Educating Future Engineers in the Age of Digital Disruption

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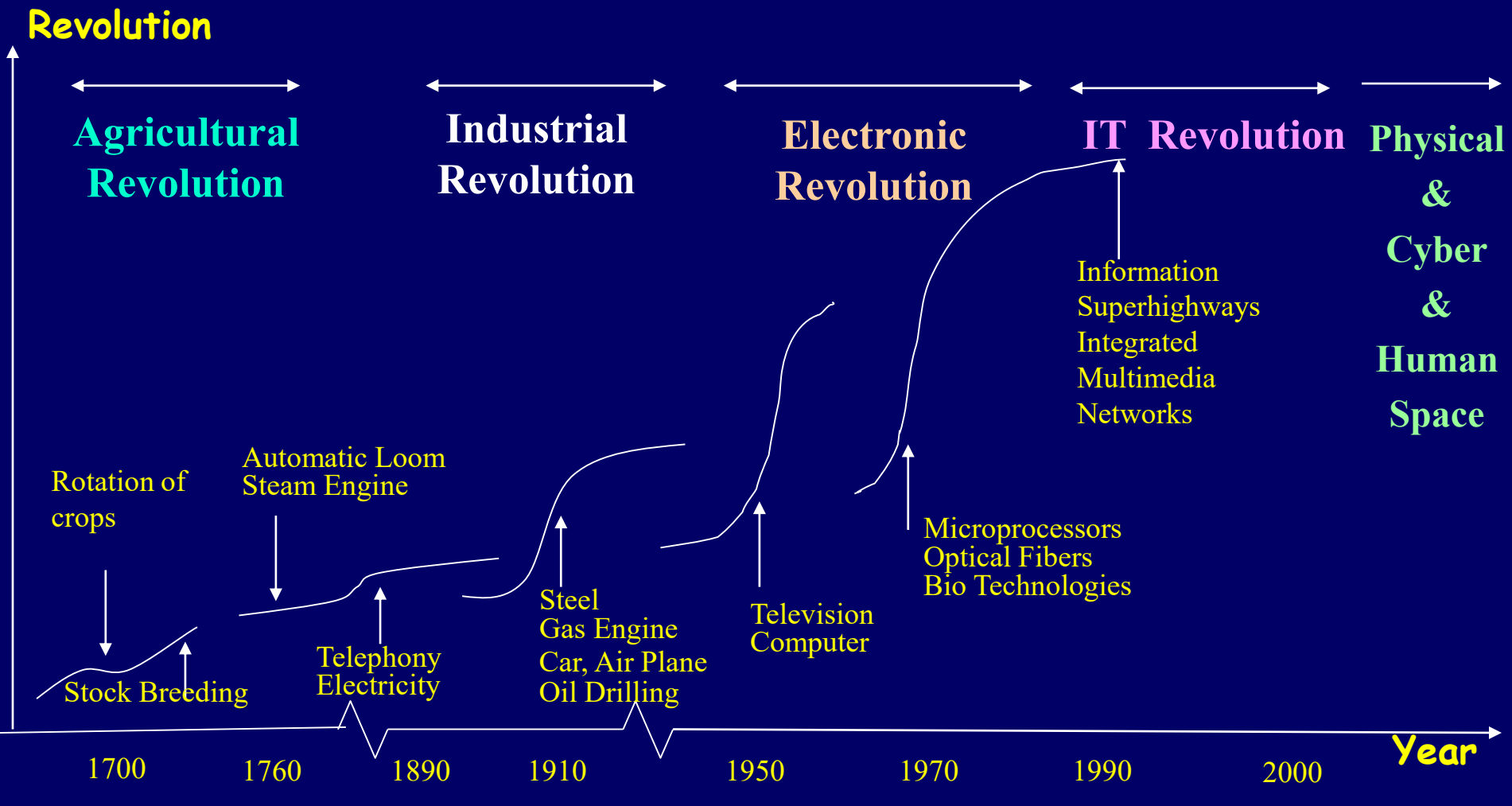
Overview

- Mobility of Engineering Team
- Engineering Education
- Skill Outlook for Future Graduates
- Training of Ready-to-Evolve Engineers
- Complex Problem Solving Skills & Evidence-based Engineering Solution
- International Collaboration
- Concluding Remarks

