UTM
UNIVERSITI TEKNOLOGI MALAYSIA

KEMENTERIAN PENDIDIKAN TINGGI

Educational Technology as a Key to Unlocking the Fourth Industrial Revolution -Malaysian Higher Learning Perspectives

Ali Selamat
Chief Information Officer (CIO)
Universiti Teknologi Malaysia &
Chair – IEEE Computer Society Malaysia
Email: aselamat@utm.my

CICT UTM Open Day – 24 Nov 2017
*The materials are compiled with the co-authors:
Rose Alinda Alias, Syed Norris Hikmi, Samad Ismail, Hamisah Tapsir, Marlia Puteh

SOARING UPWARDS
MALAYSIAN HIGHER EDUCATION

UTM

Our Team Members

- Datin Paduka Ir. Dr. Siti Hamisah Tapsir
  - Director General of Higher Education (Ministry of Higher Education, Malaysia)
- Assoc. Prof. Dr Marlia Puteh
  - Head of Strategic Communication Unit,
  - Department of Higher Education (Ministry of Higher Education, Malaysia)
- Prof. Dr Rose Alinda Alias
  - President – MyAIS - Association for Information Systems (Malaysia Chapter)

UTM

innovative • entrepreneurial • global www.utm.my

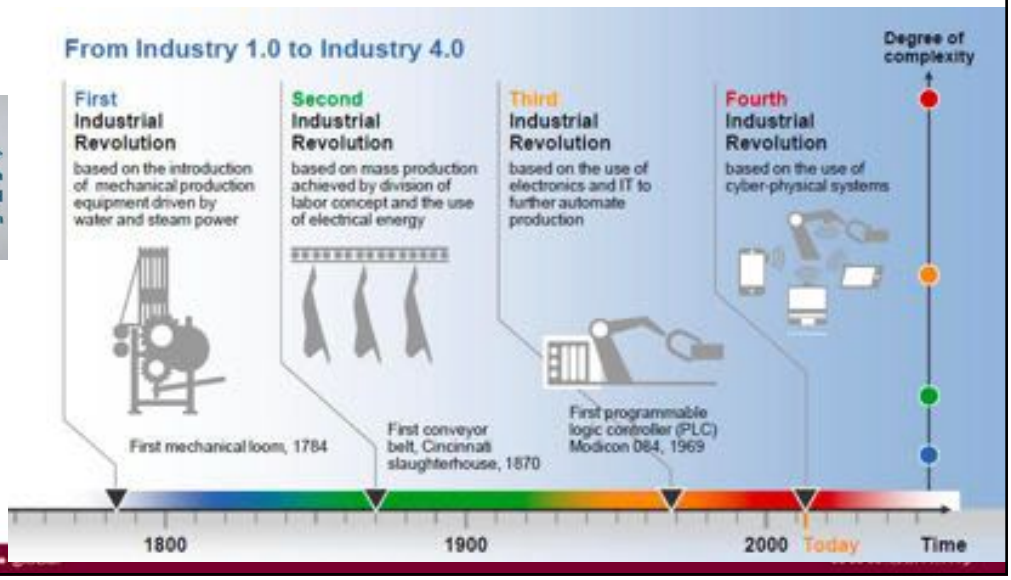
Outlines

- About Universiti Teknologi Malaysia (UTM)
- Industrial Revolution 4.0
- Malaysia Higher Education 4.0 (MyHE 4.0)
- UTM 4.0 Initiatives (Digital Nervous System)
- Conclusions and future outlook

International Conference on University 4.0 , Nguyen Tat Thanh University, Ho chin Minh, Vietnam on July 20-21, 2017 (http://university40.ntt.edu.vn/)

Industrial Revolution 4.0

From Industry 1.0 to Industry 4.0



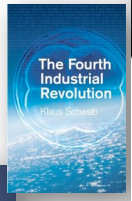
Source: DFKI

4IR (Fourth Industrial Revolution)

World Economic Forum Annual Meeting 2016, Davos-Klosters, Switzerland.

Theme: "Mastering the Fourth Industrial Revolution"

20-23 January 2016



Professor Klaus Schwab,

Founder and Executive Chairman of the World Economic Forum

What does 4IR mean?

- "We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before. We do not yet know just how it will unfold, but one thing is clear: the response to it must be integrated and comprehensive, involving all stakeholders of the global polity, from the public and private sectors to academia and civil society."

Professor Klaus Schwab,

Founder and Executive Chairman of the World Economic Forum

World Economic Forum Reports

January 2016

January 2017

innovative • entrepreneurial • global www.utm.my

WHY iS THE 4TH REVOLUTION UNDER WAY?

- **Velocity**: Contrary to the previous industrial revolutions, this one is evolving at an exponential rather than linear pace. This is the result of the multifaceted, deeply interconnected world we live in and the fact that new technology begets newer and ever more capable technology.
- **Breadth and depth**: It builds on the digital revolution and combines multiple technologies that are leading to unprecedented paradigm shifts in the economy, business, society, and individually. It is not only changing the "what" and the "how" of doing things but also "who" we are.
- **Systems Impact**: It involves the transformation of entire systems, across (and within) countries, companies, industries and society as a whole.

innovative • entrepreneurial • global www.utm.my

The University of the Future

Source: **Sabina Jeschke**, Engineering Education for Industry 4.0, 2016

! Challenges of future teaching and learning must be turned into opportunites for change!

Change of organisational structures
- Change of business models
- Cooperative Structures enhancing interdisciplinarity
- New concept for faculties or departments

Change of accreditation procedures
- New role of examination offices
- No fixed degree programms
- Accelerationin education according to fast innovation cycles

Change of teaching methods
- New teaching concepts (e.g., flipped classroom)
- New teaching infrastructures (e.g. equipment for virtual worlds)
- Digital rights management

Change of learning
- Massive vs. Personalized learning
- New learning infrastructures e.g. increased computing capacities
- Shift from presence learning to distance learning

Digital culture
- Digital technologies pervade and **connect** all aspects of daily life
- Development of **various digital lifestyles**
- **New mental models**, e.g. distance no longer dominated by geogr. distances

!
- New forms of social communication, participation and organisation
- Leading to globalization of education
- New learning/problem solving styles
- NLP, Web „4.0" on its way

- Semantics makes „search" more efficient
- Googles on-demand philosophy spreading
- Melting of all types of information, seamless integration

Individualization
- Individualism – a global phenomenon
- Few strong, many lose relationships

!
- **Complex biographies and identities**
- Personalisation and individualisation in learning and education **„DIY education"**
- Social cohesion shifted from physical to virtual world
- Distances in mind sets become even more visible

- Individual education for the masses
- Self-paced learning
- Individual modular degrees

Industry 4.0 Framework (PWC, 2016)

Industry 4.0 framework and contributing digital technologies

Source: PwC, 2016

Industry 4.0 Technologies, IT/OT Applications and & Engineering Transformations

Table 1. Industry 4.0 technologies[22]

Product impact	Potential IT/OT applications
Physical ⟶ digital	• Sensors and controls • Wearables • Augmented reality
Digital	• Signal aggregation • Optimization and prediction • Visualization and POU delivery • Cognitive and high-performance computing
Digital ⟶ physical	• Additive manufacturing • Advanced materials • Autonomous robotics • Digital design and simulation

ce: Deloitte analysis. Graphic: Deloitte University Press | DUPress.com

Table 5. Potential Industry 4.0 applications for engineering transformation

Engineering impact	Potential IT/OT applications
Reduce idea-to-market time	Use rapid prototyping and production capabilities to design new products and eliminate supply chain dependencies; configure new software solutions through cloud-enabled development tools
Better link design to product intelligence	Use data to anticipate design flaws and correct for them; design products and simulate usage based on total cost of ownership and supply implications; evaluate product design options based on manufacturability
Improve the overall effectiveness of engineering[32]	Design and test new products through virtual simulation software; allow open source sharing of intellectual property to spur or improve designs

