Program Evaluator Training for ET, SC & BM
(Academics)

8th Oct 2019, New Council Hall, 1st Floor, IEB HQ, Ramna, Dhaka, Bangladesh
16.00 – 17.40 (1hr 40mn)
18.00 – 20.00 (2hr)

Megat Johari Megat Mohd Noor

BEM Board Member & P.Eng.
MySET President & Fellow
MJIIT Professor (Retired)

EAC Chair
Megat Johari MEGAT MOHD NOOR

Board Member, BEM
Chair, Engineering Accreditation Council (EAC), BEM
Council Member, Engineering Technology Accreditation Council (ETAC), BEM
Professional Engineer with Practicing Certificate, BEM
Founding Director, Engineering Accreditation Department, BEM
Associate Director (International), Engineering Accreditation Department (EAD), BEM
President & Fellow, Malaysian Society for Engineering & Technology (MySET)
Vice President, Federation of Engineering Institutions of Islamic Countries (FEIIC)
Former Vice-President & Fellow, Institution of Engineers Malaysia (IEM)
Former Director, Centre for Quality & Risk Management (QRiM), UTM
Former Professor & Founding Dean, Malaysia Japan International Institute of Technology (MJIIT), UTM
Former Head, Department of Civil Engineering, UPM
Former Head, Quality Unit, Faculty of Engineering, UPM
Member, Malaysia Research University Committee, MoHE

9 October 2019
Introduction
Engineering & Engineering Technology Domains

Research & Design
- Strong in Mathematics, Engineering Sciences, Professional courses (Theoretical)
- Engineering Breadth & Depth of Curricula

Supervision & Maintenance
- Appropriate Mathematics, Engineering Sciences, Professional courses (Practical)

Education

Engineers

Work

Engineering Technologists
Career Paths

PROVISION OF ENGINEERING SERVICES

Domain

Research & Design
- Research
- Consultancy

Building, Operation & Maintenance
- Construction
- Operation
- Maintenance

Career Path

Graduates of Civil, Mechanical, Chemical Engineering Technology Programmes

Graduates of Civil, Electrical, Mechanical, Chemical Engineering Technology Programmes
Accreditation
Accreditation Issues & Challenges

• Engineering education is to prepare graduates to face challenges of the future while meeting the current needs

• Paradigm Shift – **Outcome & Quality**

• Maintain **Fundamentals** while Encourage Inclusion of Latest Technology Advancement in the Curriculum

• Allow Academic **Innovation** and **Creativity**

• Variety of Modes of **Delivery**
The Dilemma

• Educational **delivery** systems may **change** dramatically
• Traditional educational providers will be different in the future – the **Mosaic degree**
• **Boundaries** between traditional disciplines will be increasingly **fuzzy**
• Exciting technical areas will be at the **boundaries of engineering and non-engineering disciplines**
Importance of Accreditation to Institutions of Higher Learning

• Recognises institutional missions and goals
• Involves faculty/staff in evaluation and planning
• Assists institutions in determining the acceptability of transfer credits
• Promotes “best practices” in education
• Increases visibility and reputation of the institution
• Aids engineering schools to identify required operational resources to institution management
Importance to the Profession

• Ensures that graduates have **met the educational requirements** to enter the profession
• Enhances the **mobility of graduate** professionals
• Provides **professional development** for faculty and industry practitioners
• Provides opportunity for the profession to **guide the educational process** to reflect current and future needs
Washington Accord Review
Bangladesh Washington Accord Route (till 2020?)

- **Nominator**
  - First visit: ....
  - Provisional Status: ....

- **Previous Mentor**

- **Current Mentor**

- **1a Reviewer (........)**
  - Visit: 2019 ?

- **1b Reviewer (ADM)**
  - Visit: 2019 ?

**Nominators**

- **Mentors**
  - Prof Wan (MAL)
  - Prof Siti (MAL)
  - Prof Lock (SIN)

**Reviewers**

- Full Signatory in Jun 2020
- at IEAM Cape Town, South Africa ?
WA is a long arduous journey and lonely......
Common Questions on Outcome Based Education (OBE)

• What is OBE?
• Why OBE?
• When to start OBE?
• Who to develop and implement OBE?
• Where are the facilities for OBE?
• How to develop and implement OBE?
Why do we need OBE?

Who is that Smart Aleck who brought this OBE idea?

This is American (WASHINGTON) hegemony!

