NBA Interactive Workshop

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Evidence-Based on-site Assessment during Accreditation Visits

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Key Points

- Target audience - PEVs
- Evidence-based on-site assessment during accreditation visits
- Program outcomes (POs) attainment-assessment methodology.
- Continuous Improvement – assessment methodology

Attributes of PEVs

- Trust
- Integrity
- Competent
- Professionalism

Conflict of interest

- Definition of possible conflict of interest:
  - have **financial or personal interest** in the university; or
  - have or have had a **close, active association with the programme or faculty/school** in the university. Close or active association are, for example:
    - **Employment**, as staff or consultant by the faculty/school;
    - **Attendance**, as student at the faculty/school;
    - **Business**, significant business dealing
    - **Receipt** of honorary degree from the faculty/school;
    - **Membership** of a board of the university or any committee advising on the programme being accredited.

Accreditation Criteria - NBA

1) Vision, Mission & Programme Educational Objectives
2) Programme Outcomes
3) Programme Curriculum
4) Students' Performance
5) Faculty Contributions
6) Facilities & Technical Support
7) Academic Support Units and Teaching-Learning Process
8) Governance, Institutional Support and Financial Resources
9) Continuous Improvement
10) Specific Programme Criteria

Outcome-Based Education

- William Spady:
  - Defining, designing, building, focusing and organizing everything in an education system on the things of lasting significant that we ultimately want every learner to demonstrate successfully as the result of their learning experiences in that system.

Outcomes - Spady

- Outcome is “a culminating demonstration of learning”
- “Demonstration” meant that learners would actually DO something tangible, visible, and observable – e.g., describe, explain, design, construct, produce, negotiate, operate, etc. – with the concepts and content embodied in the typical curriculum
- Doing required skill and competence, not just knowledge and understanding
- Competence and its demonstration are equally important in an Outcome Statement

OBA not OBE

- OBA does not require the institutions or the programs to fully embrace the outcome-based education (OBE).
- For accreditation purpose, the program shall provide evidences that the set of graduate attributes or student learning outcomes stipulated by the accreditation body are achieved by the students at the time of graduation.
- Education providers have freedom to design programs with different detailed structure, learning pathways and modes of delivery.
- Outcome-based assessment and evaluation systems must be put in place to verify the achievement of defined program education objectives and graduate attributes.

Learning Outcomes

- Knowledge and competencies profiles
- Graduate attributes (WA) which form the student learning outcomes:
  1. Engineering knowledge
  2. Problem analysis
  3. Design/development of solutions
  4. Investigation
  5. Modern tool usage
  6. The engineer and society
  7. Environment and sustainability
  8. Ethics
  9. Individual and team work
  10. Communications
  11. Project management and finance
  12. Life-long learning

Outcomes-Focused Accreditation Criteria

1) Vision, Mission & Programme Educational Objectives
2) Programme Outcomes
3) Programme Curriculum
4) Students' Performance
5) Faculty Contributions
6) Facilities & Technical Support
7) Academic Support Units and Teaching-Learning Process
8) Governance, Institutional Support and Financial Resources
9) Continuous Improvement
10) Specific Programme Criteria

Enabling Resources & Facilities

1) Vision, Mission & Programme Educational Objectives
2) Programme Outcomes
3) Programme Curriculum
4) Students' Performance
5) Faculty Contributions
6) Facilities & Technical Support
7) Academic Support Units and Teaching-Learning Process
8) Governance, Institutional Support and Financial Resources
9) Continuous Improvement
10) Specific Programme Criteria

Quality Assurance – Engineering Programs

- Paradigm shift in focusing on outcomes that matter & relevant
- Setting appropriate PEO and PO which are relevant, measurable and meeting OBA requirements
- Securing commitments from faculty to implement the continuous quality improvement mechanism, particularly at individual course module
- Obtaining resources and support to institute outcomes-based teaching and learning

Part 1:
Review of NBA's Requirements

Criterion 1 –
Programme Educational Objectives (PEOs)

- Consistent with vision and mission
- Published & disseminated
- Participation of stakeholders
- Specific to programme
- Supported by POs/POs
- Achievement of PEOs – assessment and evaluation
- Periodic review based on feedback of stakeholders

Evidence of alignment of PEO with Vision & Mission

PEO Statements	M1	M2	....	Mn
PEO1:				
PEO2:				
PEON:				

Note: M1, M2, . . Mn are distinct elements of Mission statement. Enter correlation levels 1, 2 or 3

Criterion 2 –
Programme Outcomes

- POs formulated for each programme by the institution must be consistent with the NBA's Graduate Attributes. (Best practice to follow NBA's Graduate Attributes, and add additional POs where required)
- POs must foster the attainment of the PEOs – mapping of POs to PEOs
- How and where POs are published and disseminated

Educational institution's Student Learning Outcomes [if different from graduate attributes in Criterion 2(i) (a) to (j)]	Graduate attributes in EAB's Criterion 2(i) (a) to (j)*									
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
(1) *Student learning outcome (..)*										
(2) *Student learning outcome (...)*										
(3)										
(4)										

POs not well matched

- POs are not “perfect” match to those stipulated by the accreditation body
- Difficult to evaluate the shortfalls in breadth and depth of outcomes achievement
- Suggestion
  - Adopt all 12 NBA’s Graduate Attributes as POs without changes
  - Add additional POs if necessary (but bear in mind the additional work in assessment, and the curriculum support)

Criterion 2 –
Programme Outcomes

- Illustrations of how
  - course outcomes
  - modes of delivery of the courses
  - assessment tools
  - laboratory
  - project course work

    are used to assess the impact of course delivery/course content, and are contributing towards the attainment of the POs
- Attainment of POs assessed by direct and indirect methods

Criterion 2 –
Programme Outcomes

- Results of assessment of each PO shall be indicated as they play a vital role in implementing the Continuous Improvement process of the programme
- How the results of assessment of the POs are used to improve the programme in terms of
  - curriculum
  - course delivery
  - assessment methods
  - processes of revising/redefining the POs

Mapping of POs and PEOs

Programme Outcomes	Programme Educational Objectives (PEOs)			
	PEO#1	PEO#2	PEO#3	PEO#4
PO1				
PO2				
PO3				
PO4				
PO5				
PO6				
PO7				
PO8				
P09				
PO10				
PO11				
PO12				

3.1. Establish the correlation between the courses and the Program Outcomes (POs) & Program Specific Outcomes (25)

- NBA defined Program Outcomes as mentioned in Annexure I and Program Specific Outcomes as

Program Articulation Matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C101												
C202												
C303												
....												
....												
C4...												