Source: Deloitte analysis. Graphic: Deloitte University Press | DUPress.com

innovative • entrepreneurial • global www.utm.my

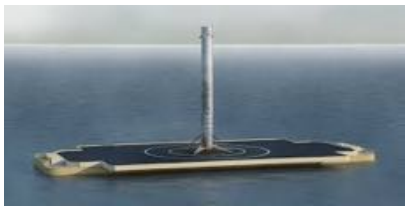
Disruptive Science and Technology Innovations

TANGIBLE AND INTANGIBLE

Self Driving Car

Tesla

3D Printing



SpaceX Reusable Rocket

Boston Dynamics Robots

innovative • entrepreneurial • global www.utm.my

Disruptive Science and Technology Innovations

PRIMARILY STEM SKEWED

Virtual and Augmented Reality

Drone

Microsoft Holoportation

Realtime Face2Face Reenactment of Video

Google AlphaGo

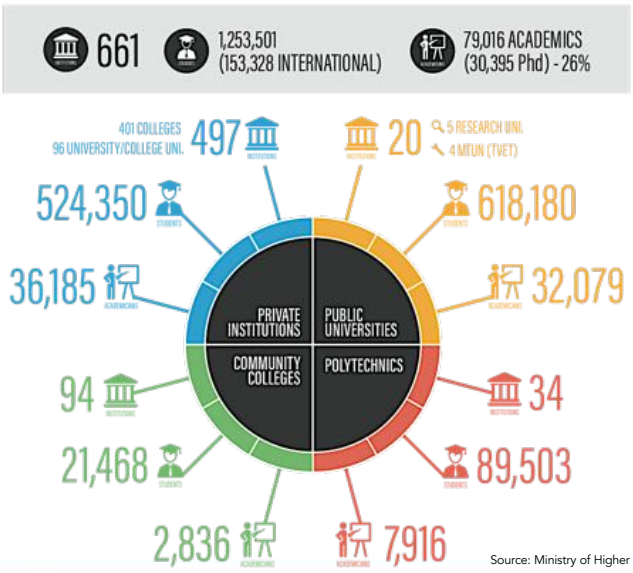
Disruptive Science and Technology Innovations

IBM Watson

Repetitive jobs that can be automated will be replaced

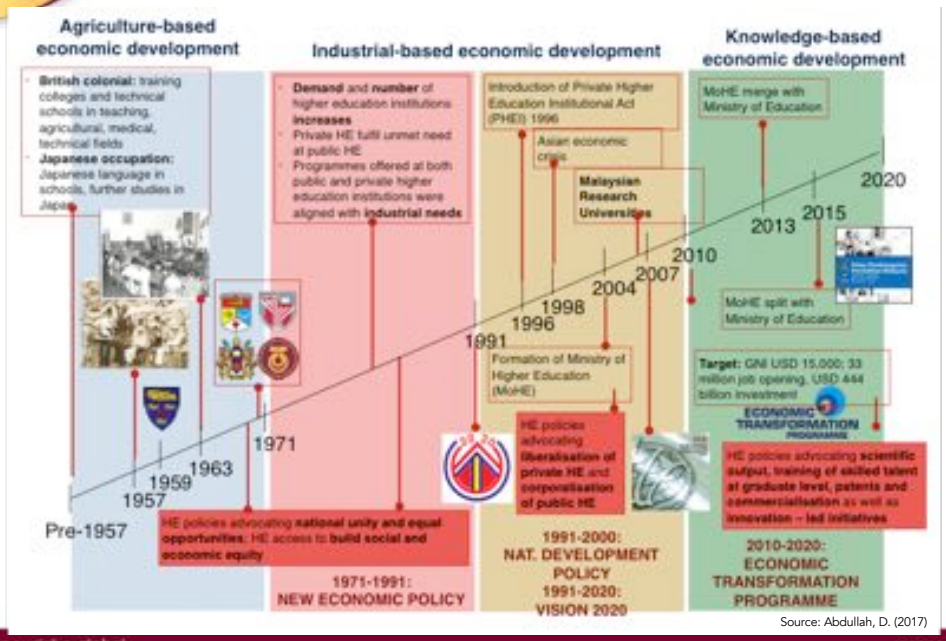
Malaysia Higher Education 4.0 (MyHE 4.0)

Malaysian Higher Education Landscape



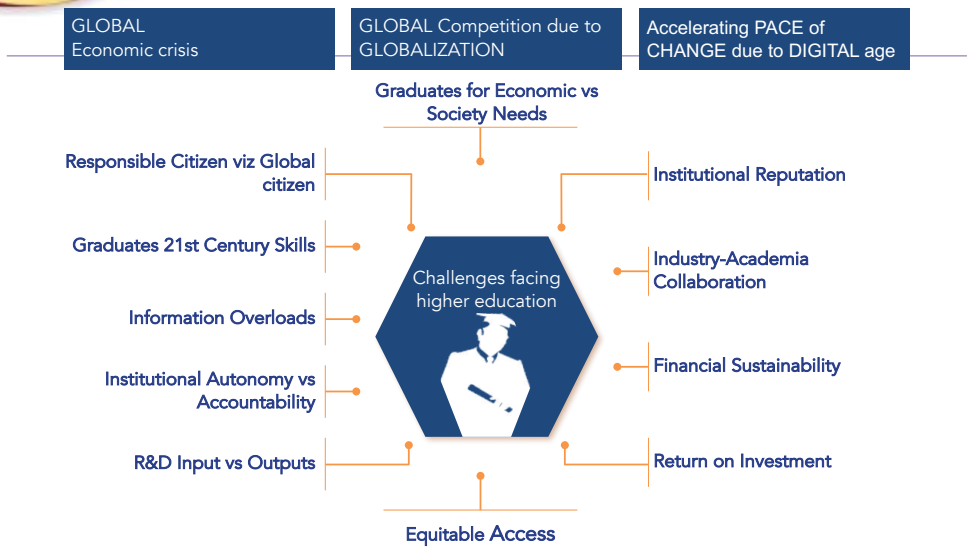
Source: Ministry of Higher Education, Malaysia (2017b)

Developments of Malaysian Higher Education

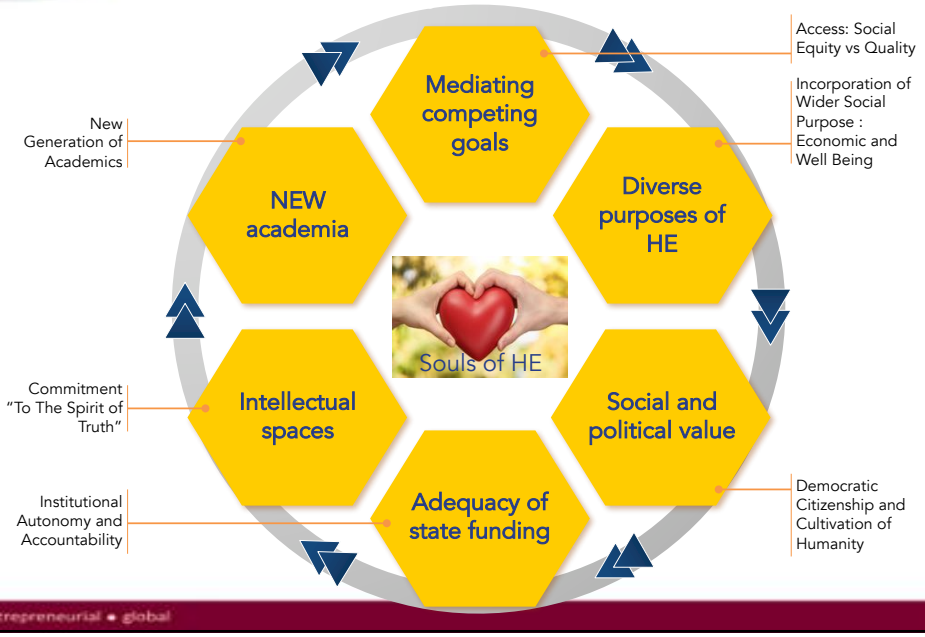


Source: Abdullah, D. (2017)