We have been graduating students with flying colours.
Preparation - Key Factors

- Accrediting Body
- Management Commitment
- Full Time Champion & Committed Knowledgeable Team
- Panel Evaluators Training & Commitment
- Institutions of Higher Learning Training & Commitment
- Financial Commitment
Universities at Threshold

Universities

1st Quartile

2nd Quartile

3rd Quartile

4th Quartile

Univ 1

Univ 2

Threshold

Prog 1

Prog 2

Prog 1

Prog 2
Itinerary of Reviewer Visit – an example

<table>
<thead>
<tr>
<th>Date</th>
<th>Activities</th>
<th>Venue</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-6 Nov</td>
<td>Arrival of Washington Accords Reviewers</td>
<td>Royale Chulan, Kuala Lumpur &amp; Sama-Sama Hotel KLIA</td>
</tr>
<tr>
<td>7 Nov</td>
<td>Meeting with Washington Accords Reviewers</td>
<td>Sama-Sama Hotel, KLIA</td>
</tr>
<tr>
<td>7-9 Nov</td>
<td>Accreditation Visit to Univ 1</td>
<td>Philea Resort &amp; Spa, Melaka &amp; Univ 2</td>
</tr>
<tr>
<td>10 Nov</td>
<td>Visit Melaka Historical City</td>
<td>Philea Resort &amp; Spa, Melaka</td>
</tr>
<tr>
<td>11 Nov</td>
<td>Dinner with BEM</td>
<td>Royale Chulan, Kuala Lumpur &amp; KL Tower</td>
</tr>
<tr>
<td>12-14 Nov</td>
<td>Accreditation Visit to Univ 2</td>
<td>Lights Hotel, Penang &amp; Univ 2</td>
</tr>
<tr>
<td>15 Nov</td>
<td>Departure</td>
<td>Penang International Airport</td>
</tr>
</tbody>
</table>
Programme Evaluators (PEVs)

- **Chair** *(Criteria of appointment)*
- **Two members** *(Criteria of appointment)*
  - knowledgeable
  - trained
  - independent
EAC Panel Evaluators – Capacity Building

<table>
<thead>
<tr>
<th>Year</th>
<th>No of Trained Evaluators (Cumulative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>148</td>
</tr>
<tr>
<td>2020</td>
<td>200</td>
</tr>
<tr>
<td>2021</td>
<td>300</td>
</tr>
<tr>
<td>2022</td>
<td>400</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>No of Trainings</th>
<th>No of Candidates</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>2020</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>2021</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>2022</td>
<td>4</td>
<td>100</td>
</tr>
</tbody>
</table>
EAC Documents

EAC Engineering Programme Accreditation Manual 2020
Accreditation Standard

- Malaysia’s evolving accreditation standard from INPUT BASED to OUTCOME BASED

EAC Standard 2020 Criteria

- Students (6.4)
- Programme Objectives (6.1) & Outcomes (6.2)
- Teaching & Support Staff (6.5)
- Facilities (6.6)
- Academic Curriculum (6.3)
- Quality Management Systems (6.7)

Continual Quality Improvement
SAR based on
Board of Accreditation for Engineering & Technical Education
Accreditation Criteria

4.1 Organization and Governance
4.2 Financial and Physical Resources
4.3 Faculty
4.4 Students
4.5 Academic Facilities and Technical Support
4.6 Curriculum and Teaching-Learning Processes
4.7 Program Educational Objectives (PEO)
4.8 Program Outcomes and Assessment
4.9 Continuous Quality Improvement (CQI)
4.10 Interactions with the Industry......
COLD RECEPTION
Some are rigorous
Champion(s) & Teamwork
Triangulation

- Staff
- Curriculum
- Students
- Outcomes
- Facilities
- QMS
Directed & Coherent Curriculum
Graduate Relevant to Industry

<table>
<thead>
<tr>
<th>Programme Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(after 3-5 Years)</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Programme Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(at Exit)</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course/Unit/Learning Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>(Abilities &amp; Intentional)</em></td>
</tr>
</tbody>
</table>

Outcome Based Education
Outcome Based Education

OBE is a process that involves **assessment** and **evaluation** practices in education to reflect the **attainment** of expected **learning** and **showing mastery** in the programme area.
Characteristics of OBE curricula

• Have **programme objectives, programme outcomes, course outcomes and performance indicators.**

• Stated objectives and outcomes can be **assessed and evaluated.**

• **Centered** around the needs of the students and the **stakeholders.**
Characteristics of OBE curricula (cont)

• **Learning outcomes** are *intentional* and assessed using suitable performance indicators.

• Programme **objectives** address the graduates attainment in their career within *3-5 years* after their graduation.

• Programme **outcomes** (*abilities* attained by students before they graduate) are formulated based on the programme objectives – **TOP DOWN**.
Characteristics of OBE curricula (cont)

- Programme outcomes address Knowledge, Skills and Attitudes to be attained by students.
- Course outcomes must satisfy the stated programme outcomes. There is no need for ANY (individual) course to address all programme outcomes.
- Teaching/Learning method may have to be integrated to include different delivery methods to complement the traditional Lecturing method.
ENGINEERING PROGRAMME

Education
(Knowledge & Understanding)

Training
(Skill)

Cognitive
(Knowledge – K)

Psycho
motor
(Skill – S)