1. Enter correlation levels 1, 2 or 3 as defined below:

   1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

(A) PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: 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.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

(B) PROGRAM SPECIFIC OUTCOMES (PSOs)

Program should specify 2-4 program specific outcomes.

Criterion 3 –
Programme Curriculum

- Programme curriculum that leads to the attainment of the PEOs and the POs must be designed
- Flow diagram that shows the prerequisites for the courses shall also be provided
- Each programme should cover general and specialized professional content of adequate breadth and depth
- Appropriate components in the Sciences and Humanities.

Criterion 3 –
Programme Curriculum

- The relevance of curriculum components including core engineering courses to the POs
- How the core engineering subjects in the curriculum lend the learning experience with the complex engineering problems
- Programme must satisfy Programme Specific Criteria
- Continuous Improvement process in curriculum refinement
- Evidence of assessment, evaluation and review methods – attainment of COs

2.1.3. State the components of the curriculum (5)

Program curriculum grouping based on course components

Course Component	**Curriculum Content (% of total number of credits of the program)**	**Total number of contact hours**	**Total number of credits**
Basic Sciences			
Engineering Sciences			
Humanities and Social Sciences			
Program Core			
Program Electives			
Open Electives			
Project(s)			
Internships/Seminars			
Any other (Please specify)			
Total number of Credits			

Table 3.1: Curriculum and teaching processes to achieve Student Learning Outcomes, and evaluation method/criteria

Module title	Category#	Evaluation method & criteria	Student Learning Outcomes*							
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	--
		•  •								
		•  •								
		•  •								
		• •								
		• •								
		• •								

Category is to indicate whether module is Core, Electives, Faculty Requirements, Major Requirements, University Requirements, Unrestricted Elective, etc

Table 3.2: Curriculum/Course Time Allocation and Content

(A) Course Time Allocation by semester

Semester n Year n:

Course Title	Total Number of Contact Hours					No of MCs or AUs [2]
	Lec [3]	Tut/Con [4]	Lab [5]	Proj [6]	Total Hrs	
Total						

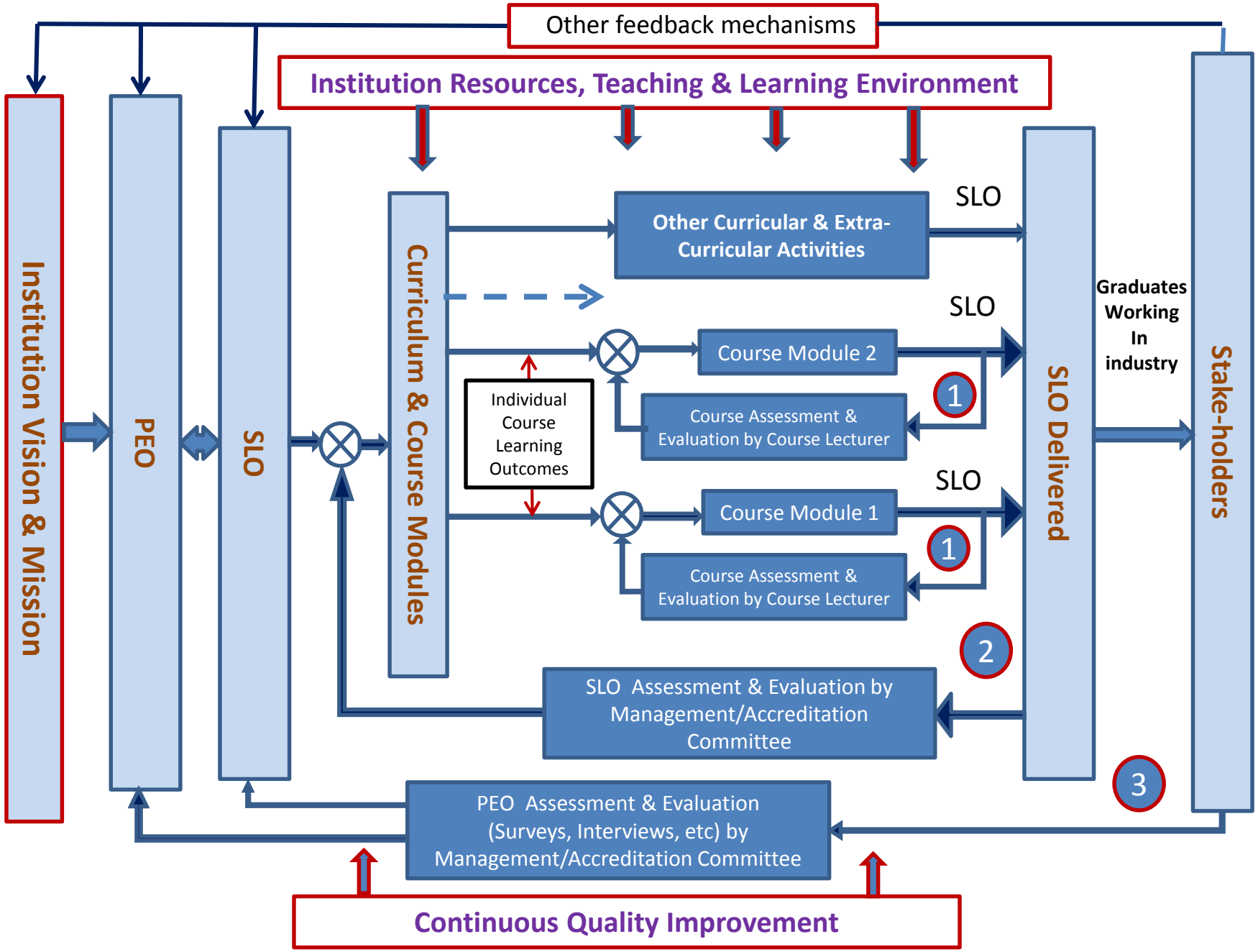
Criterion 9 – Continuous Improvement

- Modifications in the programme curriculum, course delivery and assessment brought in from the review of the attainment of the PEOs and the POs
- The programme must develop a documented process for the periodic review of the PEOs, the POs and the COs.
- PEOs and the POs need to be validated with proper documentation.

Criterion 9 –
Continuous Improvement – NBA's Specific

The institution shall provide the required information for improvement in success index of students, improvement in academic performance index of students, improvement in student-teacher ratio, enhancement of faculty qualifications index, improvement in faculty research publications, R&D and consultancy work, continuing education, curricular improvement based on the review of attainment of the PEOs, and the POs, course delivery and assessment improvement based on the review of the attainment of the PEOs, and the POs, new facility created, and overall improvement since last accreditation, if any, otherwise, since the commencement of the programme as per the format given in the SAR. However, it shall provide the information in a suitable format, wherever necessary, in case the format is not provided in the SAR.