Addressing Current and Future Challenge

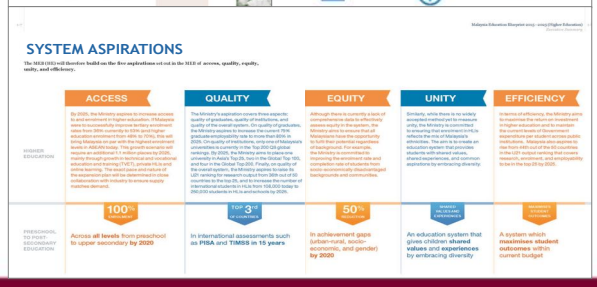


Challenges in Transformation for HE



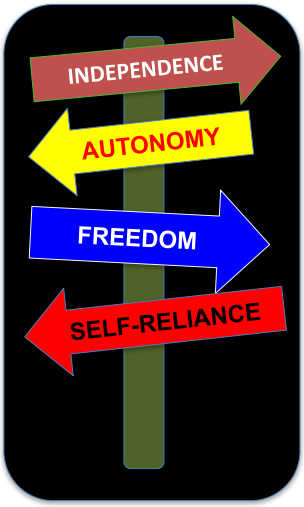
Malaysian Education Blueprint (MEB) 2015-2025 (Higher Education)

Launched in April 2015



Agile University Governance

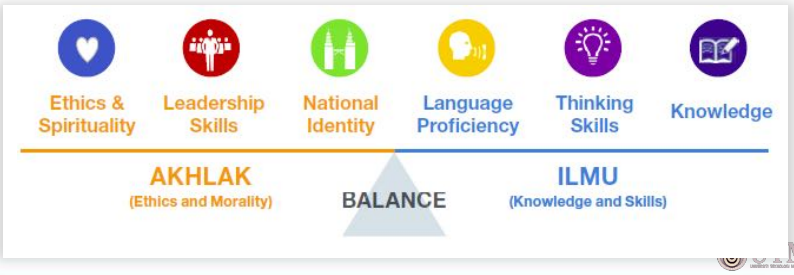
1. **SELF-GOVERNING INSTITUTIONS** – autonomous, both UA/US (high)Compoundable
2. **SELF-ACCREDITATION**
3. **WAQAF CONTRIBUTION AND UNIV REVENUE** = 30 to 50 ?%
4. **OPEN ACADEMIC TENURESHIP** (Freelance)
5. **SHARED GOVERNANCE** – students in Senate, Board, students host convos
6. **Lean MOHE/MQA**



The MEB (HE) Sets Out Clear System and Student Aspirations

System Aspirations

Student Aspirations



NOT ONLY Engineering Challenges of 21st Century

Improvement of Human Life

http://www.engineeringchallenges.org/

Higher Education 4.0 (TANGIBLE)

Challenged by emerging technologies in Industrial 4.0, smart services and globalization

Hidden Elements of 4.0IR (INTANGIBLE)

Powered by character building, high order thinking, multiple intelligences, mind and hands, soft skills, lifelong learning to face new challenges