Affective
(Attitude – A)
Different Levels of Outcomes

Programme Educational Objectives

Programme Learning Outcomes

Course/subject Learning Outcomes

Weekly/Topic Learning Outcomes

Upon graduation

Upon subject completion

Upon weekly/topic completion

Few years after Graduation – 3 to 5 years
Bloom’s Taxonomy

- Knowledge (list)
- Comprehension (explain)
- Application (calculate, solve, determine)
- Analysis (classify, predict, model, derived)
- Synthesis (design, improve)
- Evaluation (judge, select, critique)
# New Bloom’s Taxonomy

<table>
<thead>
<tr>
<th>Remembering: can the student recall or remember the information?</th>
<th>define, duplicate, list, memorize, recall, repeat, reproduce state</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Understanding</strong>: can the student explain ideas or concepts?</td>
<td>classify, describe, discuss, explain, identify, locate, recognize, report, select, translate, paraphrase</td>
</tr>
<tr>
<td><strong>Applying</strong>: can the student use the information in a new way?</td>
<td>choose, demonstrate, dramatize, employ, illustrate, interpret, operate, schedule, sketch, solve, use, write.</td>
</tr>
<tr>
<td><strong>Analyzing</strong>: can the student distinguish between the different parts?</td>
<td>appraise, compare, contrast, criticize, differentiate, discriminate, distinguish, examine, experiment, question, test.</td>
</tr>
<tr>
<td><strong>Evaluating</strong>: can the student justify a stand or decision?</td>
<td>appraise, argue, defend, judge, select, support, value, evaluate</td>
</tr>
<tr>
<td><strong>Creating</strong>: can the student create a new product or point of view?</td>
<td>assemble, construct, create, design, develop, formulate, write.</td>
</tr>
</tbody>
</table>
Psychomotor Domain

(doing, skills)

**Perception**

*Definition:*
Senses cues that guide motor activity.

*Sample Verbs:*
- detect
- hear
- listen
- observe
- perceive
- recognize
- see
- sense
- smell
- taste
- view
- watch

**Set**

*Definition:*
Imitates and practices skills, often in discrete steps.

*Sample Verbs:*
- copy
- duplicate
- imitate
- manipulate with guidance
- operate under supervision
- practice
- repeat
- try

**Guided Response**

*Definition:*
Performs acts with increasing efficiency, confidence, and proficiency.

*Sample Verbs:*
- complete with confidence
- conduct
- demonstrate
- execute
- improve efficiency
- increase speed
- make
- pace
- produce
- show dexterity

**Complete Overt Response**

*Definition:*
Adapts skill sets to meet a problem situation.

*Sample Verbs:*
- adapts
- reorganizes
- alters
- revises
- changes

**Adaption**

*Definition:*
Creates new patterns for specific situations.

*Sample Verbs:*
- designs
- originates
- combines
- composes
- constructs

*Organization*
# Affective Domain

*(feeling, attitudes)*

### Receiving

**Definition:**
- Selectively attends to stimuli.

**Sample Verbs:**
- accept
- acknowledge
- be aware
- listen
- notice
- pay attention
- tolerate

### Responding

**Definition:**
- Responds to stimuli.

**Sample Verbs:**
- agree to
- answer freely
- assist
- care for
- communicate
- comply
- conform
- consent
- contribute
- cooperate
- follow
- obey
- participate willingly
- read voluntarily
- respond
- visit
- volunteer

### Valuing

**Definition:**
- Attaches value or worth to something.

**Sample Verbs:**
- adopt
- assume responsibility
- behave according to
- choose
- commit
- desire
- exhibit loyalty
- express
- initiate
- prefer
- seek
- show concern
- show continual desire to
- use resources to

### Organization

**Definition:**
- Conceptualizes the value and resolves conflict between it and other values.

**Sample Verbs:**
- act upon
- advocate
- defend
- exemplify
- influence
- justify behavior
- maintain
- serve
- support

### Internalizing

**Definition:**
- Integrates the value into a value system that controls behavior.

**Sample Verbs:**
- adapt
- adjust
- arrange
- balance
- classify
- conceptualize
- formulate
- group
- organize
- rank
- theorize

---

Based on “Taxonomy of Educational Objectives”, B.S. Bloom Editor. 1956
Course Outcome (CO) contributing to Programme Outcome (PO)

Ability to function in a multidisciplinary team

- Assign *multidisciplinary design* projects in engineering courses.
- Implement design projects with *multidisciplinary teams*

Exercise:
Identify a course and discuss how it can be implemented
Course Outcome (CO) contributing to Programme Outcome (PO)

Broad education necessary to understand the impact of engineering solutions in a global, environment and societal context + knowledge of contemporary issues

- Include structured **controversies** in engineering course
- Conduct class exercise or homework **problems that involve global/societal issues**

Exercise:
Identify a course and discuss how it can be implemented
Course Outcome (CO) contributing to Programme Outcome (PO)

Life Long Learning

- Teach students about **learning styles** and help them identify the strength and weakness of their styles and give them strategies to improve
- Use **active learning** methods to accustom them to relying on themselves
- Give assignments that requires **library and www searches**
- Anything done to fulfil criteria on: (a) understanding ethical and professional responsibility and (b) understanding societal and global context of engineering solutions, will **automatically satisfy this criteria**
Curricula Models

