

Comparison of Different Existing Approaches to Accreditation and Assessment

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Why Bother?

Facts versus Rumors

- Significant mis-statements of fact:
 - In published documents
 - In e-mail correspondence on lists
 - In conversation, debate, and presentations
- Solution:
 - Review the facts for two models
 - AMS (American Meteorological Society)
 - ABET (specifically, for Geological Engineering)

Survey on Accreditation

- GSA Ad Hoc Committee
 - Listed **5 models** of Accreditation (not identified in the survey):
 - (1) the existing system of **no accreditation** specific to the geosciences, but a requirement for reviews by regional accrediting boards for colleges and universities;
 - (2) a general system designed specifically for the survey to be **less restrictive than any existing systems** of formal accreditation;
 - (3) the current system **used in chemistry** and administered by the American Chemical Society with modifications specific to the geosciences;
 - (4) the current system **used for geosciences in the UK** and administered by The Geological Society (London); and
 - (5) the current system **used in engineering** and administered by **ABET**.

*Quoted directly from:
Ad Hoc Committee on Accreditation,
GSA Today, Sept 2008*

First: ABET

- ABET, Inc. (formerly Accreditation Board for Engineering and Technology) is a “federation of 29 professional and technical societies.”
- It is the members of those societies who develop practices and guidelines for the various disciplines under accreditation.
- For Geological (or Mining) Engineering, the lead society is SME (Society for Mining, Metallurgical, and Exploration).

Overview (ABET)

- General Engineering criteria:

1. Students
2. Program Educational Objectives
3. Program Outcomes (a-k)
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Support

- Program criteria

(Geological Engineering):

1. Curriculum (1-6 or l-q)
2. Faculty

Overview (ABET)

- General Engineering criteria:

1. Students

“The program must evaluate student performance, advise students...”

2. Program Educational Objectives

3. Program Outcomes (a-k)

4. Continuous Improvement

5. Curriculum

6. Faculty

7. Facilities

8. Support

- Program criteria

(Geological Engineering):

1. Curriculum (1-6 or l-q)

2. Faculty

Overview (ABET)

- General Engineering criteria:

1. Students

2. Program Educational Objectives



“...must have in place:

- a) published educational objectives ... consistent with the mission of the institution...
- b) ... periodically ... demonstrate that the objectives are based on the needs...
- c) an assessment and evaluation process...”

5. Curriculum

6. Faculty

7. Facilities

8. Support

- Program criteria

(Geological Engineering):

1. Curriculum (1-6 or l-q)

2. Faculty

Overview (ABET)

3. Program Outcomes (a-k)

“Engineering programs ... demonstrate that ... students attain the following outcomes:

- a) an ability to apply knowledge of **mathematics, science, and engineering**
- b) an ability to design and conduct **experiments**, as well as to analyze and interpret **data**
- c) an ability to **design a system**, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- d) an ability to function on multidisciplinary **teams**
- e) an ability to **identify, formulate, and solve** engineering problems
- f) an understanding of professional and **ethical responsibility**
- g) an ability to **communicate** effectively
- h) the broad education necessary to understand the impact of engineering solutions in a **global, economic, environmental, and societal** context
- i) a recognition of the need for, and an ability to engage in **life-long learning**
- j) a knowledge of **contemporary issues**
- k) an ability to use the techniques, skills, and modern engineering tools necessary for **engineering practice**

.... There must be an **assessment** and evaluation process that **periodically documents** and demonstrates the degree to which the program outcomes are attained.”

Overview (ABET)

- General Engineering criteria:

1. Students
2. Program Educational Objectives
3. Program Outcomes (PO)
“... show evidence ... based on available information... [assessment]”
4. Continuous Improvement 
5. Curriculum
6. Faculty
7. Facilities
8. Support

- Program criteria

(Geological Engineering):

1. Curriculum (1-6 or l-q)
2. Faculty

Overview (ABET)

5. Curriculum

“The curriculum requirements specify subject areas appropriate to engineering but **do not prescribe specific courses**. The faculty must ensure that the program curriculum devotes adequate attention and time to each component, consistent with the outcomes and objectives of the program and institution. The professional component must include:

- a) one year of a combination of college level **mathematics** and basic **sciences** (some with experimental experience)
- b) one and one-half years of engineering topics, consisting of **engineering sciences and engineering design** appropriate to the student’s field of study. ... Engineering design is the process of devising a system, component, or process to meet desired needs.
- c) a **general education** component that complements the technical content of the curriculum and is consistent with the program and institution objectives.