innovative • entrepreneurial • global www.utm.my

KEMENTERIAN PENDIDIKAN TINGGI

UTM UNIVERSITI TEKNOLOGI MALAYSIA

UTM4.0 4th INDUSTRIAL REVOLUTION

DIGITAL NERVOUS SYSTEM

SOARING UPWARDS MALAYSIAN HIGHER EDUCATION

innovative • entrepreneurial • global

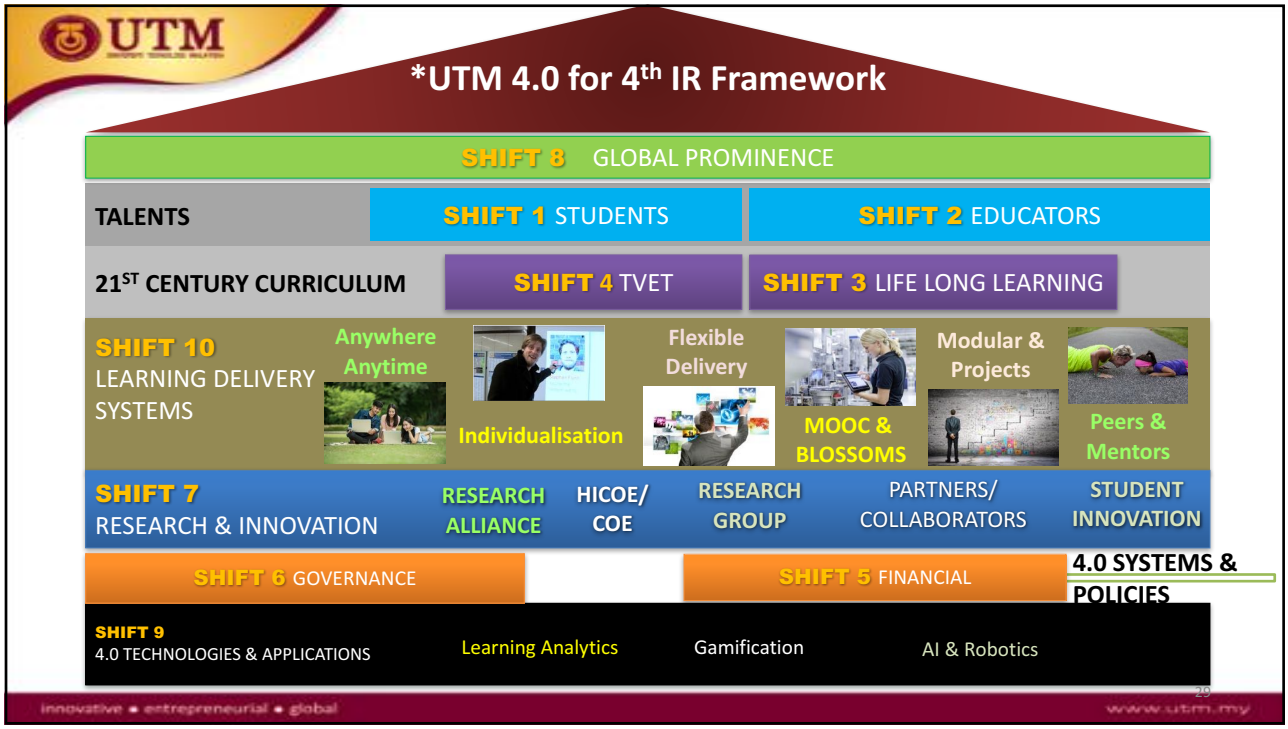
www.utm.my

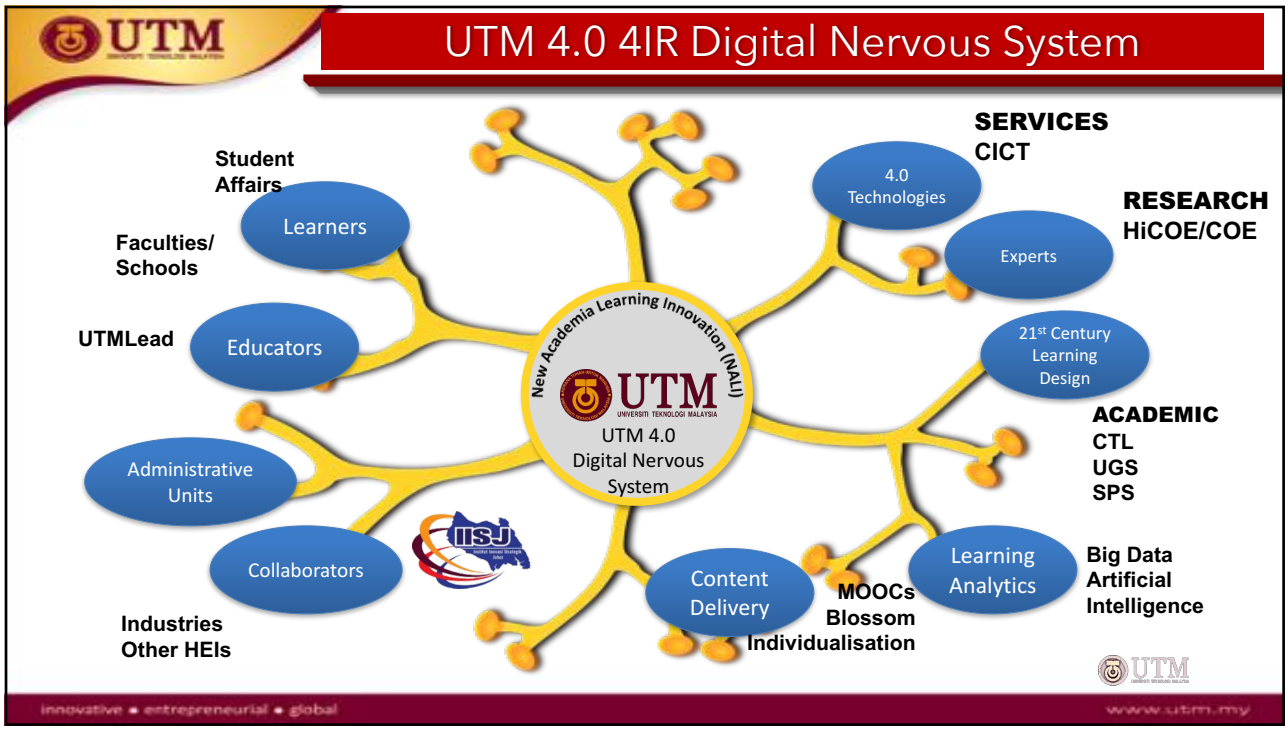
10 Shifts to Support the Attainment of System and Student Aspiration

Malaysia Higher Education Blueprint

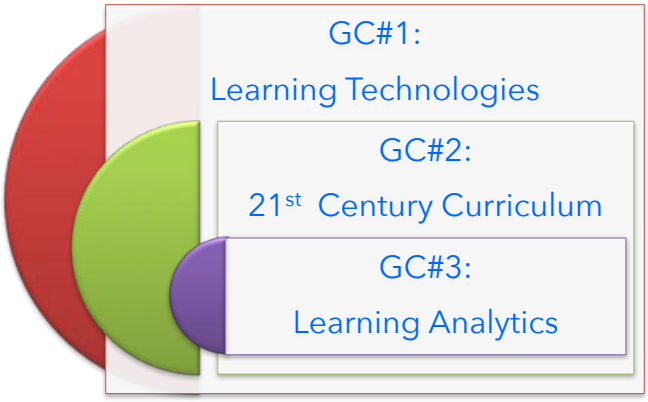
innovative • entrepreneurial • global

www.utm.my


UTM
*UTM 4.0 for 4th IR Framework
SHIFT 8 GLOBAL PROMINENCE
TALENTS
SHIFT 1 STUDENTS
SHIFT 2 EDUCATORS
21ST CENTURY CURRICULUM
SHIFT 4 TVET
SHIFT 3 LIFE LONG LEARNING
SHIFT 10
LEARNING DELIVERY SYSTEMS
Anywhere Anytime
Individualisation
Flexible Delivery
MOOC & BLOSSOMS
Modular & Projects
Peers & Mentors
SHIFT 7
RESEARCH & INNOVATION
RESEARCH ALLIANCE
HICOE/ COE
RESEARCH GROUP
PARTNERS/ COLLABORATORS
STUDENT INNOVATION
SHIFT 6 GOVERNANCE
SHIFT 5 FINANCIAL
4.0 SYSTEMS & POLICIES
SHIFT 9
4.0 TECHNOLOGIES & APPLICATIONS
Learning Analytics
Gamification
AI & Robotics
innovative • entrepreneurial • global
www.utm.my


UTM
UTM 4.0 4IR Digital Nervous System
Student Affairs
Learners
Faculties/ Schools
UTMLead
Educators
Administrative Units
Collaborators
Industries Other HEIs
New Academia Learning Innovation (NALI)
UTM
UTM 4.0 Digital Nervous System
IISJ
SERVICES
CICT
4.0 Technologies
RESEARCH
HiCOE/COE
Experts
21st Century Learning Design
ACADEMIC
CTL
UGS
SPS
Learning Analytics
Big Data
Artificial Intelligence
Content Delivery
MOOCs
Blossom
Individualisation
innovative • entrepreneurial • global
www.utm.my

3 Grand Challenges as Proof of Concept by UTM COEs



GRAND CHALLENGES

MaGICX

CAIRO
UNIVERSITI TEKNOLOGI MALAYSIA

CENTRE FOR ENGINEERING EDUCATION
CEE
UNIVERSITI TEKNOLOGI MALAYSIA

UTM BIG DATA CENTRE
TOGETHER WE MAKE MOTIONS...

UTM COEs

innovative • entrepreneurial • global www.utm.my

GC#1: Learning Technologies: Gamification, AIS and Robotics

Exhibit 7: Most educational technologies are focused on developing foundational literacies

	Personalized and adaptive content and curricula	Open educational resources	Communication and collaboration tools	Interactive simulations and games
Character Qualities	*Additional tools are strongly needed to develop competencies and character qualities*			• Games for Change
Competencies			• Google Apps for Education • OneNote • Facebook • Ponder	• Glass Lab • Games for Change • Molecular Workbench • Explore Learning • Tynker
Foundational Literacies	• Knewton • Dreambox • Read180 • Khan Academy • Smart Sparrow	• Betterlesson • LearnZillion • Curriki Geometry • reTrekker • Fishtree • Pearson • McGraw-Hill • Houghton Mifflin		• Explore Learning • Glass Lab • STMATH

UTM4.0 4th INDUSTRIAL REVOLUTION
DIGITAL NERVOUS SYSTEM

innovative • entrepreneurial • global www.utm.my

Gamification Technology in Teaching and Learning

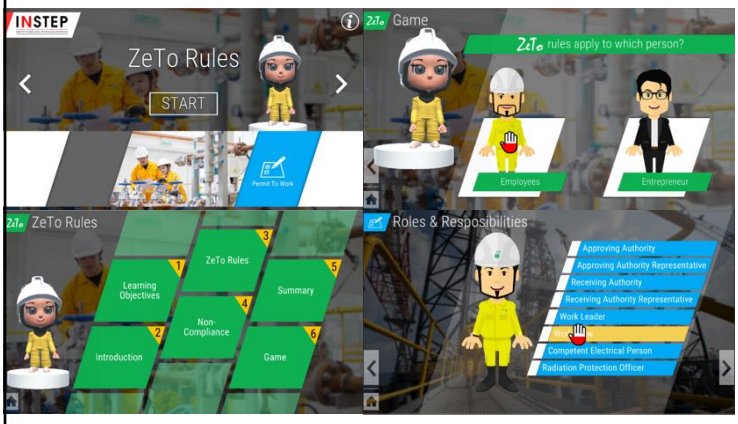
MaGICX Media and Game Innovation Centre of Excellence