Distribution of Knowledge, Skills & Attitude elements throughout the 4 years

Yr. 4
Yr. 3
Yr. 2
Yr. 1

K 70%
K 70%
K 70%
K 70%
S&A 30%
S&A 30%
S&A 30%
S&A 30%
PO Attainment

- Final Year Project
- Final Year Design Project
- Final Year Courses
- Third Year Courses
- Second Year Courses
- First Year Courses
Design of subject 1
Design of subject 2
Implement the design
Implement the design
Assess
Assess

PEOs

POs

Improve IAP
EE
Others

Internally Driven CQI
OBE in a nut shell

- **What** do you want the students to have or able to do?  
  - Knowledge, Skill, Affective

- **How** can you best help students achieve it?  
  - Student Centred Delivery

- **How** will you know what they have achieved it?  
  - Assessment

- **How** do you close the loop  
  - PDCA
## Depth of Knowledge Required

<table>
<thead>
<tr>
<th>(WA) Complex Problems</th>
<th>(SA) Broadly Defined Problems</th>
<th>(DA) Well defined Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-depth knowledge that allows a fundamentals-based first principles analytical approach</td>
<td>Knowledge of principles and applied procedures or methodologies</td>
<td>Solved using limited theoretical knowledge, but normally requires extensive practical knowledge</td>
</tr>
</tbody>
</table>
Programme Outcomes or Graduate Attributes

Students are expected to know and be able to perform or attain (knowledge, psychomotor & affective) by the time of graduation

I. **Engineering Knowledge** - Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialisation as specified in WK1 to WK4 respectively to the solution of complex engineering problems;

II. **Problem Analysis** - Identify, formulate, conduct research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences (WK1 to WK4);

III. **Design/Development of Solutions** - Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations (WK5);

IV. **Investigation** – Conduct investigation of complex engineering problems using research-based knowledge (WK8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions;

V. **Modern Tool Usage** - Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations (WK6);
<table>
<thead>
<tr>
<th>Programme Outcomes or Graduate Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>vi. <strong>The Engineer and Society</strong> - Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems (WK7);</td>
</tr>
<tr>
<td>vii. <strong>Environment and Sustainability</strong> - Understand and evaluate the sustainability and impact of professional engineering work in the solutions of complex engineering problems in societal and environmental contexts. (WK7);</td>
</tr>
<tr>
<td>viii. <strong>Ethics</strong> - Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice (WK7);</td>
</tr>
<tr>
<td>ix. <strong>Individual and Team Work</strong> - Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings;</td>
</tr>
<tr>
<td>x. <strong>Communication</strong> - Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions;</td>
</tr>
<tr>
<td>xi. <strong>Project Management and Finance</strong> - Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one’s own work, as a member and leader in a team, to manage projects in multidisciplinary environments;</td>
</tr>
<tr>
<td>xii. <strong>Life Long Learning</strong> - Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.</td>
</tr>
</tbody>
</table>
Focus of Accreditation (the big picture)

- Ensuring the expected engineering education level is maintained (Breadth & Depth)
- Outcome-based Engineering Education (OBE)
- Quality Management System (QMS)
- Continual Quality Improvement (CQI)
Accuracy & Consistency

Panel Evaluators

- Eyes & Ears
- Credibility
- Decorum
- Helicopter View
- Listening

- Triangulate
- Evidence based
- Standard
- Conclude
- Report
Consistency of Decision

3 decisions meetings per year

Stage 1 (During Visit)

Stage 2

Pre-ADM

Stage 3

Stage 4

EAC Accreditation Decision Meeting (ADM)

Director

Associate Directors (Discipline)

Head of Delegation

Panel 1

Panel 2

Report

Report
Cause for concerns at Decision Meetings in Malaysia

• Phases of OBE
  – Planning
  – Implementation
  – Effectiveness
• CQI
• List of concerns
• Breadth & depth (taxonomy & complex problem)
• Staffing
• Industrial Training
• Commitment to change
• System failure
• Stagnant (no improvement)
• Repeat offender
• Safety
• 3 PEs
Plan, Do, Check & Act (PDCA), 2015
Complex Problem
Complex Problem

Need to think broadly and systematically and see the big picture

Complex Problem
Difficult Decision
Uncertain Strategy
Confusing Idea
Contentious Product
Intractable Change
Difficulty & Uncertainty

• **Complexity** – the problem contains a large number of diverse, dynamic and interdependent elements

• **Measurement** – it is difficult or practically unfeasible to get good qualitative data

• **Novelty** – there is a new solution evolving or an innovative design is needed
Characteristics

Technical Problems
• Isolatable boundable problem
• Universally similar type
• Stable and/or predictable problem parameters
• Multiple low-risk experiments are possible
• Limited set of alternative solutions
• Involve few or homogeneous stakeholders
• Single optimal and testable solutions
• Single optimal solution can be clearly recognised