Figure 1 – Continuous Quality Improvement Process in Outcome-based Accreditation



Perspectives on Program Accreditation

- Program Accreditation is a scheme of granting recognition to an education program by an independent body after a systematic and consistent process of evaluating the program in accordance with the stipulated accreditation policy and criteria, and making judgment that the program has satisfied the benchmark standard.
- To gain accreditation, first and foremost the program must satisfy the full set of accreditation criteria - to cross the bar.
- Continuous quality improvement (CQI) is a necessary criterion, but not the overriding component.

Proper Perspectives

- The narrow focus of accreditation based on continuous improvement has resulted in below-bar programs being granted accreditation just because the programs showed strong efforts in continuous improvement, even without meeting the rigors of the accreditation criteria.
- CQI may be a mitigating factor in marginal cases, but must not be taken as the predominant or even over-riding criterion.
- CQI is a process, not the outcomes which really matter in the long run – those outcomes students take with them at the exit point of the program.

Misleading Interpretation

- It is misleading to interpret accreditation as:
  - *“Accreditation is for continuous improvement of delivery of education for producing human resource needed for national development.”*

Terminology

- Observation – a comment or suggestion not affecting accreditation decision; is to assist improvement process
- Concern – indicates criterion, policy or procedure is met, but situation could potentially exists for criterion, policy or procedure not to be met in near future
- Weakness – criterion, policy or procedure met substantially, but lacks strength of compliance; remedial action to strengthen compliance is necessary before next evaluation
- Deficiency – criterion, policy or procedure is not met

- Recommendation - aspects which are suggestions rather than mandatory requirements
- Requirement - items requiring follow-up action as a condition of accreditation

Possible accreditation decisions

- Full accreditation - for maximum of 5 years:
  - Possible even when there are some concerns
  - If weaknesses are **not** severe, need to indicate:
    - whether the adequacy of the corrective action(s) can be determined on the basis of a written report (with appropriate supporting documentation); or
    - whether a follow-up review visit is required in order to assess the adequacy of the action(s)

Possible accreditation decisions?

- Full accreditation but for a shorter term, say 2 to 3 years:
  - If weaknesses are severe
  - If deficiencies are not severe
  - Need to indicate:
    - Whether corrective action(s) can be determined on the basis of a written report (with appropriate supporting documentation); or
    - whether a follow-up review visit is required in order to assess the adequacy of the action(s)

Possible accreditation decisions

- Not to be accredited
  - If deficiencies are severe
  - When one or more of NBA's 10 criteria are not met
  - Requirements in order to achieve accreditation should be specified

Part 2:
Evidence-Based On-site Assessment

Purpose of campus visit

- Assessment of qualitative factors which cannot be documented in written submission
  - intellectual atmosphere, morale, professional attitudes, quality of staff and students
- Examination of materials compiled by educational institution, i.e. those which cannot leave the campus
  - examination papers, student reports, instruction materials
- Clarify issues in the written submission by educational institution

Outcomes of Campus Visits & Assessment based on Pre-Visit Documents

- The role of the Evaluation Team is for the sole purpose of determining whether the program satisfies the 10 NBA accreditation criteria
- For each criterion, the degree of compliance to be summed up as:
  - Compliance
  - Concerns
  - Weakness
  - Deficiency

Outcomes of Campus Visits & Assessment based on Pre-Visit Documents

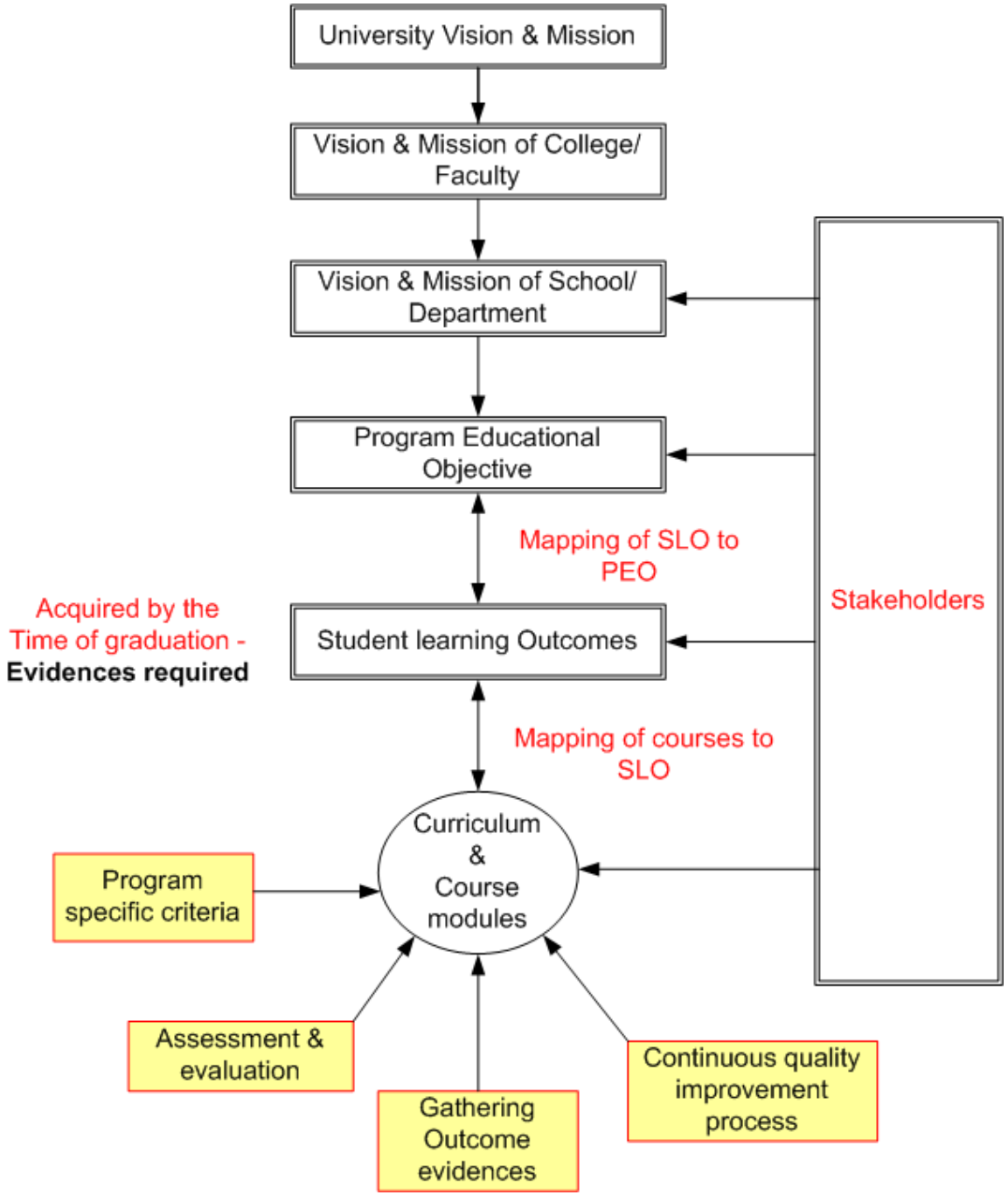
- Where requirements of a particular criterion are not fully met, the Team will include:
  - Recommendation - aspects which are suggestions rather than mandatory requirements
  - Requirement - items requiring follow-up action as a condition of accreditation
- The Team may include observations/comments/suggestion to assist improvement process, not affecting accreditation decision

What the PEVs looks for?