Gamification Technology in Teaching and Learning

PETRONAS INSTEP INSTITUT TEKNOLOGI PETROLEUM PETRONAS

MaGICX Media and Game Innovation Centre of Excellence

Health, Safety, Environmental for Oil and Gas Industry



Centrifugal Oil Compressor for Oil and Gas

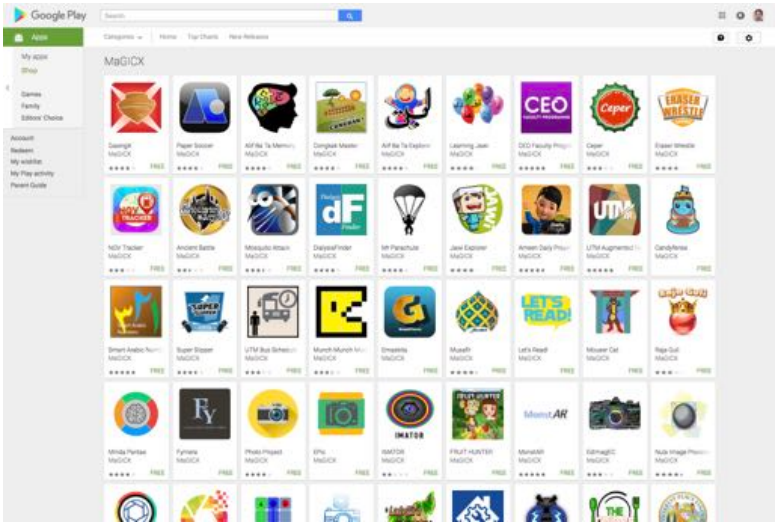
Augmented Reality in Culture and Heritage

Galeri Memorial Tun Abdul Razak

MaGICX
Media and Game Innovation Centre of Excellence

KEMENTERIAN PELANCONGAN DAN KEBUDAYAAN MALAYSIA

Mobile Games and Apps



MaGICX
Media and Game Innovation Centre of Excellence

More than 150 mobile games/apps

GET IT ON Google Play

Download on the App Store

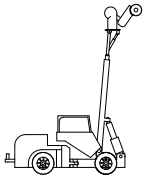
UTM

Industrial 4.0 @ CAIRO Centre for AI & Robotics

MJIIT MALAYSIA-JAPAN INTERNATIONAL INSTITUTE OF TECHNOLOGY

AGRICULTURE 4.0
Flagship Programme:
Digital Technologies for Oil Palm Industries

Harvesting Technology	Data Driven Plant Management
• Exoskeleton • Intelligent Harvesting • Harvesting Robot	• Growth Monitoring • Pest & Disease Control • Fertilizer Management • Yield Prediction

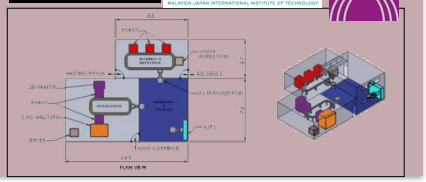


MANUFACTURING 4.0
Flagship Programme:
Industrial IoT Lab

CNC Machine, 3D Printer, Robotics Assembly, Intelligent Drone Delivery System, Automated Storage, Prototyping, Components Production, Consultancy, Training, Research

Production Optimization, Process Operational Efficiency, Predictive Maintenance, Real-time Info Display

IIoT Lab Layout MJIIT MIMOS



DISASTER MANAGEMENT
Flagship Programme:
Intelligent Drones for Disaster Rescue Operation

Request sets from field

Generate optimized mission plan

Drones mission assignment

Guidance & Control

MJIIT

UNIVERSITI SAINS MALAYSIA

37

UTM

innovative • entrepreneurial • global www.utm.my

EXPERTS & TALENT DEVELOPMENT

- **CAIRO's Comprehensive IoT Training Programmes**
  - Embedded System, Internet Communication System, Artificial Intelligence, Data Analytics, Control & Instrumentation, Database System, Cloud Management.
- **Training on System Integration & Maintenance for Agriculture 4.0 and Manufacturing 4.0**
- **Awareness Programmes** for Executives to Onsite Personnel

KenalKayu – Wood Species Recognition System

Web-Based KenalKayu

Handheld KenalKayu

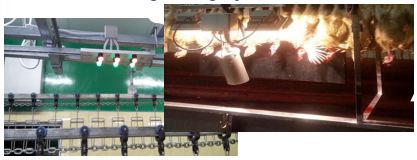
- Mobile
- Small
- Light
- Fast
- Accurate

CR2 – Rehabilitation Robot for Wrist &

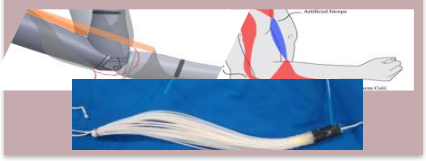
- Cloud-Based Monitoring
- Interactive
- Modular
- Portable

Flood/Landslide Simulation System

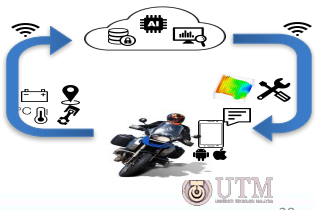
SYCUT – Syariah Compliant Chicken Slaughtering System



Lightweight Exoskeleton Suit for Oil Palm Harvesting



IoT Based Adaptive Fuel Map



UTM

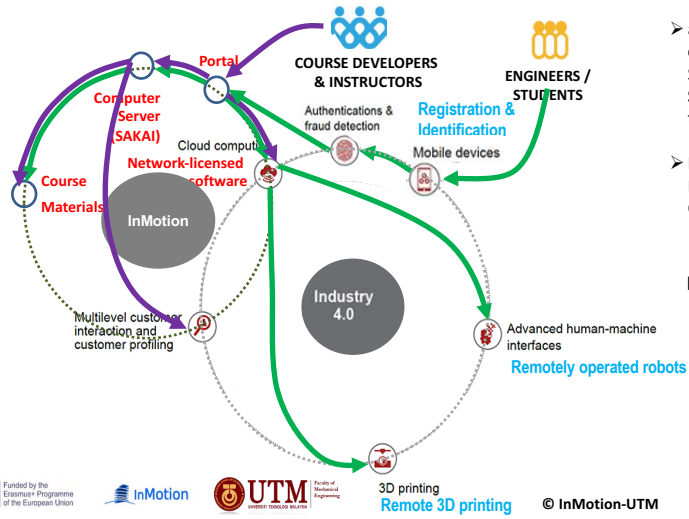
39

innovative • entrepreneurial • global www.utm.my

InMotion Project in Relation to Industry 4.0

InMotion Concept

Innovative teaching and learning strategies in open modelling and simulation environment for student-centered engineering education



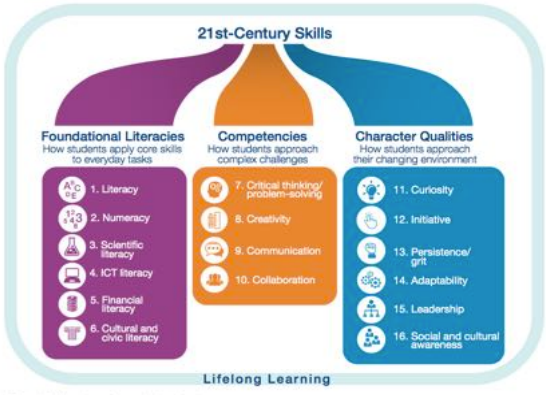
- an EU Grant project carried out in FKM (UTM), which aims to **create new eLearning Materials** for Computer Modelling and Simulation for Engineering (CMSE) field with **Open Modelling and Simulation Environment platform** (OMSE) based on innovative teaching strategies and creative learning approaches.
- InMotion target to train graduates, engineers, researches from European Countries and Pacific Countries to be competent in the CMSE field and hence the realization of Industry 4.0.