Complex Problems
• No definitive problem boundary
• Relatively unique or unprecedented
• Unstable and/or unpredictable problem parameters
• Multiple experiments are not possible
• No bounded set of alternative solutions
• Multiple stakeholders with different views or interest
• No single optimal and/or objectively testable solution
• No clear stopping point
Limited Explanation, Prediction, Control

Explanation, Prediction, Control

Limited Explanation, Prediction, Control

Unbounded Systems, No Experiment

Results in an educated guest

Results in a Covering Law

Isolatable Systems, Controlled Experiment

Complex causal Chains

Simple causal Chains

Complex

Technical

Difficult to measure

Measurable

Operating with scare resources

Operating with adequate resources

A limited number of features are captured by the Model

All the Salient features are captured by the Model

f(x,y,z)
Scientific/Technical Problems can combine to form A Complex Problem
## Complex Engineering Activities *(Project based)*

**Complex activities** means (engineering) activities or projects that have *some or all* of the following characteristics listed below.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of resources</td>
<td><strong>Diverse resources</strong> (people, money, equipment, materials, information and technologies).</td>
</tr>
<tr>
<td>Level of interaction</td>
<td>Require resolution of significant problems arising from interactions between <em>wide ranging</em> or <em>conflicting</em> technical, engineering or other issues.</td>
</tr>
<tr>
<td>Innovation</td>
<td>Involve creative use of engineering principles and <em>research-based</em> knowledge in <em>novel</em> ways.</td>
</tr>
<tr>
<td>Consequences to society and the environment</td>
<td>Have <strong>significant consequences</strong> in a <em>range of contexts</em>, characterised by <em>difficulty</em> of prediction and mitigation.</td>
</tr>
<tr>
<td>Familiarity</td>
<td>Can extend <strong>beyond previous</strong> experiences by applying <em>principles-based</em> approaches.</td>
</tr>
</tbody>
</table>
### Complex Problems *(Need High Taxonomy Level)*

Complex Engineering Problems have characteristic WP1 and some or all of WP2 to WP7, EP1 and EP2, that can be resolved with in-depth forefront knowledge.

<table>
<thead>
<tr>
<th>WP1</th>
<th>Depth of Knowledge required</th>
<th>Resolved with <strong>forefront in-depth</strong> engineering knowledge (WK3, WK4, WK5, WK6 or WK8) which allows a fundamentals-based, first principles analytical approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP2</td>
<td>Range of conflicting requirements</td>
<td>Involve <strong>wide-ranging or conflicting</strong> technical, engineering and other issues.</td>
</tr>
<tr>
<td>WP3</td>
<td>Depth of analysis required</td>
<td>Have <strong>no obvious solution</strong> and require abstract thinking, originality in analysis to formulate suitable models.</td>
</tr>
<tr>
<td>WP4</td>
<td>Familiarity of issues</td>
<td>Involve <strong>infrequently encountered</strong> issues</td>
</tr>
<tr>
<td>WP5</td>
<td>Extent of applicable codes</td>
<td><strong>Beyond codes of practice</strong></td>
</tr>
<tr>
<td>WP6</td>
<td>Extent of stakeholder involvement and level of conflicting requirements</td>
<td>Involve <strong>diverse groups of stakeholders</strong> with widely varying needs.</td>
</tr>
<tr>
<td>WP7</td>
<td>Interdependence</td>
<td>Are <strong>high level problems</strong> including many component parts or sub-problems.</td>
</tr>
<tr>
<td>EP1</td>
<td>Consequences</td>
<td>Have <strong>significant consequences</strong> in a range of contexts.</td>
</tr>
<tr>
<td>EP2</td>
<td>Judgement</td>
<td>Require judgement in <strong>decision making</strong></td>
</tr>
</tbody>
</table>
Example 1: Complex Problem Solving

• Two villages in Timbuktu are separated from each other by a valley, at its deepest section about 30 metres.
• The valley is dry all the year around, except for the four months, from October to December each year, where torrential rainfall can flood major parts of the valley to a depth of over 12 metres in some site.
• The soil is generally lateritic with firm bedrock underneath. A bridge connecting the two villages is in a state of disrepair and has to be replaced.
• Write a project brief on how would you approach to design for the replacement bridge.
• You are limited to the use of locally available building materials.
• Heavy equipment is not available for the construction.
Aspects

- Economics
- Social
- Environment
- Ethics
- Management
- Technology
- Analysis
- Evaluation
Thinking

• Site condition
• Weather
• Available technology
• Building materials
• Design
• Costing
• Scheduling
Solutions?

- Problem solving skills
- Formulate the problem
- Literature
- Experiment?
Assessment

- Report – style and content (flow)
- Display – attractive?
- Viva / Articulation
- Teamwork
- Management – scheduling
Example 2: Complex Problem Solving

- Sandy soil
- Fissured Rocks
- Igneous rock
- Clayey soil
- Groundwater flow
- Spring
- River
How does complexity relates to curriculum?