Waves of Technological Revolution



Trends in the Globalised World:

Past and Current

- Small Group of Experts
- Hardware
- Big Capital Investment
- Controlled Environment
- Local Markets
- Single Specialisation
- Manual/Semi-Auto

Future

- Human Centric
- Knowledge Creation
- Software
- Small Investment
- Global Market
- Free and Open Market
- Multi-disciplinary
- Automation/AI

Roles of Engineering Team

Engineer Graduate	Engineering Technologist Graduate	Engineering Technician Graduate
Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization respectively to the solution of complex engineering problems	Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to defined and applied engineering procedures, processes, systems or methodologies	Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to wide practical procedures and practices

Global Mobility of Engineering Team

- Movement of Globally Engineering Professionals who are capable of Independent Practices
- Examples of Understanding/Agreements for Mobility of Engineering Professionals:

❖ ASEAN Chartered Professional Engineers Register
❖ International Professional Engineers Agreement (formerly EMF)
❖ APEC Engineers Register
❖ International Engineering Technologist Agreement
❖ Agreement for International Engineering Technicians

Engineering Education for Public Good

- What is good for the Development of the Country?
- What is good for the Industry in the Country?
- What is good for one country/region may not be suitable for another country/region in terms of human resource requirement.
- It is important that the Scientists, Engineers and Technologists must contribute towards economic growth of the country and be able to support the industry.

Be Trend Setters, Be Catalysts of Change

Engineering Education

- **Strengthening of the Fundamentals**
- **Development of Analytical Mind**
- **Knowledge Exploration**
- **Self-Development**
- **Social Network Linkage**
- **Surviving Constraint Challenges**

Engineering Education

- **Deep Expertise in one's specialization**
- **Broad Knowledge across many domains – engineering, management, communications, leadership etc**
- **Collaboration with team members from diverse background**
- **Communication and Negotiation Skills**

Main Challenges in Engineering Education

- Democratization of Education
- Knowledge-based Digital Economy
- Keen Competition
- Globalisation & Internationalisation
- New Emerging Areas
- Graduate Employability
- Human Networking
- Incorporating Sustainable Development Goals

Study report "The Future of Jobs" in 2016 by World Economic Forum

Significant Highlights:

- Digital Technologies, combined with other Socio-economic and Demographic Changes, will transform labour markets in the next five years, leading to a net loss of over 5 million jobs in 15 major developed and emerging economies.
- There will be new 2 million jobs created in digital industrial and services sectors, and there will be 7 million job loss in the traditional industrial and services sectors.
- 65% of children entering primary school today will ultimately end up working in completely new job types that don't yet exist.

Paradox: BUT WE ALWAYS READ ABOUT SHORTAGE OF HUMAN RESOURCES – KEY is are WE GOOD ENOUGH?

Annual Meeting of the New Champions (2018) by Vesselina Stefanova Ratcheva and Till Leopold, World Economic Forum

1. Automation, Robotization and Digitization look Different across Different Industries

   Humanoid Robots (23%) - Financial Services & Investors

   Stationary Robots (37%) – Automotive, Aerospace, Supply Chain

   Aerial & Underwater Robots (19%) – Oil & Gas

   Non-humanoid Land Robots (33%) – Automotive, Aerospace, Supply Chain

Annual Meeting of the New Champions (2018) by Vesselina Stefanova Ratcheva and Till Leopold, World Economic Forum

2. Net Positive Outlook for jobs

By 2022, Newly emerging occupations grow from 16% to 27%, while jobs currently affected by technological changes decrease from 31% to 21%

75 million current jobs replaced, 133 million new jobs

THERE WILL BE JOBS – JUST HOW PREPARED YOU ARE!!!