Students must be prepared for engineering practice through a curriculum **culminating in a major design experience** based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.”

Overview (ABET)

- General Engineering criteria:

1. Students

2. Program Educational Objectives

3. Program Outcomes (a-k)

“The faculty must be of sufficient **number** and must have the **competencies** to cover all of the curricular areas of the program. There must be sufficient faculty ...

The program faculty must have appropriate **qualifications** ...”

6. Faculty

7. Facilities

8. Support

- Program criteria

(Geological Engineering):

1. Curriculum (1-6 or l-q)

2. Faculty

Overview (ABET)

- General Engineering criteria:

1. Students
2. Program Educational Objectives
3. Program Outcomes (a-k)
4. Continuous Improvement
5. Curriculum

“Classrooms, laboratories, and associated equipment must be adequate ...”

7. Facilities
8. Support

(Geological Engineering):

1. Curriculum (1-6 or l-q)
2. Faculty

Overview (ABET)

- General Engineering criteria:

1. Students
2. Program Educational Objectives
3. Program Outcomes (a-k)

“**Institutional support, financial resources, and constructive leadership** must be adequate to assure the quality and continuity of the program. Resources must be sufficient to attract, retain, and provide for the continued professional development of a well-qualified faculty. Resources also must be sufficient to acquire, maintain, and operate facilities and equipment appropriate for the program. In addition, support personnel and institutional services must be adequate to meet program needs.”

8. Support 

1. Curriculum (1-6 or l-q)
2. Faculty

“The program must demonstrate that graduates have:

- 1) the ability to **apply mathematics** including differential equations, calculus-based physics, and chemistry, to geological problems;
- 2) proficiency in geological science topics that emphasize **geologic processes** and the **identification of minerals and rocks**;
- 3) the ability to **visualize and solve geological problems** in three and four dimensions;
- 4) proficiency in the **engineering sciences** including **statics**, properties/strength of **materials**, and **geomechanics**;
- 5) the ability to apply principles of geology, elements of **geophysics**, **geological** and **engineering field methods**; and
- 6) engineering knowledge to **design solutions** to geological engineering problems, which will include **one or more of the following** considerations: the distribution of physical and chemical properties of earth materials, including **surface water**, **ground water** (hydrogeology), and **fluid hydrocarbons**; the effects of surface and **near-surface natural processes**; the **impacts of construction projects; the impacts of exploration, development, and extraction** of natural resources, and consequent **remediation; disposal of wastes**; and **other** activities of society on these materials and processes, as appropriate to the program objectives.”

7. Facilities

8. Support

- **Program criteria**
(Geological Engineering):
 1. Curriculum (1-6 or l-q)

Overview (ABET)

- General Engineering criteria:

1. Students
2. Program Educational Objectives
3. Program Outcomes (a-k)
4. Continuous Improvement
5. Curriculum

“Evidence must be provided that the program’s faculty members understand professional engineering practice and maintain currency in their respective professional areas. The **program’s faculty must have responsibility and authority** to define, revise, implement, and achieve program objectives.”

8. Support

1. Curriculum (1-6 or 1-9)

2. Faculty



Evaluate Critics' Claims (ABET)

- Frequent reporting
- Little or no input by professoriate
- Stifle innovation; dictate courses
- Burden of work

Reporting (ABET)

- GSA Today report re model #5 (ABET):
 - “An approx. 5-year cycle of self-reporting of course-work with content, faculty size & specialty, and resources provided to program in check-list format, student statistics (no. of majors, degrees completed), and major student:faculty ratio.”
- According to ABET:
 - A 6-year cycle, not 5-year.
 - Other details OK.

Input by Professoriate (ABET)

- GSA Today report re model #5 (ABET):
 - “Only one degree program acceptable and must meet agency specified accreditation requirements, which **may or may not reflect significant society input.**”
- According to ABET:
 - “ABET is a federation of 29 professional and technical **societies. Individual members of these societies** - practicing professionals from industry and academe - form the body of ABET through its program evaluators (PEVs), Board of Directors, and four accreditation commissions, ...”

Curriculum (ABET)

- General opinion: “stifles innovation”
- GSA Ad Hoc Committee re model #5 (ABET):
“Program content defined by requiring specific courses, which have specified content.”
- ABET: “... requirements specify subject areas... but do not prescribe specific courses.”

Burden of Work (ABET)

- Most critics: “crushing burden...”
- Most practitioners
 - ... agree.
- ABET says “... must evaluate ... must have in place ... published ... documents ... assessment ... process ... periodically demonstrates ...”