- PEVs are sent to evaluate programs, certifying that they satisfy the criteria stipulated
- They look for evidences that the required criteria are met
- They identify deficiencies, weaknesses, concerns

Focus of Outcomes-based Accreditation

- Attainment of published Program Education Objectives
- Attainment of Program Learning Outcomes
- Continuous Quality Improvement system in place to sustain and improve PEO & PLO
- Resources and system available


University Vision & Mission
Vision & Mission of College/ Faculty
Vision & Mission of School/ Department
Program Educational Objective
Mapping of SLO to PEO
Acquired by the Time of graduation - Evidences required
Student learning Outcomes
Mapping of courses to SLO
Curriculum & Course modules
Program specific criteria
Assessment & evaluation
Gathering Outcome evidences
Continuous quality improvement process
Stakeholders

Outcomes of Significance

- The focus of accreditation is on “Outcomes of Significance”
- Spady articulated as something that “really mattered in the long run”, long after that particular segment of curriculum or time block was over – something that learners could ultimately “take out the door and apply” …. when they “exited” the system.
- That outcomes-of-significance is encapsulated in the set of WA graduate attributes which form the multi-lateral recognition of substantial equivalency of programs within the WA framework.

Complex problems

(A requirement of WA)

- *Involve wide-ranging or conflicting technical, engineering and other issues*
- *Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models*
- *Requires research-based knowledge much of which is at, or informed by, the forefront of the professional discipline and which allows a fundamentals-based, first principles analytical approach*
- *Involve infrequently encountered issues*
- *Are outside problems encompassed by standards and codes of practice for professional engineering*
- *Involve diverse groups of stakeholders with widely varying needs*
- *Have significant consequences in a range of contexts*
- *Are high level problems including many component parts or sub-problems*

Evaluation of POs

- Attainment of each POs must be carefully evaluated in terms of depth and breadth stipulated – going through evidences provided
- Application to Complex Engineering Problems

What the PEVs looks for?

- PEVs are sent to evaluate programs, certifying that they satisfy the criteria stipulated
- They look for evidences that the required criteria are met
- They identify deficiencies, weaknesses, concerns

Where to look for evidences of outcomes attainment?

Evidence beyond mapping exercise

- Program Accreditation Committee undertake the task of mapping subjects/courses to each outcomes
- Faculty teaching a particular subject is not aware of the outcomes contribution from his subject, and has not conducted proper outcomes assessment
- Just a mapping exercise – not acceptable

Evidences from Meetings/Interviews

- Provost/President
- Dean and Head of Department/Program
- Group of faculty members
- Group of alumni
- Group of students
- Group of other constituencies, e.g. members of industrial advisory board, employers

Evidences from Examination of Exhibits (1)

- Sample of teaching materials
- CV of faculty staff, publications
- Sample of exam papers
- Sample of exam scripts –excellent, good, marginal
- Transcripts of immediate past graduates
- Sample project and design reports
- Sample of industry attachment reports & assessment

Evidences from Examination of Exhibits (2)

- Samples of student feedback form
- Reports of other internal or external reviews of the course, department and faculty
- Results of quality assurance reviews
- Statistics of graduate employment
- Other documents requested by the evaluaton team

Start with SAR

- SAR provides a lead to what evidences should look out for during onsite visit
- Evidences to verify claims in SAR

Evidence of understanding of OBA

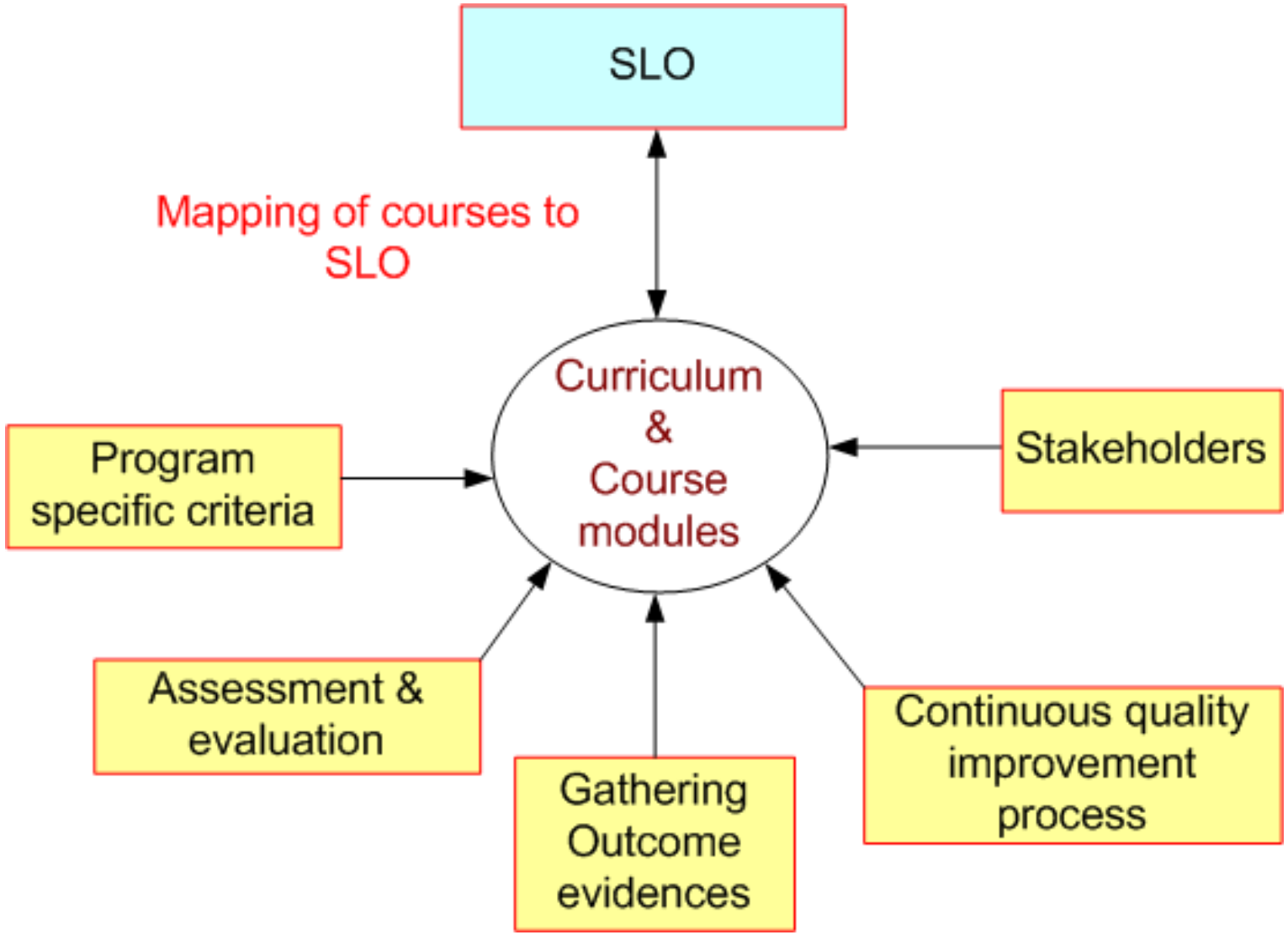
- Program director and faculty did not have fundamental appreciation of the requirements of outcome-based accreditation
- No knowledge of terms used, e.g. PEO, PO
- Mix up of PEO and PO in SAR
- PEO written in the form of PO
  - e.g. students will be able to do ….
- Faculty not conducting outcomes assessment