We are in the State of Anxiety

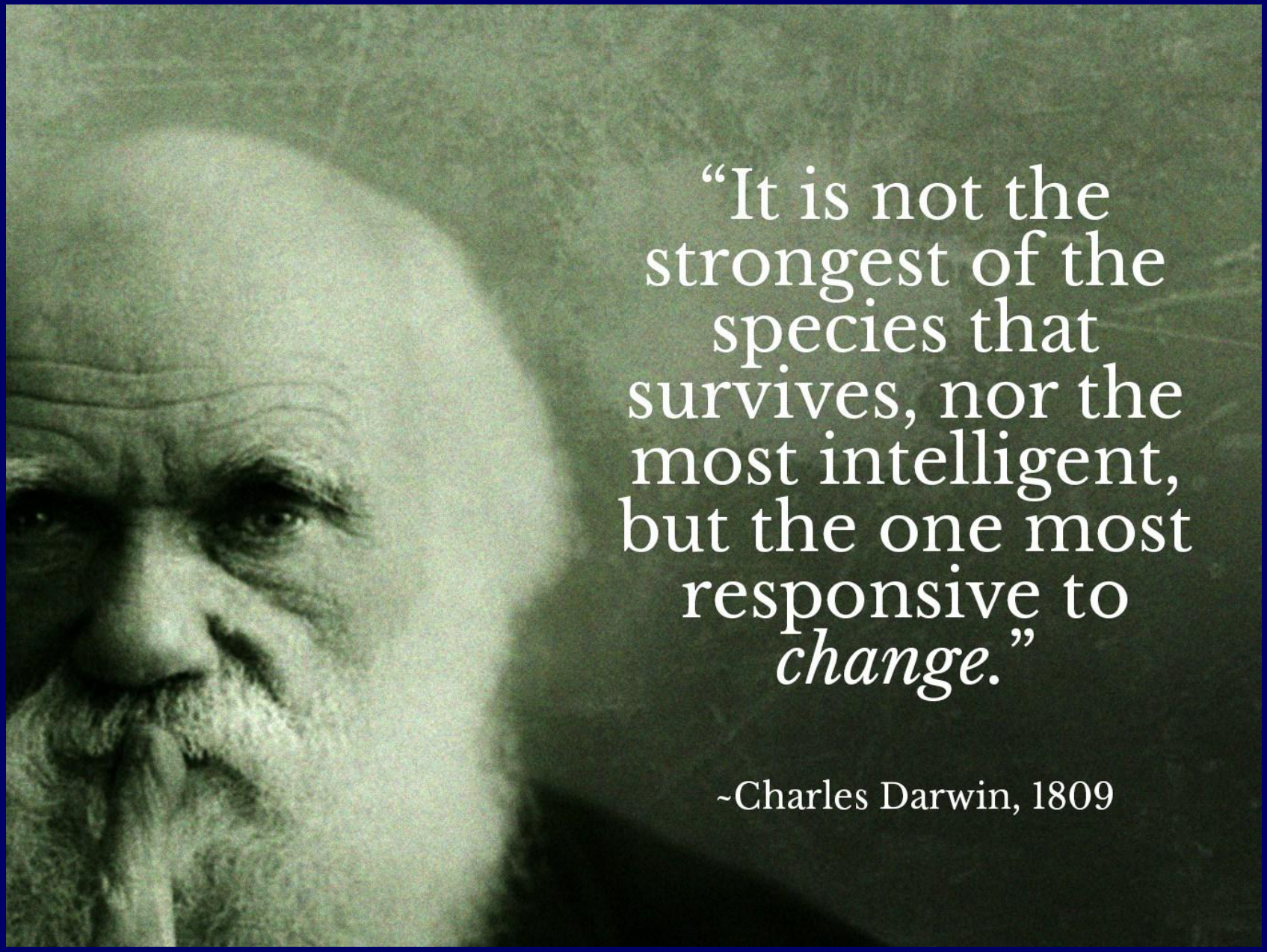
When Industry Development is ahead of Education, we have **Anxiety**

We are not sure of the Disruptive Technology

We are not sure of the Future Requirements of Industry

We are not sure of the Market Trends

WE MUST CONTINUE TO DO THE RIGHT THING


"It is not the strongest of the species that survives, nor the most intelligent, but the one most responsive to *change*."
~Charles Darwin, 1809

Points to Ponder

- Wholesome Individuals with High Moral and Ethical Values, and Analytical Minds?
- How to help to Train our Students to have Inquisitive Minds?
- How to give International Exposure to the Students?
- How to help to develop their Interests and Potentials via personalized education?
- What kind of Soft or Professional Skills and Hard Skills does one need?
- *What is the Balance between "Ready-to-Market" and "Ready-to-Evolve" Training (Utilitarian versus Scholarly?)?*
- How to train a Person with Globalised Outlook with Cultural Intelligence?
- How to train Graduate to solve *Complex Problem*?