International Partners

Universität Bremen, SPIIRAS, University of Ljubljana, SMTU, Novosibirsk State Technical University, POLYTECH, UNED, UTP, UniKL

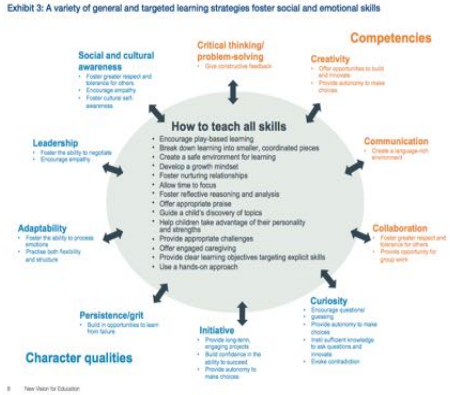
GC#2: 21st Century Curriculum

Exhibit 1: Students require 16 skills for the 21st century



Note: ICT stands for information and communications technology.

Exhibit 3: A variety of general and targeted learning strategies foster social and emotional skills

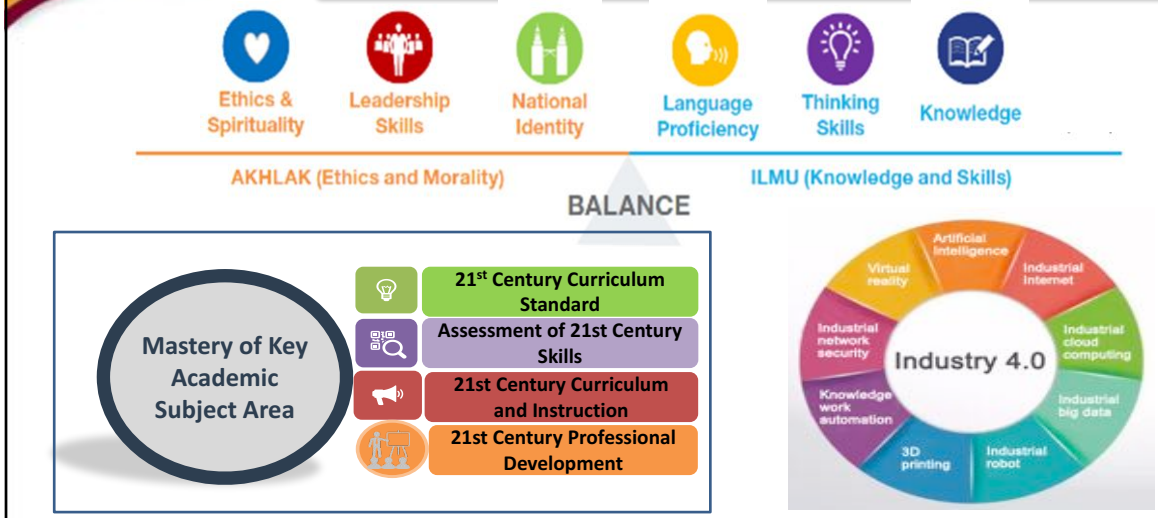


21st Century Skills and Learning Strategies

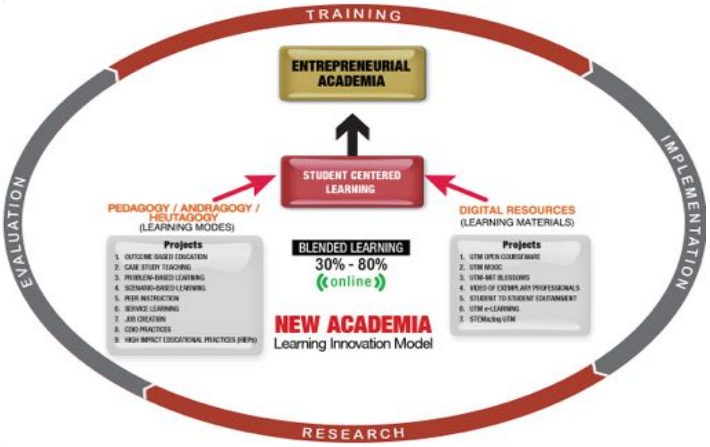
(Source: Soffel, 2016, Website Editor, World Economic Forum)

UTM4.0 4th INDUSTRIAL REVOLUTION
DIGITAL NERVOUS SYSTEM

The Impact of 21st Century Curriculum & 4.0 Technologies



UTM New Academia Learning Innovation (NALI)
21st Century Learning Model to support 4IR



	New academia academia	Action
Faculty members	Professors, inventors, entrepreneurs	Adjunct staff, fellows
Learning materials	Books, journals, experiences, Internet, internship	Internship, students' business venture
Philosophy	Integration	New pedagogy, RA
Funding	Grants, fees, VC, endowment, REITs	Creative fund raising
Students	School leavers, mid-career, businessmen, early-career, life-long	Top UG; PG from corporations, research
Venue	Campus, Internet, incubators, brands	Wifi, 4G, MTDC, Proton
Learning modes	Lectures, tutorials, lab, studios, peer instruction, internship, incubators, experiential learning, 5 minds	**NEW PEDAGOGY:** learner-centric, Silicon V-culture, **GOP**, ethics
Outcomes	Degrees, expertise, business models, capital, networks, culture	**JOB CREATION**; micro-credit, spin-off, projects

UTM

The impact on people

"One of the features of this 4th Industrial Revolution is it doesn't change what we are doing but it changes us" – It changes the role of educators in UTM!

Focus:
Open access learning (BLOSSOMS, MOOC, STEMazing etc.) with pedagogy, andragogy, and heutagogy approaches enhances creativity, reduce gaps (every individual poor or rich able to get access to quality education), empower many people to improve their living conditions.

Source:
http://www3.weforum.org/docs/WEF_EGW_Whitepaper.pdf

innovative • entrepreneurial • global

Initiatives related to 4IR CTL, UTMLead

NALI 21st Century learning

"Future-ready' curricula: Design and deliver interventions that strengthen STEM skills, employability skills, and/or global citizenship skills

MOOC

- A new deal on lifelong learning
- Adult learners: It is vital to ensure that the 3 billion people already in the workforce get access to quality training and learning opportunities;
- Other than andragogy and pedagogy, HEUTAGOGY approach is required to cater professionals/ working individuals .
- Develop more MOOC Courses for Technical and vocational education and training (TVET)

BLOSSOMS & STEMazing

- While increasing the STEM-literacy of the population is certainly very important, currently these subjects are often taught in a way that reinforces a disconnect between sciences and humanities and existing education gender gaps, and focuses on theory over application and experiential learning
- bridging gap between lower and higher education
- Teachers have regular opportunities to refresh their own skills and knowledge.