Evidence of PEO Compliance

- Check university website to verify
- Alignment with mission of institution?
- Published and known to stake-holders? – how and where to verify
- Evidence of PEO achievement – assessment and evaluation, e.g. employers and alumni survey, feedback of focused groups
- Evidence of Continuous Improvement process

Achievement of PEO

- Are assessment and evaluation processes in place to determine attainment of PEO?
- Is there a continuous improvement mechanism in place?
- Evidence and documentation is important.


SLO
Mapping of courses to SLO
Curriculum & Course modules
Program specific criteria
Stakeholders
Assessment & evaluation
Gathering Outcome evidences
Continuous quality improvement process

Course Learning Outcomes

- A learning outcome is what a student can do as a result of a learning experience.
- It describes a specific task that student is able to perform at a given level of competence under a certain situation.
- The three broad types of learning outcomes are:
  - Disciplinary knowledge and skills
  - Generic skills
  - Attitudes and values

Table 3.1: Curriculum and teaching processes to achieve Student Learning Outcomes, and evaluation method/criteria

Module	Category#	Evaluation method & criteria	Student Learning Outcomes*							
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	--

Course Learning outcomes

- Course Learning Outcomes describe the complex performances a student should be capable of as a result of learning experiences within a course.
- These are determined by the course instructor (s)
- Mapping course learning outcomes to program outcomes and how overall learning experience meet the accreditation criteria

Contribution of each course

- Each undergraduate course in the programme contributes to a list of POs
- Usually, a course may contribute strongly to some NBA's POs and less strongly to other POs
- While a course may contribute to several POs, usually only a subset of its strong outcomes need to be used for PO assessment.

Teaching-Learning Processes

- Each program should cover general and specialized professional content
- Adequate breadth and depth, and
- Appropriate components in Science and Humanities
- Evaluation of teaching-learning processes
- Modes of teaching-learning: lecture, tutorial, seminar, projects, internship, peer-group discussion, ..

Evidences of Outcomes Assessment

- Not merely mapping of courses to outcomes
- Evidence of outcomes assessment at course level
- Evidence that faculty has training in conducting outcomes assessment
- Going beyond subject/course marks & grading being used as justification that overall outcomes are contributed by the subject(s)

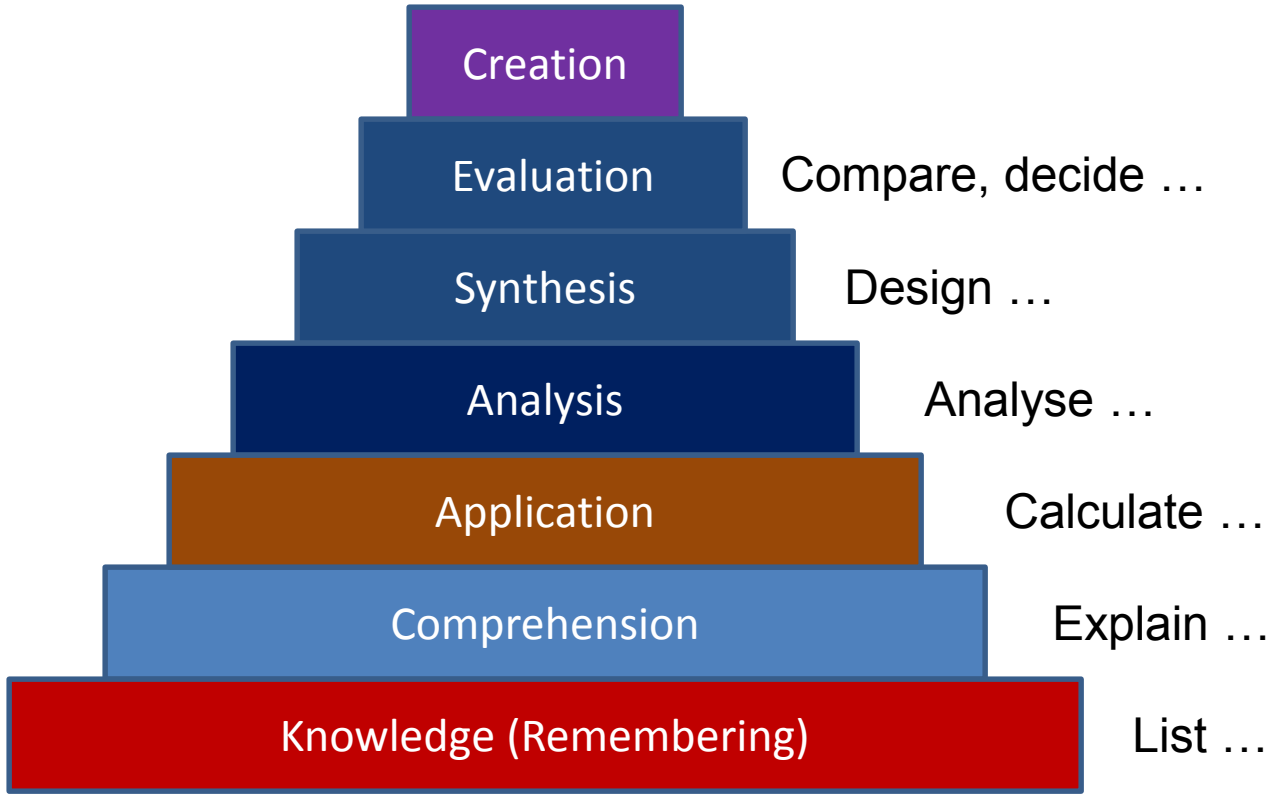
Evidence of Faculty actively involved in outcomes assessment