Outcome-Based Engineering Education

OBE develops:

- Lifelong Learner
- A knowledgeable person with deep understanding
- Complex Thinker
- Creative Person

- Active Investigator
- Effective Communicator
- Participant in an Interdependent World
- Reflective and Self-Directed Learner

Tertiary Education

OR

No Bean Counting:
Focus on the forest, not just the tree
Don’t Miss the Forest

Training of Ready-to-Evolve Graduates 1/2

- Solid Fundamental of Engineering Sciences in First 2 Years of the Programmes: Mathematics, Material Sciences, Electromagnetics, Thermodynamics, Dynamics and Kinetics etc.
- In First 2 years, while training students on basics, more engineering application examples be incorporated in lectures. More open ended assignment and projects related to everyday life and contemporary issues to be introduced
- More elective options for students (flexible for Faculty to introduce, to review, to remove) in 3rd and 4th Year as and when technology changes: Data Science, Renewable Energy, 5G/6G, AI, VR, MR, IoT, BlockChain, Cloud Computing
- Promote exchange of students internationally
- Professional Skill-sets to be introduced in lectures/tutorials and SOFT-SKILL Certificate System

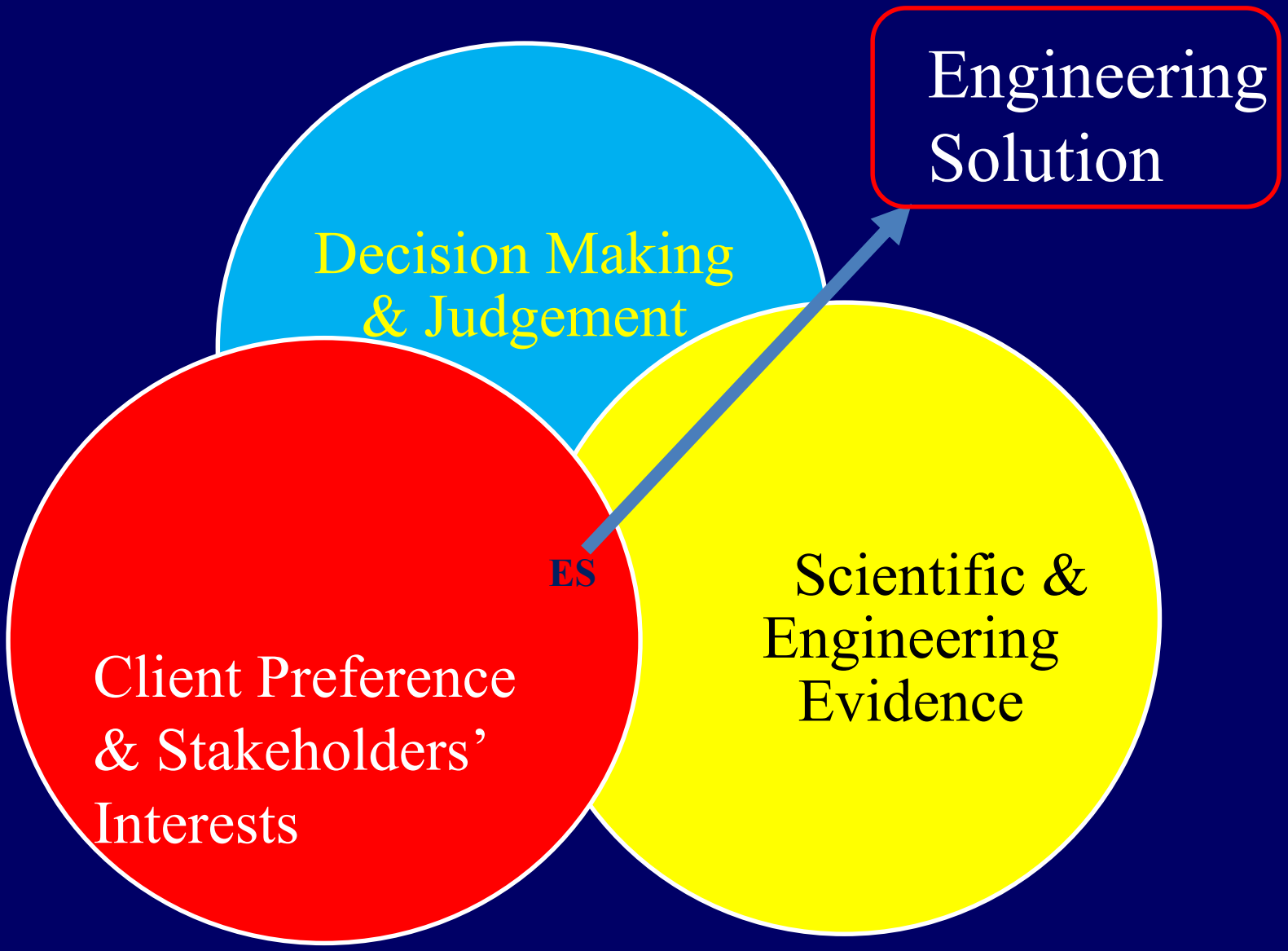
Training of Ready-to-Evolve Graduates 2/2