- General Subjects
- Industrial Placement
- Core & Specialist (Engineering) Subjects – *Complex Problem Solving*
- Elective Subjects – *Complex Problem Solving*
- Design Project – *Complex Engineering Activities*
- Final Year Project – *Complex Problem Solving*
<table>
<thead>
<tr>
<th>WA1</th>
<th>Engineering Knowledge</th>
<th>Breadth &amp; depth of knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>WA2</td>
<td>Problem Analysis</td>
<td>Complexity of analysis</td>
</tr>
<tr>
<td>WA3</td>
<td>Design/Development of Solutions</td>
<td>Breadth &amp; uniqueness of engineering problems i.e. the extent to which problems are original and to which solutions have previously been identified and coded</td>
</tr>
<tr>
<td>WA4</td>
<td>Investigation</td>
<td>Breadth &amp; depth of investigation and experimentation</td>
</tr>
<tr>
<td>WA5</td>
<td>Modern Tool Usage</td>
<td>Level of understanding of the appropriateness of the tool</td>
</tr>
<tr>
<td>WA6</td>
<td>The Engineer and Society</td>
<td>Level of knowledge and responsibility</td>
</tr>
<tr>
<td>WA7</td>
<td>Environment and Sustainability</td>
<td>Type of solutions</td>
</tr>
<tr>
<td>WA8</td>
<td>Ethics</td>
<td>Understanding and level of practice</td>
</tr>
<tr>
<td>WA9</td>
<td>Individual and Team Work</td>
<td>Role in and diversity of team</td>
</tr>
<tr>
<td>WA10</td>
<td>Communication</td>
<td>Level of communication according to type of activities performed</td>
</tr>
<tr>
<td>WA11</td>
<td>Project Management and Finance</td>
<td>Level of management required for differing types of activity</td>
</tr>
<tr>
<td>WA12</td>
<td>Life-long Learning</td>
<td>Preparation for and depth of continuing learning</td>
</tr>
</tbody>
</table>
Complex Engineering Activities *(Project based)*

<table>
<thead>
<tr>
<th>Complex activities</th>
<th>means (engineering) activities or projects that have some or all of the following characteristics listed below</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of resources</td>
<td>Diverse resources (people, money, equipment, materials, information and technologies).</td>
</tr>
<tr>
<td>Level of interaction</td>
<td>Require resolution of significant problems arising from interactions between wide ranging or conflicting technical, engineering or other issues.</td>
</tr>
<tr>
<td>Innovation</td>
<td>Involve creative use of engineering principles and research-based knowledge in novel ways.</td>
</tr>
<tr>
<td>Consequences to society and the environment</td>
<td>Have significant consequences in a range of contexts, characterised by difficulty of prediction and mitigation.</td>
</tr>
<tr>
<td>Familiarity</td>
<td>Can extend beyond previous experiences by applying principles-based approaches.</td>
</tr>
<tr>
<td>WK1</td>
<td>WK2</td>
</tr>
<tr>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>natural sciences</td>
<td>mathematics, numerical analysis, statistics, computer and information science</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WA1</th>
<th>WA2</th>
<th>WA3</th>
<th>WA4</th>
<th>WA5</th>
<th>WA6</th>
<th>WA7</th>
<th>WA8</th>
<th>WA9</th>
<th>WA10</th>
<th>WA11</th>
<th>WA12</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGINEERING KNOWLEDGE</td>
<td>PROBLEM ANALYSIS</td>
<td>IND &amp; TEAM</td>
<td>DESIGN</td>
<td>COMMUNICATION</td>
<td>MODERN TOOLS</td>
<td>ENGR &amp; SOC</td>
<td>ENV &amp; SUST</td>
<td>ETHICS</td>
<td>INVESTIGATION</td>
<td>PROJ MGMT &amp; FINANCE</td>
<td>LIFE LONG</td>
</tr>
</tbody>
</table>

4 YEARS

<table>
<thead>
<tr>
<th>EAC</th>
<th>MySET</th>
<th>EAC</th>
<th>UTM</th>
<th>MJIIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaysia</td>
<td>Malaysia</td>
<td>Japan</td>
<td>Malaysia</td>
<td>International Institute of Technology</td>
</tr>
</tbody>
</table>
**WA – WK – WP Relationships**

**WA1 – Engineering Knowledge**
(Science, Mathematics & Engineering)
(WK1, WK2, WK3, WK4)

**to solve**
Complex Engineering Problems

**WP1 – Depth of Knowledge required:**
Resolved with *forefront in-depth*
engineering knowledge
(WK3, WK4, WK5, WK6 or WK8)
which allows a fundamentals-based,
first principles analytical approach

**WK1 - natural sciences (WA1)** *(know what)*

**WK2 - mathematics, numerical analysis,**
statistics, computer and information science *(WA1)*

**WK3 - engineering fundamentals (WA1)**

**WK4 - engineering specialist knowledge (WA1)**

**WK5 - engineering design (know how)**
**WA3 - Design**

**WK6 - engineering practice (know how)**
**WA5 - Modern Tools**

**WK8 - research literature (know why)**
**WA4 - Investigation**
to solve
Complex Engineering Problems

WK1 - natural sciences (WA1)