Summary: ABET

- Curriculum details are less strict than reputed.
- Those details are created by those governed.
- But... reporting and internal consistency is extremely important.
- *My editorial comments:*
 - *Some critics use invalid arguments in order to avoid ABET-style accreditation*
 - *Some program members use ABET inappropriately to prevent changes*

ABET-Accredited GE Programs

16 programs in 14 universities

[year of first accreditation]

University of Alaska Fairbanks

Geological Engineering(BS) [1941]

University of Arizona

Geological Engineering(BS) [1950]

Colorado School of Mines

Geological Engineering(BS) [1936]

Geophysical Engineering(BS) [1953]

Michigan Technological University

Geological Engineering(BS) [1951]

University of Minnesota-Twin Cities

Geological Engineering(BGeoE) [1950]

University of Mississippi

Geological Engineering(BS) [1987]

Missouri University of Science and Technology

Geological Engineering(BS) [1973]

Montana Tech of the University of Montana

Geological Engineering(BS) [1972]

Geophysical Engineering(BS) [1978]

University of Nevada-Reno

Geological Engineering(BS) [1958]

University of North Dakota

Geological Engineering(BS) [1986]

South Dakota School of Mines and Technology

Geological Engineering(BS) [1950]

University of Texas at Austin

Geosystems Engineering and Hydrogeology(BS) [2000]

University of Utah

Geological Engineering(BS) [1952]

University of Wisconsin-Madison

Geological Engineering(BS) [1995]

Another Falsehood

- “MIT doesn’t bother accrediting their programs.”
- **ABET-accredited Engineering programs at MIT:**
 - Aerospace Engineering - Information Technology(B.S.) [2002]
 - Aerospace Engineering(BS) [2002]
 - Chemical Biological Engineering(B.S.) [2008]
 - Chemical Engineering(BS) [1936]
 - Civil Engineering(BS) [1936]
 - Computer Science and Engineering(BS) [1978]
 - Electrical Engineering and Computer Science(BS) [1996]
 - Electrical Science and Engineering(BS) [1936]
 - Engineering (Course 2-A)(B.S.) [2002]
 - Environmental Engineering Science(BS) [1993]
 - Materials Science and Engineering(BS) [1936]
 - Mechanical and Ocean Engineering(B.S.) [2008]
 - Mechanical Engineering(BS) [1936]
 - Nuclear Science and Engineering(B.S.) [1980]

Now: AMS

- American Meteorological Society
- For Atmospheric Science Programs
 - Guidance; not requirements
 - No actual accreditation
 - Programs can claim to be consistent
 - Very specific course sequence

AMS in their own words

“The primary purpose of this statement is to provide guidance to ... faculty ... who are seeking to establish and maintain undergraduate programs in atmospheric science. This statement describes the minimum curricular composition, faculty size, and facility requirements recommended by AMS...”

Curriculum (AMS)

- 12 hours of ... courses, with calculus as prereq, in atmospheric thermodynamics and dynamic, ...
- 3 hours of atmospheric physics with emphasis...
- 3 hours of atmospheric measurements, instrumentation, or remote sensing, including labs...
- 3 hours in applied/specialty meteorology topics...
- 3 hours of a synthesizing experience...
- 3 semester-sequence of calculus [ODE, vector]...
- One-year sequence of physics with calculus prereq
- One course in chemistry... for physical science majors
- ...environmental (e.g. climate change), etc.

Enforcement (AMS)

- None
- Guidelines only
- Departments can claim to be in compliance
 - No effective evaluation of these claims
- Department heads and chairs recently voted, stating their opposition to any accreditation
 - See next slide for details

Resolution: October 2008 H&C

Whereas:

- There are American Meteorological Society and National Weather Service recommendations for curricula.
- The American Meteorological Society has certification programs for broadcast meteorologists and consulting meteorologists.
- Regular self-assessment, and external university accreditation and visiting committees, provide opportunities to improve our programs.

The Heads and Chairs of Meteorology/Atmospheric Sciences Departments affirm that accountability is important and that the current system is sufficient and serves the community well.

Conclusions

- Accreditation can take many forms.
- Some popular beliefs are grossly in error.
- Some published statements by those investigating accreditation are also in error.
- Most accreditation requirements are the product of those being accredited.

This subject is worthy of debate.

That debate should be based on facts, not on innuendo or “red herrings”.

- I hope I have provided you with some facts and background to help promote an intelligent discussion of the issue of accreditation of geology programs.