- Work with Industry Players to give exposure and real life application examples in lectures/assignment and site visits
- Allow peer teaching in tutorials and laboratory sessions – the best test of own's knowledge and understanding
- Students must be trained to be independent, decisive, team players and be life-long learners, with high ethical values, social responsibility and cultural intelligence

Engineering Solution by Engineers

Design **creative solutions** for *complex* engineering problems and design systems, components or processes to meet identified needs with appropriate consideration for **public health and safety**, whole-life cost, **net zero carbon** as well as resource, cultural, societal, and environmental considerations as required

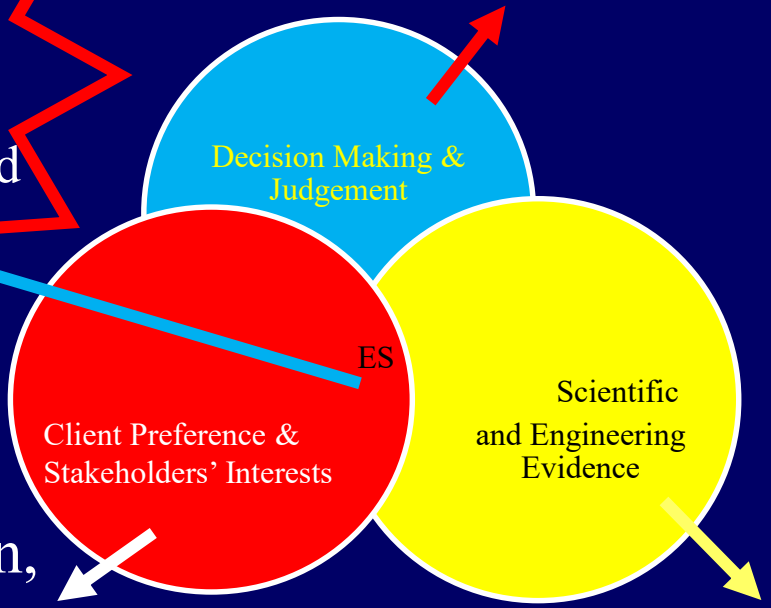
Engineering Solution



Engineering Solution

Comparison of Solutions, Cost Effectiveness, Using Relevant Tools, Selection of Best Solution,
Judgement, Decision Making