Source: http://www3.weforum.org/docs/WEF_EGW_Whitepaper.pdf

UTM

21st Century Curriculum for Engineering Education

Redefining the role of an engineer

- Developer of technology for society
- Participant in the societal process through which technology shapes society
- Integration of science and the humanities

Engineer of the 21st Century needs to develop competence not only in **technical** matters, but also in **humanistic** concerns

- **Humanistic** – understanding oneself and how one relates to nature and to the social environment
- **Does not** mean taking a few extra courses in the humanities or take a double major
- **Bridge the gap** inherent in the reductionist paradigm; the need for integration

Curriculum Reform

- Holistic curriculum
- Engineering ethics and societal values
- Shift of focus from problem solving to problem formulation
- Communicate about the costs (i.e. risks) of complex technology as well as its benefits
- Globalization and producing "flexible" engineers

The need to broaden and strengthen engineering curriculum

Essential Elements

- New context based on shift from linear to nonlinear paradigm
- New and revised content consistent with this context
- New and existing pedagogical approaches for reinforcing the context and supporting the delivery of the content

Implication of newest technology

Change in Paradigm	
Reductionist	**Holistic**
• Engineer is considered to be separate from and independent of the technical system that he or she is developing • Technology is assumed to be value neutral and engineer's personal point of view is considered irrelevant	• Engineer is understood to be part of the technical system in that his or her point of view and values are necessarily expressed in the technology • To act responsibly, the engineer must understand the implications of this recursive relationship

Principle of Context

World perceived as machine, engineer as mechanic - linear

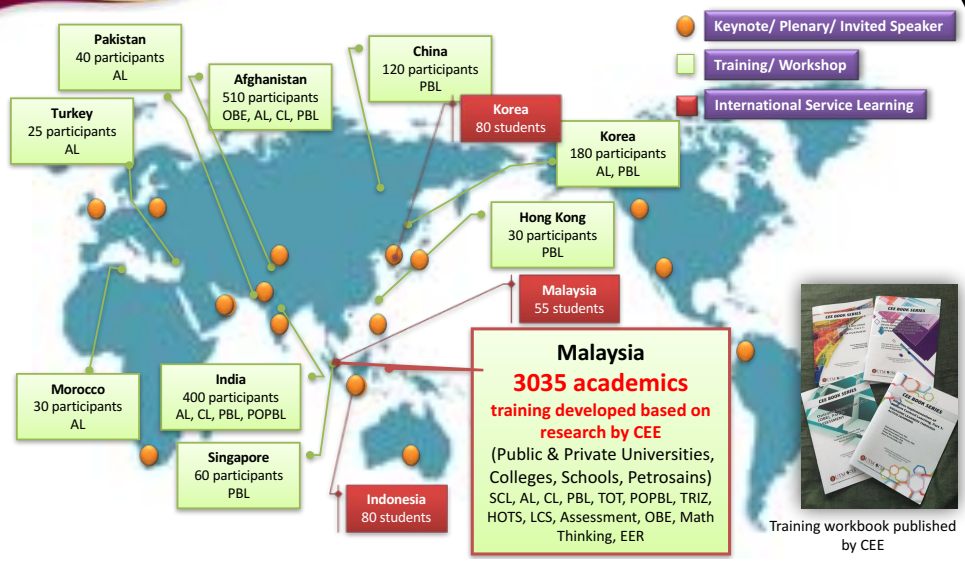
World is alive as complex adaptive system, engineer is apart – nonlinear

- Analogy: magnetic field that gives shape and meaning to the content
- Shaking up the curriculum (content and pedagogy) without reorienting the field (context) may produce some temporary changes
- Contextual shift is from **linearity** to **nonlinearity**

innovative • entrepreneurial • global www.utm.my

Reference & platform for community of practice in Training & Research in Engineering Education

UNIVERSITI TEKNOLOGI MALAYSIA
CEE
CENTRE FOR ENGINEERING EDUCATION



Malaysia
3035 academics
training developed based on research by CEE
(Public & Private Universities, Colleges, Schools, Petrosains)
SCL, AL, CL, PBL, TOT, POPBL, TRIZ, HOTS, LCS, Assessment, OBE, Math Thinking, EER

Training workbook published by CEE

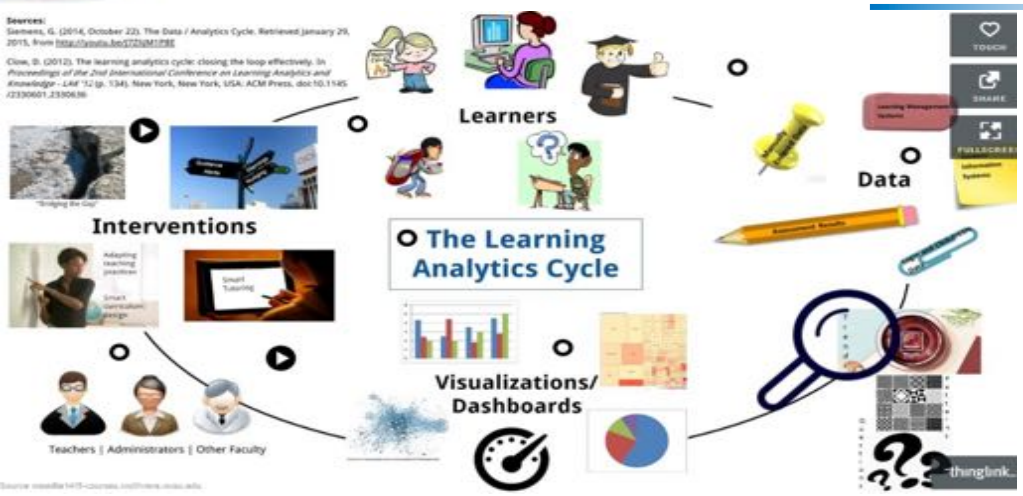
AL: Active Learning, CL: Cooperative Learning, OBE: Outcome Based Education, PBL: Problem Based Learning, POPBL: Project Oriented Problem Based Learning, TOT: Training of Trainers, TRIZ: Theory of Inventive Problem Solving, HOTS: Higher Order Thinking Skills, EER: Engineering Education Research

Learning Analytics: Data and Social Media

UTM4.0 4th INDUSTRIAL REVOLUTION

DIGITAL NERVOUS SYSTEM

Learning Analytics



Learning Analytics: Improvements in Teaching Practice

Innovative Research Universities

Malaysian Research University Network

Headline findings

- A lot of interest about learning analytics in both countries.
- At different stages of development in terms of the learning analytics journey.
- The use of an LMS varies considerably between countries and that influences the survey findings in terms of usage and relevance.
- Expectations and understandings vary considerably due to context and infrastructure.
- Professional development – more interest in attending in Australia when it is offered. In Malaysia it is not available.
- Interesting finding regarding ethical concerns which could be a reflection of institutional policies, understandings or cultural difference.

UTM

Google Online Marketing Challenge

Google ADWORDS

The Google Online Marketing Challenge is a unique opportunity for students to experience and create online marketing campaigns using Google AdWords. Over 110,000 students and professors from almost 100 countries have participated in the past 9 years.

Noor Hazarina Hashim (Malaysia) is a Senior Lecturer at Universiti Teknologi Malaysia. She teaches E-Marketing, E-Business and other marketing courses to both graduate and undergraduate students. Dr Hazarina earned her PhD from The University of Western Australia, and her research and consultation interests include effective Internet use in organizations, application of Internet in tourism industry and destination marketing. Dr Hazarina's passion is teaching, and she believes that learning goes beyond the classroom. Her publications have appeared in Tourism Management, Journal of Computer Mediated Communications, International Journal of Hospitality Management and Journal of Information Technology and Tourism.

The Global Academic Panel

innovative • entrepreneurial • global www.utm.my

Digital Transformations (DX)

UTM

innovative • entrepreneurial • global www.utm.my

The **application of 3rd Platform**–related technologies to **fundamentally change the way something is done**, generally with a **design-led approach** to business process redesign.

DX

IDC

Source: IDC Digital Transformation Research Practice, 2017

@DZ_Jimenez

WHAT IF...