WK2 - mathematics, numerical analysis, statistics, computer and information science (WA1)

WK3 - engineering fundamentals (WA1)

WK4 - engineering specialist knowledge (WA1)

WK5 - engineering design (WA3 - Design)

WK6 - engineering practice (WA5 - Modern Tools)

WK8 - research literature (WA4 - Investigation)

WP1 – Depth of Knowledge required:
Resolved with forefront in-depth engineering knowledge (WK3, WK4, WK5, WK6 or WK8) which allows a fundamentals-based, first principles analytical approach

WP2 Range of conflicting requirements
WP3 Depth of analysis required
WP4 Familiarity of issues
WP5 Extent of applicable codes
WP6 Extent of stakeholder involvement and level of conflicting requirements
WP7 Interdependence
EP1 Consequences
EP2 Judgement

Some or all WP2 – WP7, EP1 & EP2

WP2 – WP7, EP1 & EP2
to solve Complex Engineering Problems

WP1 – Depth of Knowledge required:
Resolved with forefront in-depth engineering knowledge (WK3, WK4, WK5, WK6 or WK8) which allows a fundamentals-based, first principles analytical approach.

<table>
<thead>
<tr>
<th>WP2</th>
<th>Range of conflicting requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP3</td>
<td>Depth of analysis required</td>
</tr>
<tr>
<td>WP4</td>
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<td>WP5</td>
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<td>Extent of stakeholder involvement and level of conflicting requirements</td>
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<tr>
<td>WP7</td>
<td>Interdependence</td>
</tr>
<tr>
<td>EP1</td>
<td>Consequences</td>
</tr>
<tr>
<td>EP2</td>
<td>Judgement</td>
</tr>
</tbody>
</table>

WK2 - mathematics, numerical analysis, statistics, computer and information science (WA1)

WK1 - natural sciences (WA1)

WK3 - engineering fundamentals (WA1)

WK4 - engineering specialist knowledge (WA1)

WK5 - engineering design (WA3 - Design)

WK6 - engineering practice (WA5 - Modern Tools)

WK8 - research literature (WA4 - Investigation)

WK7 - engineering in society (WA6 - engineer & society)

WA7 - environment & sustainability

WA8 - ethics

Breadth
**Design Course**

**WP1 – Depth of Knowledge required:**
Resolved with *forefront in-depth* engineering knowledge (WK3, WK4, WK5, WK6 or WK8) which allows a fundamentals-based, first principles analytical approach.

**WP2** | Range of conflicting requirements
---|---
**WP3** | Depth of analysis required (WA2)
**WP4** | Familiarity of issues
**WP5** | Extent of applicable codes
**WP6** | Extent of stakeholder involvement and level of conflicting requirements WK7 (WA6, WA7, WA8)
**WP7** | Interdependence
**EP1** | Consequences
**EP2** | Judgement

**WK1 - natural sciences (WA1)**

**WK2 - mathematics, numerical analysis, statistics, computer and information science (WA1)**

**WK3 - engineering fundamentals (WA1)**

**WK4 - engineering specialist knowledge (WA1)**

**WK5 - engineering design**

**WA3 - Design**

**WK6 - engineering practice**

**WA5 - Modern Tools**

**WK7 - engineering in society**

**WA6 - engineer & society (WK7)**

**WA7 - environment & sustainability (WK7)**

**WA8 – ethics (WK7)**

**WA2 - Problem Analysis (WK 1-4)**

**WA9 - Individual and Team Work**

**WA10 - Communication**

**WA11 - Project Management and Finance**

**WA12 - Life-long Learning**
How does complexity relate to curriculum?

- General Subjects
- Industrial Placement
- Core & Specialist (Engineering) Subjects – *Complex Problem Solving*
- Elective Subjects – *Complex Problem Solving*
- Design Project – *Complex Engineering Activities*
- Final Year Project – *Complex Problem Solving*
Panel Evaluators
Expectations on Evaluators

- Commitment
- Not “Auditors”
- Reference Material: Accreditation Standards
- Pre-Visit Planning & Discussion
- Day -1 meeting (be seen doing it)
- Visit Day Aplomb & Decorum
- Reporting
- Response to factual inaccuracies
Pre-Accreditation Visit Meeting

• Meet at least once (in addition to the meeting on Day -1) before the Accreditation Visit, to study and discuss documents, and systematically identify shortcomings.