Engineering Solution based on Sound Judgement – Education Outcomes Demonstrated



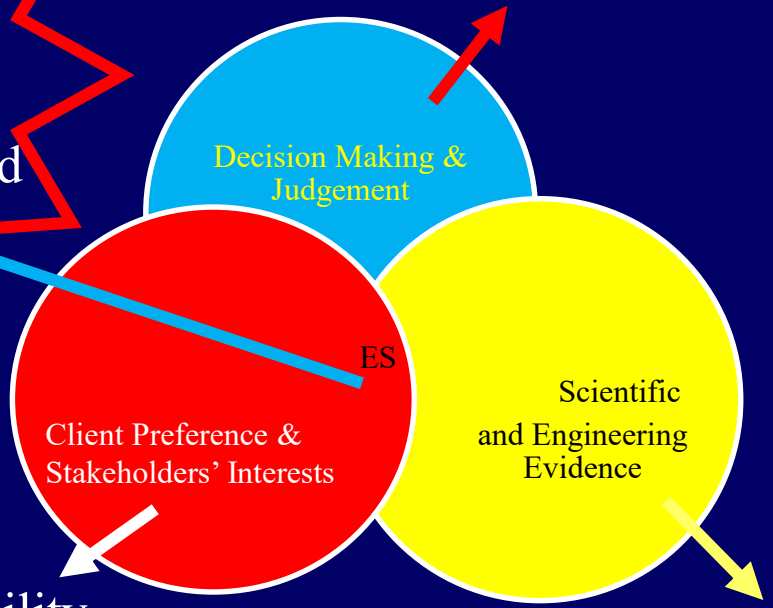
Collecting Information, Negotiation, Values, Resolving Conflicting Issues & Interests, Convincing Stakeholders

Research, Experiences of Others, Relevant Engineering Principles and Scientific Theories and Methods

Education Outcomes: Engineering Solution

Design & development of Solution, Modern Tool Usage, Individual & Teamwork, Project Management & Finance

Engineering Solution based on Sound Judgement – Education Outcomes Demonstrated



Engineer & Society, Environment & Sustainability, Ethics, Individual & Teamwork. Communication, Project Management & Finance

Engineering Knowledge, Problem Analysis, Investigation, Lifelong Learning

In Line with UN Sustainable Development Goals

Goal 1: No Poverty
Goal 2: Zero Hunger
Goal 3: Good Health and Well Being
Goal 4: Quality Education
Goal 5: Gender Equality
Goal 6: Clean Water and Sanitation
Goal 7: Affordable and Clean Energy
Goal 8: Decent Work and Economic Growth
Goal 9: Industry, Innovation and Infrastructure

via Best Practices in Engineering Profession/Projects, and Innovative Engineering Solutions

In Line with UN Sustainable Development Goals

Goal 10: Reduced Inequalities
Goal 11: Sustainable Cities and Community
Goal 12: Responsible Consumption and Production
Goal 13: Climate Action
Goal 14: Life Below Water
Goal 15: Life on Land
Goal 16: Peace, Justice and Strong Institutions
Goal 17: Partnerships for the Goals

via Best Practices in Engineering Profession/Projects, and Innovative Engineering Solutions, Mobility of Engineering Personnel for Development and Smart Partnership

How are Complexity and UN Sustainable Development Goals integrated into the curriculum?

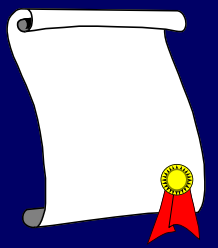
- Final Year Project – Real-life *Complex Problem Solving*
- Industrial Placement
- Design Project – Real-life *Complex Engineering Activities*
- General Courses
  - Core & Specialist (Engineering) Courses
  - Elective Courses