PROFITABILITY

NET PROMOTER SCORE

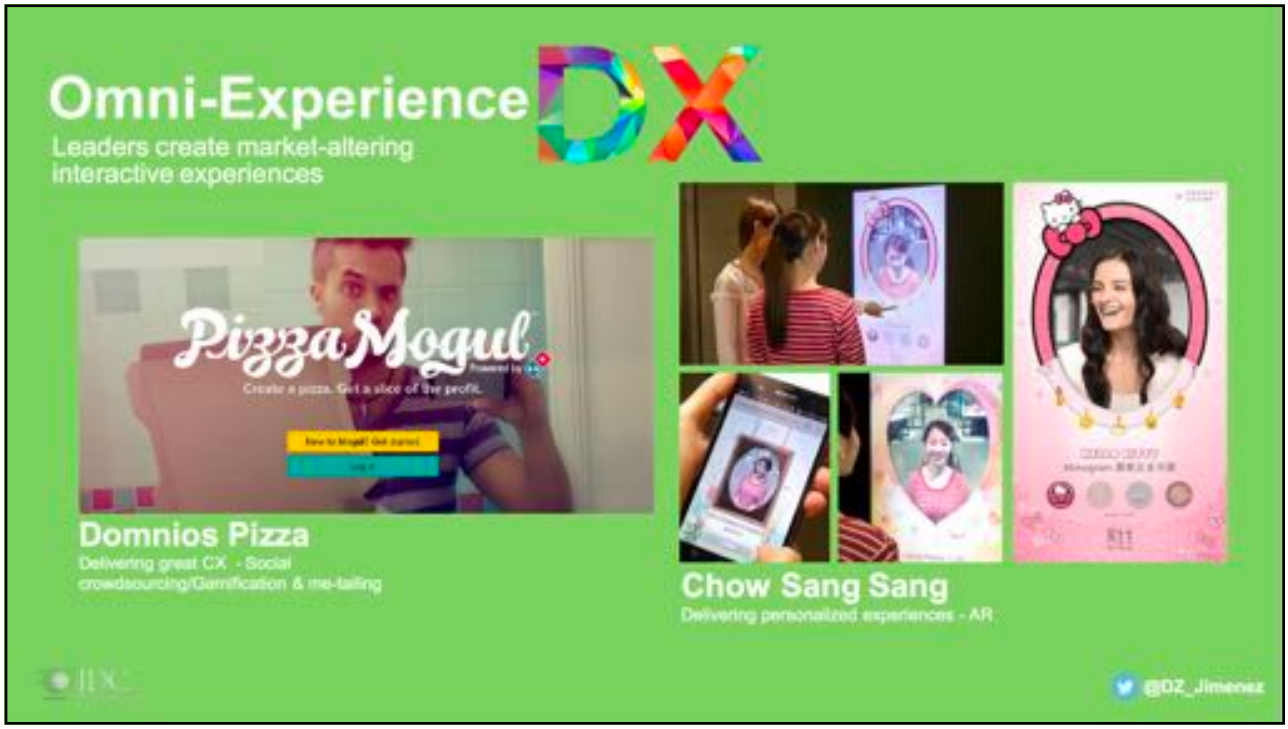
CUSTOMER ACQUISITION

IDC

@DZ_Jimenez

The DX Journey
Leadership transformation
Omni-experience transformation
Information transformation
Operating model transformation
Worksource transformation
Data
Strategy
Technology
People
Process
IDC
@DZ_Jimenez

Which areas are being transformed?
Leadership transformation
An "Outside In" Business Environment
Omni-experience transformation
Blend Physical and Digital Experiences
Information transformation
Information as a Competitive Advantage
Operating model transformation
New Digital Revenue Streams
Worksource transformation
Ecosystem-based Workforce
IDC
Source: IDC Digital Transformation Research Practice, 2017
@DZ_Jimenez


Omni-Experience DX
Leaders create market-altering interactive experiences
Pizza Mogul
Domnios Pizza
Delivering great CX - Social crowdsourcing/Gamification & me-tailing
Chow Sang Sang
Delivering personalized experiences - AR
@DZ_Jimenez

UTM
Domino Pizza Mogul

Information DX

Leaders leverage information effectively for competitive advantage

Kroger, Tesco

Data monetization. Leveraging customer data for improved service and loyalty

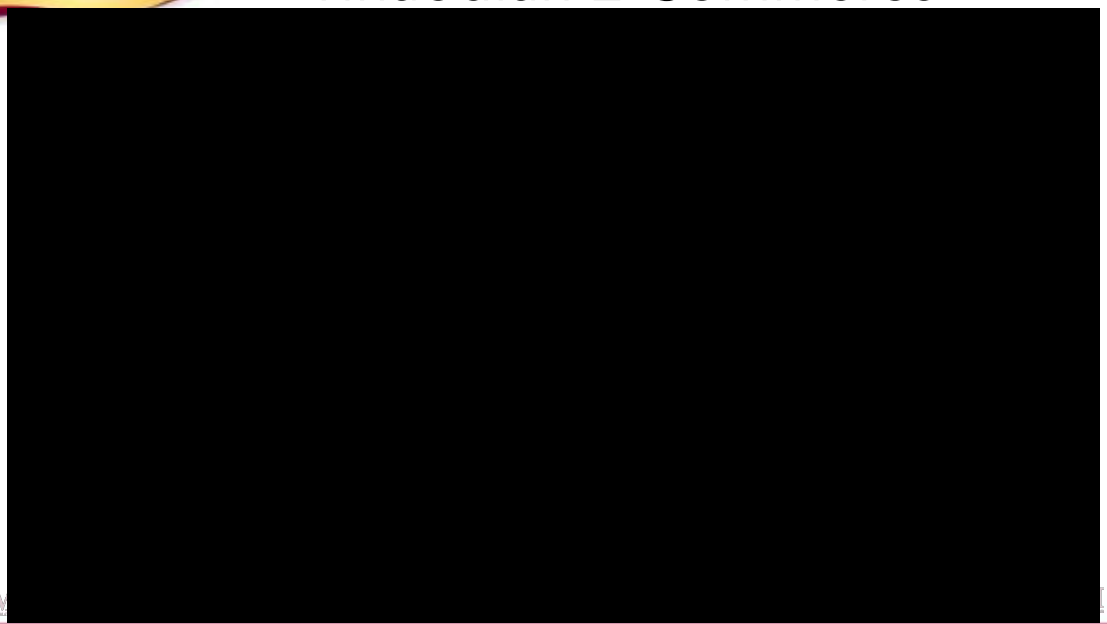
Beam

A startup building an insurance business around a smart toothbrush (usage-based insurance–Smart premiums)

IDC

@OZ_Jimenez

Yihaodian E-Commerce



Operating Model

Leaders challenge traditional business and operating models

Yihaodian

Challenging traditional retail models with augmented reality

TeatreNeu

Disrupting the arts scene with an innovative business & operating model

@DZ_Jimenez

Pay Per Laugh

Conclusion & Future outlook

- Challenges of future jobs
- Disruptive innovations
- Individualization of learning
- Accreditations of higher education academic programs
- Innovations as key for University 4.0
  - Inequality represents the greatest societal concern associated with the Fourth Industrial Revolution

Thank You

aselamat@utm.my

Sources:

1. Jaafar, I. (2017). *Transforming Malaysian Higher Education – 2025 and Beyond*, Seminar Pelan Global UTM 2012-2020 (Fasa III: 2018-2020), Universiti Teknologi Malaysia, Johor Bahru, 12 March 2017.
2. Ministry of Education, Malaysia (2015). *Malaysia Education Blueprint (2015-2025) (Higher Education): Executive Summary.* Putrajaya, Malaysia: Ministry of Education.
3. Ministry of Higher Education, Malaysia (2017a). *New Year Address 2017 By the Hon. Minister.* Putrajaya, Malaysia: Malaysia Ministry of Higher Education.
4. Ministry of Higher Education, Malaysia (2017b). *Soaring Upwards: Malaysian Higher Education 2015/2016.* Putrajaya, Malaysia: Malaysia Ministry of Higher Education.