• Strategically plan and/or request supplementary input from the University to fill the gaps. (Prepare interim report, checklist, schedule and assignment)

• Further information required, communicate through ......
Day -1 Meeting

- Findings (interim report)
- Strategy (schedule & assignment)
- Update checklist
EVALUATION DAY

• Opening meeting
• Meeting with
  • staff members,
  • students,
  • external stakeholders such as alumni, employers, and industry advisor
• Visiting facilities.
• Checking relevant documents.
• Exit meeting
OPENING MEETING

• Introduce evaluation team members
• Mention the objective of the visit (programmes)
• Mention that it is not fault finding exercise but to identify the programme conformance to the Accreditation criteria
• Explain the methods of conducting the evaluation
• Review the plan and schedule
• Confirm the time of the closing meeting
• Invite the Programme owner to fill up the latest (within a specified timeframe) if any
TRIANGULATION ... example

- Curriculum development (specification/input)
- Curriculum implementation (process)
- Demonstrated outcomes (output)

It's a horse?
Evidence is the facts or information used to prove or disprove a proposition. It should be collected through:

- Interviewing
- Observation of environment
- Observation of implementation
- Checking of records or document
Objective Evidence

- Evidence that exists
- Not influenced by emotion or prejudice
- Can be documented
- Is about quality
- Can be quantitative or qualitative
- Can be verified
Objective Evidence

The facts or information used to conclude whether a programme has or has not undertaken appropriate activities effectively to demonstrate attainment of the necessary outcomes.
EVALUATOR’S APPROACH

• Sensible questioning
• Check records
• Observing processes
• Analyse inputs and outputs
• Organised using tables, matrices, flowcharts and checklists
Questioning


Best friend – Show Me

Additional skills of LISTENING and OBSERVING
EFFECTIVE COMMUNICATION

Occurs when the right person, says the right things, to the right people, at the right place at the right time and in the right way to be heard and understood and to produce the right response.

Important

• Person is at ease in communicating with the Evaluator.
• Evaluator should do all he/she can to make person feel at ease.
EFFECTIVE COMMUNICATION (Cont..)

Tips

- Gain attention from the person before starting.
- Explain clearly the purpose of the session/visit.
- Include friendly remarks or express your interest in what he/she is doing.
- Politeness all the way never antagonise or belittle the person.
- Establish eye contact all the times.
- Communicate in the language he/she is comfortable.
- Use of body language to promote the dialogue. (Spoken message is 7%, verbal and vocal 38% and 55% facial).
- Listen, listen, listen, an Evaluator need to train himself to be an active listener.
POINTS TO CONSIDER IN DERIVING FINDINGS/CONCLUSION

- Establish requirement
- Probe process
- Whom do you speak to?
- What to look for?
- Sampling
- How long to persist?
- Is there any shortcomings?
- Is it significant?
- Consult team members
Exit Meeting - Evaluators

- Greetings
- Thank IHL
- Relate strength
- Raise concerns
- Mention “detailed report & response to factual accuracies”
- Decision
Aplomb & Decorum

• Peer Assessment
• Common Sense
• Commitment
• Before
• During
• After

CONCLUSION

• Assurance
• Self-confidence
• Composure
• Cool
• Confident poise

Evaluators

Being Professional

• Assumption
• Correctness
• Restraint
• Politeness
• Tact
• Etiquette
• Respectability
• Good manners

• Knowledgeable
• Industrious
• Inquisitive
• Analytical
• Pleasant
<table>
<thead>
<tr>
<th>Dos</th>
<th>Don’ts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formal attire</td>
<td>Track suit</td>
</tr>
<tr>
<td>Preparedness</td>
<td>Based on presentation</td>
</tr>
<tr>
<td>Time management</td>
<td>Not punctual</td>
</tr>
<tr>
<td>Well versed</td>
<td>Lack of knowledge</td>
</tr>
<tr>
<td>Probing</td>
<td>Surface</td>
</tr>
<tr>
<td>Big Picture</td>
<td>Compartmentalized</td>
</tr>
<tr>
<td>Triangulate</td>
<td>Single evidence</td>
</tr>
<tr>
<td>State the fact</td>
<td>Giving solutions</td>
</tr>
<tr>
<td>No surprises</td>
<td>Shocking decision</td>
</tr>
<tr>
<td>Collegial</td>
<td>Too formal</td>
</tr>
<tr>
<td>Serious</td>
<td>Too lighthearted</td>
</tr>
</tbody>
</table>
Don’ts

• Answering phone calls
• Silent
• Excused early
• Poor listener
• Opinionated
• Argumentative
• Please complete the list ....
COMPETENCY OF EVALUATORS

• Organizing skills
• Knowledge of the manual
• Questioning skills
• Comprehensiveness of the evaluation
• Listening to persons
• Overall appearances
• Reporting
• Overall judgment
• Overall rapport with persons
• Aplomb (self-confidence) and decorum (etiquette)
Random Observations

- Bullet points & Aggregation
- Ambiguous
- Poor time management
- Guidelines supersede Manual
- Keywords as sole determination
- Interrogative

Cut & Paste
Assessment for Decision
Reporting

• Qualitative
• Strength
• Shortcomings (weaknesses)
• Concerns
• Opportunities for Improvement
Thank You
Arigato-gosai-masu