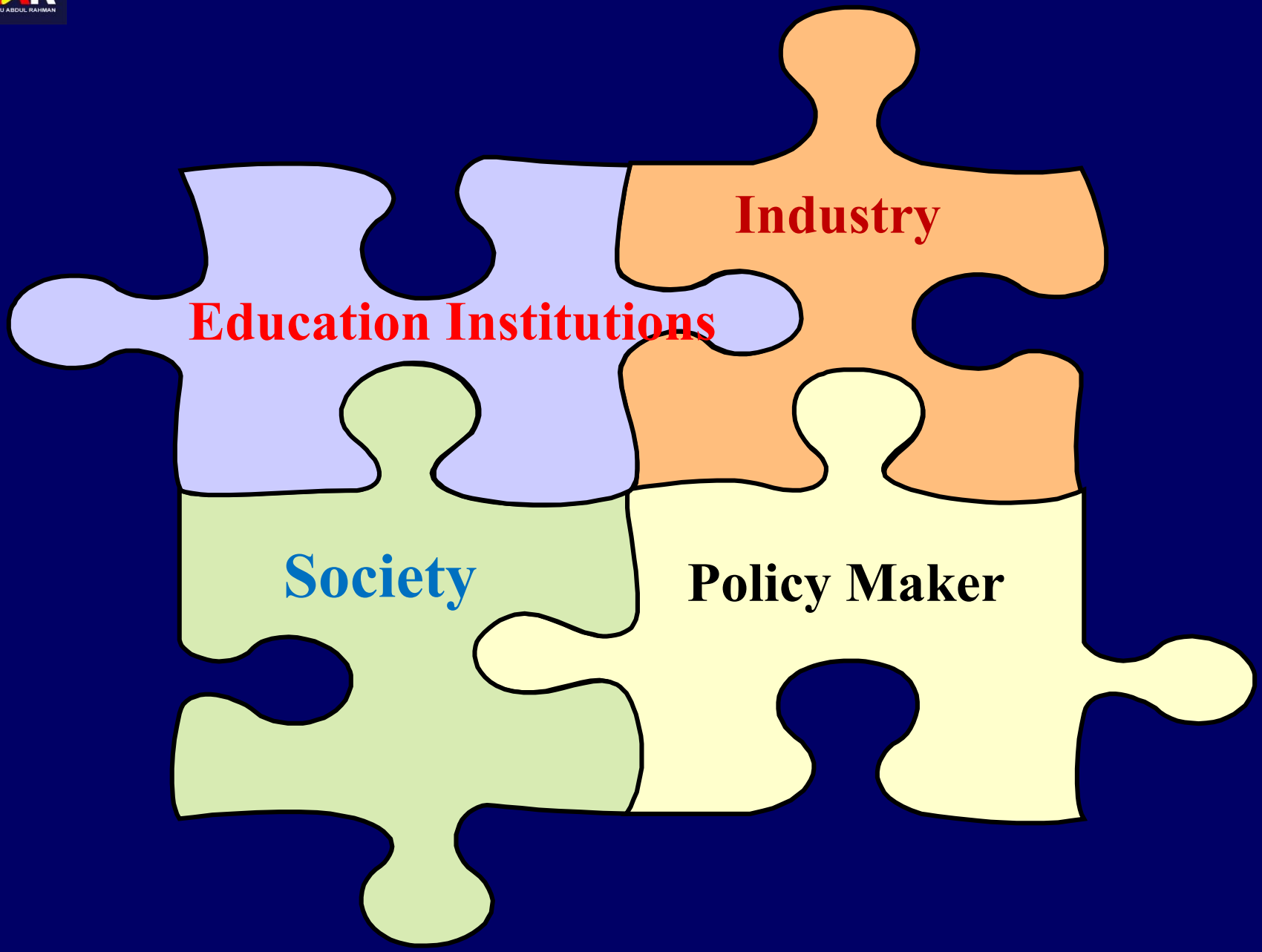
  with Open-ended Questions and Assignment

International Cooperation

- Malaysia – 33 million
- AEC – 640 million
- AEC+China+Korea+Japan+Australia+New Zealand – 2.3 billion (RCEP Nov 15, 2020)
- Belt and Road Initiative:

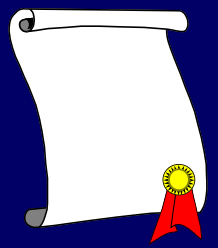
  55% world GNP, 75% energy reserves, 70% population
- Capitalise on our Strength and Complement Each Others
- Global Market and Thus Human-Network




Industry
Education Institutions
Society
Policy Maker

Apply 3 IC's

- **Integrity & Competence**
- **Integration & Communications**
- **Internationalisation & Cooperation**



Final Take-Away

- Your Values determine your Code of Conduct
- Your Global Perspective determines your Order of Thinking
- Your Life Outlook determines your Life Pursuit


thank you
gracias
danke
謝謝
merci
obrigado
dziękuję
bedankt
ngiyabonga
teşekkür ederim
go raibh maith agat
mochchakkeram
sukriya
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terima kasih
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