- Do faculty members know the requirements of outcome-based accreditation?
- Are they trained in outcomes assessment?
- Evidence of faculty conducting outcomes assessment at their courses
- Reflection and continuous improvement at course level

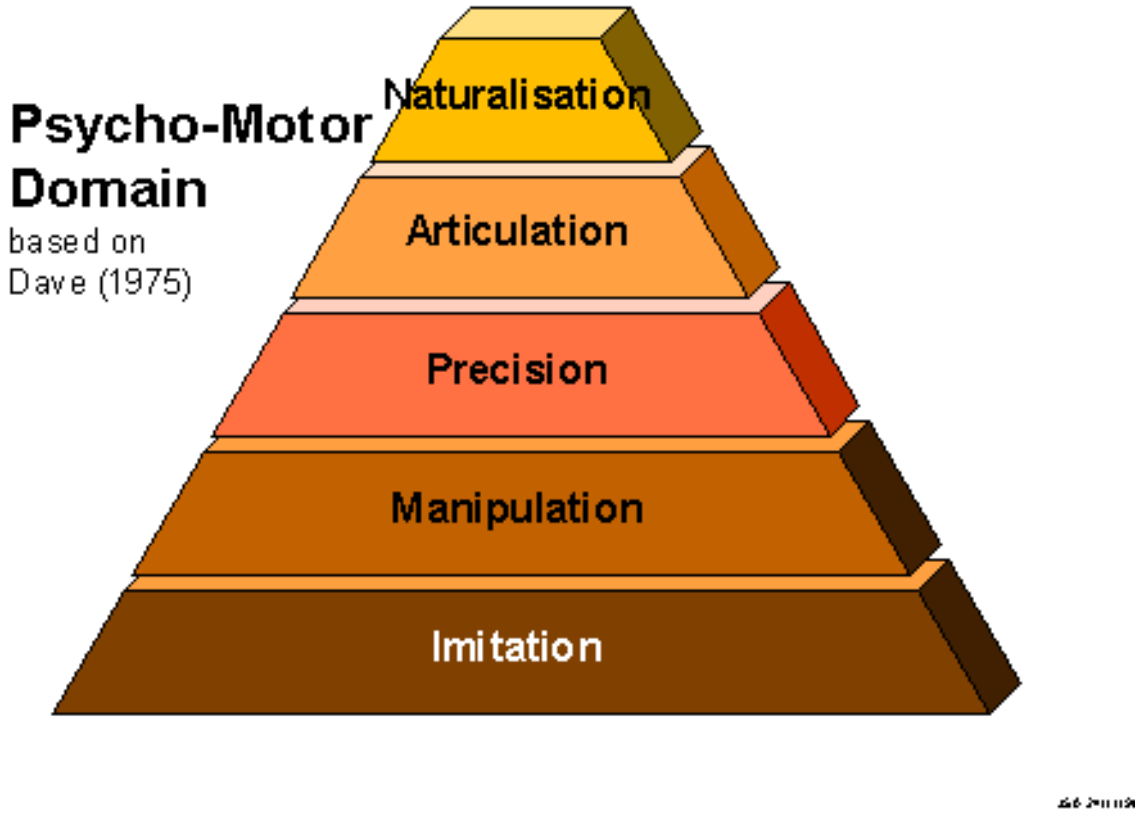
Avoid Obsession with Assessment

- Assessment involves:
  - Cognitive domain (thinking, knowledge)
  - Psychomotor domain (doing, skills)
  - Affective domain (feeling & attitude)
- Is the assessment efforts sustainable?

Bloom's Taxonomy – Cognitive Domain
(modified by Anderson & Krathwohl)

