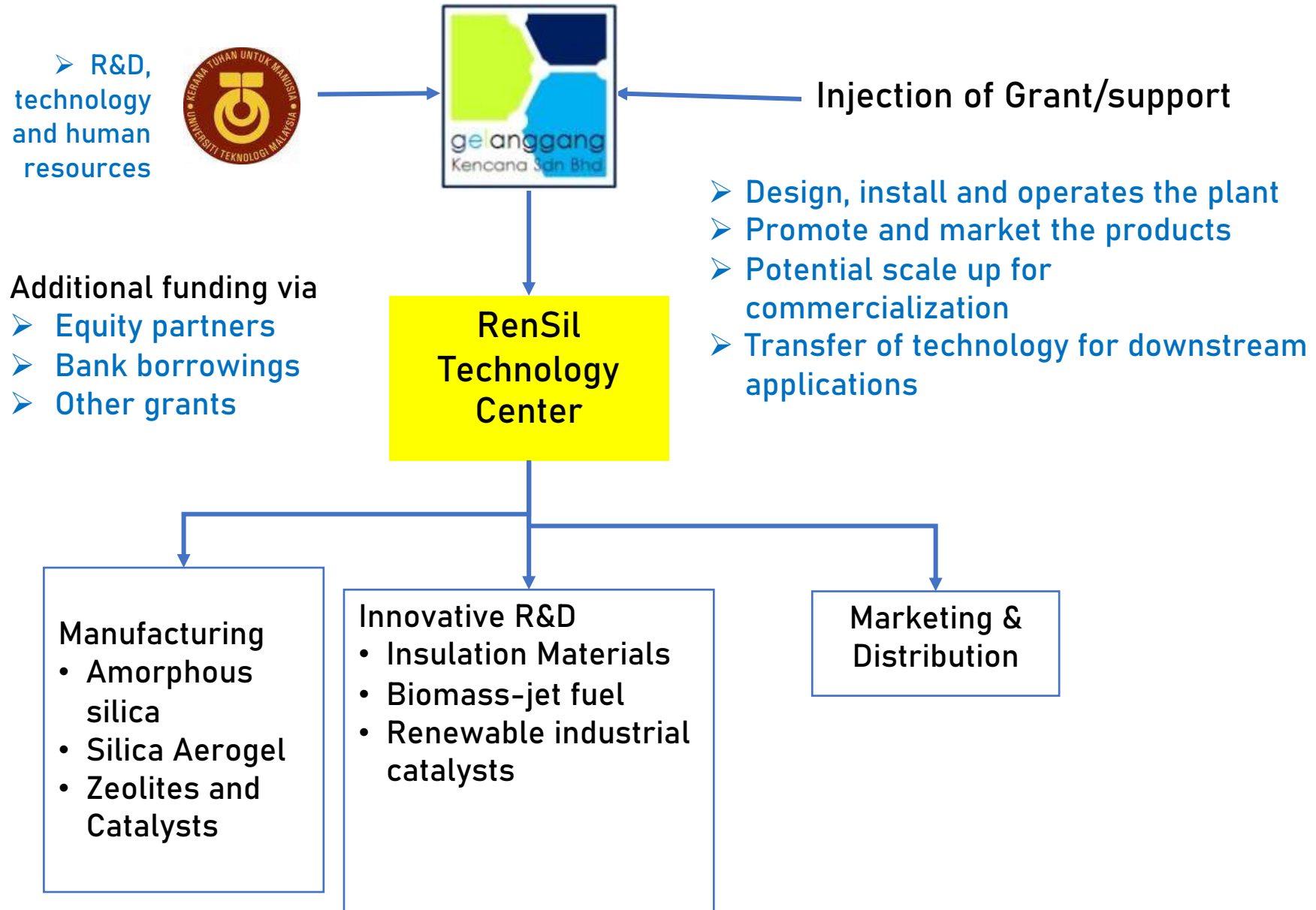


Our Solutions to global problems:

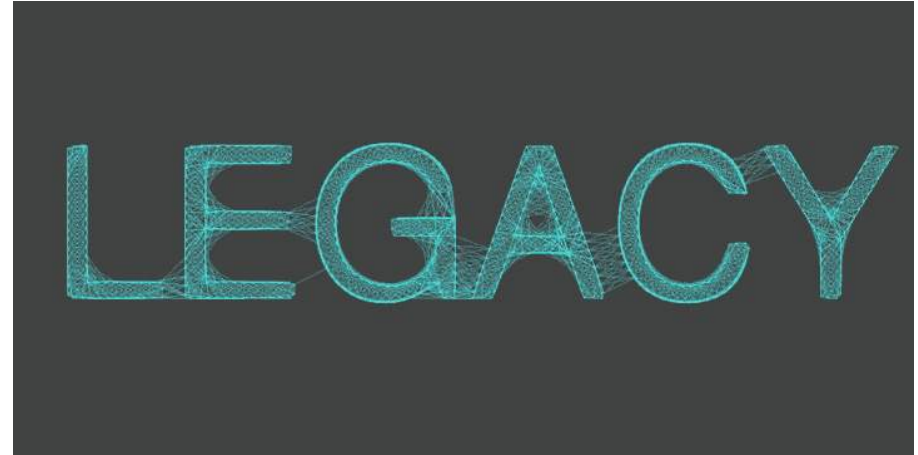
1. Heavy oil cracking (HOC)
2. Conversion of empty fruit bunches (EFB) and biomass to biofuel and jetfuel
3. Alcohol to gasoline
4. Visible light photocatalyst for water treatment



RENEWABLE SILICA (RenSil)TECHNOLOGY



Concluding Remarks



Impactful and sustainable STI research legacy is not just for the goals of discovery and economic growth, but the difference made to the lives of mankind



In 1816 women had
no rights.

In 1916
women
fought
for some
rights.

In 2016 women are
doing things right.



I thank you for your leadership in science towards
a progressive and prosperous Malaysia



halimatonhamdan@gmail.com