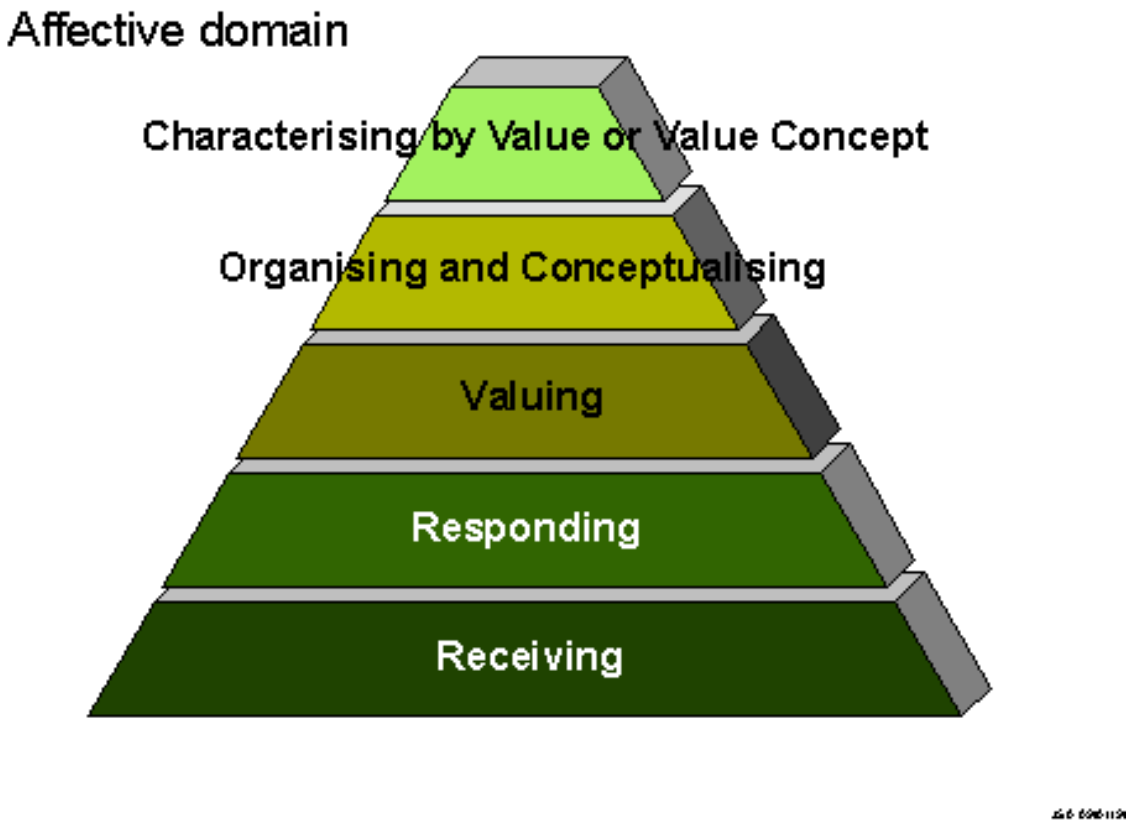


Psychomotor Domain



http://www.learningandteaching.info/learning/bloomtax.htm

Affective Domain



http://www.learningandteaching.info/learning/bloomtax.htm

Wrong Justification of Outcomes Attainment

- Wrong interpretation of the Bloom's Taxonomy
- Entry level courses are used to map achievement of outcomes at mastery level simply because some assessment exercises include activities of
  - Write
  - Evaluate
  - Design, etc
- Note that Complex Engineering Problems should be used for assessment at masterly level

Abilities

- Knowledge (gathering & recall)
- Comprehending information
- Application (making use of knowledge)
- Analysis (taking apart)
- Synthesis (putting together)
- Evaluation (judging the outcome)
- Creation

Activities	Action Verbs that provides evidence
Knowing	define, describe, identify, label, name, outline, reproduce, recall, select, state, present, be aware of, extract, organise, recount, write, recognise, measure, underline, repeat, relate, know, match.
Comprehension	interpret, translate, estimate, justify, comprehend, convert, clarity, defend, distinguish, estimate, explain, extend, generalise, exemplify, give examples of, infer, paraphrase, predict, rewrite, summarise, discuss, perform, report, present, restate, identify, illustrate, indicate, find, select, understand, represent, name, formulate, judge, contrast, translate, classify, express, compare.
Application of knowledge (understanding)	apply, solve, construct, demonstrate, change, compute, discover, manipulate, modify, operate, predict, prepare, produce, relate, show, use, give examples, exemplify, draw (up), select, explain how, find, choose, assess, practice, operate, illustrate, verify.
Analysis	recognise, distinguish between, evaluate, analyse, break down, differentiate, identify, illustrate how, infer, outline, point out, relate, select, separate, divide/subdivide, compare, contrast, justify, resolve, devote, examine, conclude, criticise, question, diagnose, identify, categorise, point out, elucidate.
Synthesis	propose, present, structure, integrate, formulate, teach, develop, combine, compile, compose, create, devise, design, explain, generate, modify, organise, plan, rearrange, reconstruct, relate, reorganise, revise, write, summarise, tell, account for, restate, report, alter, argue, order, select, manage, generalise, precise, derive, conclude, build up, engender, synthesise, put together, suggest, enlarge.
Evaluation	Judge, appraise, assess, conclude, compare, contrast, describe how, criticise, discriminate, justify, defend, evaluate, rate, determine, criticise, choose, value, question.

Ability/ competency	Level	Definition
Knowledge	1	the remembering of previously learned material; it may involve the recall of a wide range of material from specific facts to complete theories, but all that is required is the bringing to mind of the appropriate information.
Comprehension	2	the ability to grasp the meaning of material; may be shown by translating material from one form to another (words to numbers), by interpreting material (explaining or summarizing), and by estimating future trends (predicting consequences or effects); this goes one step beyond the simple remembering of material, and represent the lowest level of understanding
Application	3	the ability to use learned material in new, concrete situations; may include the application of rules, methods, concepts, principles, laws, and theories; requires a higher level of understanding than those under comprehension.
Analysis	4	the ability to break down material into its component parts so that its organizational structure may be understood; may include the identification of parts, analysis of the relationship between parts, and recognition of the organizational principles involved; represents a higher level than comprehension and application because it requires an understanding of both the content and the structural form of the material.
Synthesis	5	the ability to put parts together to form a new whole; may involve the production of a unique communication, a plan of operations (research proposal), or a set of abstract relations (scheme for classifying information); stresses creative behaviors, with major emphasis on the formulation of new patterns or structure
Evaluation	6	the ability to judge the value of material for a given purpose, based on definite criteria; contains elements of all the other categories, plus conscious value judgments based on clearly defined criteria.
Creation	7	

Evidences that Curriculum adequate to support all the 12 POs

- Curriculum adequately structured to achieve all the 12 POs?
- Common curriculum deficiencies
  - The engineer and society
  - Environment and sustainability
  - Ethics
  - Finance and project management

Curriculum

- Does the curriculum satisfy the program specific criteria of the particular engineering discipline?
- Are performance indicators established to measure the outcomes of the courses with respect to the program outcomes of NBA criteria)?
- Major design experience?
- Prerequisites
- Course syllabi
- Cores and electives

Industry stakeholder adequately involved?

- Program Advisory Committee (PAC) with industry members?
- Industry involved in setting PEO and curriculum review?
- Check frequency of PAC meetings
- Evidence from minutes of PAC meeting of deliberation of academic matters (PEO, PO, student learning activities)

Interaction between institution & industry

- Involvement of industry stake-holders to ensure relevance of curriculum
- Opportunity for students to acquire industrial experience via internships and design projects by professional engineers and faculty members with industrial experience
- Communication channel with industry, e.g. industry advisory board

Adequate evidences to demonstrate compliance with criteria?

- Sufficient evidences to demonstrate compliance with criteria?
- Best practices
  - Course folders
  - Folders for each outcomes
  - Samples of student portfolio

Check Samples of Student Works

- Each course is required to save samples of student homework solutions, laboratory reports, project or design reports, and exam solutions, typically from poor to good quality.
- At the end of each quarter, the lecturers of all undergraduate courses must compile a binder containing in addition to the solutions, the corresponding homework questions, exam questions, lab description, and project description.

Assessment
&
Demonstration of Outcomes Achievement

Breadth

Depth

Where gained

Learning Process

Assessment Methods

Reference: **Designing Better Engineering Education Through Assessment**

by JE Spurlin, SA Rajala & JP Lavelle

Stylus Publishing LLC, 2008

Assessment of PO

- Assessment is big subject and probably the major challenge of the teaching faculty
- Are assessment methods adequate to provide evidence of achievement of PO?
- Each PO may be measured or evaluated in terms of performance indicators
- Is there a system in place to ensure that students will acquire the stated PO before graduation? (bearing in mind the various core and optional subjects available, and overseas attachment)

Evidences Required

- Demonstrate that students have achieved the specified learning outcomes at appropriate level by the time of graduation, and
- Provide evidence that the program has contributed to students' ability to achieve the POs

Assessment of PO – Where?

- Course work & curricular activities
  - Classes chosen, major
- Classroom experience
  - Pedagogy, facilities, faculty & student interaction
- Out-of-class experience
  - Co-curricular, internships, support services

Capstone/Final Year Project

- A well-designed capstone/final year project is a culminating demonstration of whole range of learning outcomes
- Depth of specialized topic, e.g. design, analysis, investigation, ..
- Breadth of other outcomes, e.g. communication, environment, project management, …

1. Engineering Knowledge

- Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering* problems.

Assessment of PO (1)

- “Apply” - Level 3 BT
- Demonstrate breadth and depth of education and type of knowledge, both theoretical and practical
- Show students can employ general principles, theories, concepts, and/or formulas from mathematics, science, and engineering in the solution of problems in their field of engineering.
- For a particular complex engineering problem, students should demonstrate that they can
  - Define and describe the pertinent principle, theory, concept, and/or formula,
  - Explain why it is appropriate to the problem, and
  - Demonstrate how it has been applied in the solution of the problem.
  - Best demonstrated via capstone project or design work

Assessment of PO (1)

- Show evidence that students required to take modules in mathematic and science
- Respond positively, after students have been on the job, in applying knowledge of mathematics, science, and engineering to the particular engineering problems they encountered at work;
- Achieve a positive rating from their employers regarding their ability to apply general principles of mathematics, science, and engineering to particular engineering situations.

2. Problem Analysis

- Identify, formulate, research literature and analyse *complex* engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

Assessment of PO (2)

- Identify – level 2 BT
- Formulate – level 3 BT
- Research – level 3 BT
- Analyse, Solve – level 4 BT
- reaching substantiated conclusions – level 6 BT
- Demonstrate complexity of analysis
- Show that students can identify engineering problems. Problem identification entails two procedures:
  - Ability to recognize an engineering problem. An engineering problem is an opportunity for change in which engineering solutions can be applied to improve on existing or anticipated conditions and
  - Ability to define an engineering problem. Defining a problem means describing, in concrete and specific terms, the existing or anticipated condition that creates the opportunity for change and the goal state(s) that provides the direction and end-point for change

Assessment of PO (2)

- Show that they have taken assignment and project work and have the ability to research through relevant literature review
- Show that they can represent a problem in a form that makes finding solutions more efficient and effective.
- Show that they can analyze problems, that is, isolate and describe the important components of a problem; what is given (design specifications, availability of materials, performance requirements, testing standards, etc); what is known from previous experience relevant to the problem; and what the unknown are;

Assessment of PO (2)

- Show that they can apply engineering principles and mathematics to find the unknowns and arrive at appropriate solutions to the problem;
- Show that they are able to reach substantiated conclusions based on an analysis of various relevant factors
- Respond positively, after they have been on the job, to the training and guidance they received in solving engineering problems;
- Achieve a positive rating from their employers regarding their ability to solve engineering problems.

3. 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.

Assessment of PO (3)

- Level 5 of BT
- Demonstrate breadth and uniqueness of engineering problems, i.e. extent to which problems are original and to which solutions have previously been identified or codified
- Show, via capstone project or design assignments, that students can engage productively and creatively in the process of design.
  - Establishing the goal of the design project, the outcome that must be attained
  - Defining the project
  - Take account of public health and safety, cultural, societal, and environmental considerations
  - Brainstorming for alternative possibilities
  - Choosing the best of the possible solutions
  - Creating a prototype or model that embodies or represents the chosen solution
  - Testing the prototype or model against the criteria for the project, and
  - Choosing and justifying to an appropriate audience the final system, component, or process

Assessment of PO (3)

- Provide evidence that curriculum covers public health and safety, cultural, societal, and environmental issues
- Respond positively, after they have been on the job, to the training and guidance in design process they received at university
- Achieve a positive rating from their employers regarding their ability to engage productively and creatively in the process of design

Assessment Methods

- Written exams
- Class tests
- Project reports
- Final Year/Capstone projects
- Design assignments
- Locally developed examinations, e.g. FEE for Professional Engineers
- Oral exam
- Internship/Industry Attachment report
- Lab reports
- Written surveys and questionnaires
- Exit and other interviews
- Focus groups
- External examiner
- End-of-course instructor survey
- End-of-course student survey
- Portfolios
- …

Sustainable Program Assessment Processes

- Direct and indirect methods of assessment to be applied to measure a wide variety of different student abilities
- Consider best fit between program needs, satisfactory validity and affordability (time, money and effort)
- Need to use multiple methods to maximise validity and reduce bias of any approach – triangulation.

Assessment

- Assessment is one or more processes that identify, collect, and prepare data to evaluate the attainment of student learning outcomes and program educational objectives.
- Effective assessment uses relevant direct, indirect, quantitative and qualitative measures as appropriate to the objective or outcome being measured.
- Appropriate sampling method may be used as part of an assessment process.

Assessment tools and methods

- **Formative assessment**
  The collection of information about student learning during the progression of a course or program in order to improve students learning. Example: reading the first lab reports of a class to assess whether some or all students in the group need a lesson on how to make them succinct and informative.

Assessment tools and methods

- **Summative assessment**

  The gathering of information at the conclusion of a course, program, or undergraduate career to improve learning or to meet accountability demands. When used for improvement, impacts the next cohort of students taking the course or program. Examples: examining student final exams in a course to see if certain specific areas of the curriculum were understood less well than others; analyzing senior projects for the ability to integrate across disciplines.

Rubric

- A rubric is a set of criteria for assessing student work or performance. Rubrics are particularly suited to learning outcomes that are complex or not easily quantifiable, for which there are no clear “right” or “wrong” answers, or which are not evaluated with standardized tests or surveys. Assessment of writing, oral communication, critical thinking, or information literacy often requires rubrics.

Evaluation

- Evaluation is one or more processes for interpreting the data and evidence accumulated through assessment processes.
- Evaluation determines the extent to which student outcomes and program educational objectives are being attained.
- Evaluation results in decisions and actions regarding program improvement.

Student survey and feedback mechanisms

- Exit interview/survey
- End-of-course survey
- Student feedback may be collected through two additional mechanisms:
  - *Exit surveys administered to graduating seniors.*
  - *Student Advisory Committee.*

Concluding Remarks

- Onsite accreditation visits should focus on evidence-based assessment of attainment of outcomes
- Adequate breadth and depth of POs
- Evidences of outcomes assessment – at course level
- Evidence of Continuous Improvement process
- Outcomes folder, course folder, portfolio of student work
- Evidences from interactions with stakeholders – faculty, students, alumni, …

Q&A

Thank you