Q&A: Background on ABET and Natural Sciences accreditation

1. What is driving the consideration of exploring expansion into the natural sciences? Is it coming from inside or outside of ABET?

The driving force for consideration of ABET expansion into natural science program accreditation was initiated from outside ABET and has since been confirmed by the ABET Board of Directors as consistent with ABET Strategic Objectives.

ABET has had a policy for decades, starting with EAC and ETAC, that programs can approach the ABET commissions and ask for accreditation under the general criteria of that commission if there are no applicable program criteria. For EAC, this related to general engineering programs but also programs with names such as Paper Science Engineering or Plastics Engineering. There are currently 50 engineering programs accredited under the EAC general criteria that have no lead society. This number does not include the Engineering, General Engineering, Engineering Physics, and Engineering Science programs, whose lead society is the American Society for Engineering Education (ASEE), but for which there is also no program criteria. Similarly, there are 40 engineering technology programs accredited by ETAC that have no program criteria or lead society, not including the Engineering Technology programs accredited under the ETAC general criteria with ASEE as the lead society.

Following ABET's transformation to outcomes-based accreditation in the early 2000s, the ABET Board of Directors specifically voted to allow the Applied Science Accreditation Commission to evaluate programs for which there are no applicable program criteria. Programs approaching ASAC with such requests for accreditation drove the change. The change was made following renaming the commission from the Engineering Related Commission (RAC) to the Applied Science Accreditation Commission (ASAC). The Board approved the change to allow the commission to encourage a broader area of interest than the select few disciplines accredited by the commission at that time.

Some of the new programs contacting ASAC were more closely aligned to the natural sciences than ASAC had traditionally accredited, although they all included a curriculum culminating in comprehensive projects or experiences based on the cumulative knowledge and skills acquired in earlier course work, as required by the ASAC general criteria, as well as meeting the student outcomes. The first program ASAC accredited under the Applied Science general criteria was a bachelor's program in Integrated Science and Technology at James Madison University. Since then, of the programs ASAC has accredited under the general criteria, those most

closely related to natural science are Bachelor of Science programs: Petroleum Geosciences, Applied Physics, Chemistry and Pharmacobiology.

In 2013, construction management programs began approaching ABET about accreditation, preferring ABET's outcomes-based accreditation model. At the same time, those programs began looking for a society to represent their interests that would be willing to become a member of ABET and take curricular responsibility. As a result, the first two cycles of accreditation of construction management programs were conducted under the ASAC general criteria, with the understanding that when those programs applied for reaccreditation six years later, they would have to meet the construction management program criteria as well. Thereafter, the Construction Management Association of America (CMAA) became a member of ABET and took curricular responsibility for the programs, writing the program criteria and developing a pool of program evaluators.

In 2014, chemistry programs at a number of universities in Mexico approached ABET, stating that they were interested in ABET accreditation. Internationally, ABET began receiving other inquiries from physics, biology, environmental science, mathematics and others who were interested in bringing their programs in under ASAC. When ABET created a committee to consider such accreditation, ABET almost immediately received a request for evaluation from a domestic geology program now undergoing ASAC review. The Applied Science Accreditation Commission considered the potential expansion to science and mathematics as complementing the engineering and technology programs ABET accredits, such that ABET would in general accredit STEM programs. ASAC has refused overtures from programs related to the social sciences and psychology as not being consistent with the overall math and science components ASAC requires.

Another driver for natural science accreditation is the fact that a number of state educational systems and universities in the U.S. and the higher education systems in countries outside the U.S. require that all programs undergo an external review. For universities already familiar with ABET accreditation through their accredited engineering, engineering technology, computing and applied science programs, recommendation to the natural science and mathematics programs to avail themselves of ABET accreditation as the external reviewer is an attractive option. In those situations, programs have told ABET staff that by approaching ABET to be the external reviewer, they are assured of getting a quality external reviewers and at the end of the process, their programs obtain ABET accreditation and recognition.

2. Which of the natural sciences seem to be the most promising candidates for ABET accreditation? Is that promise in the accreditation of undergraduate or graduate programs? Is that promise based on feedback

from industry, government, universities or professional societies in the discipline?

The most promising candidates appear to be programs at the baccalaureate level outside the United States. ASAC has received inquiries from universities in 16 countries. The most promising candidates appear to be physics, chemistry, biology, environmental science and mathematics.

Domestically the main interest has come from geology and environmental science programs. The response of the professional societies not already part of ABET in the United States has been mostly to stay in communication with ABET, assessing over time whether ABET generates sufficient interest in accreditation of these programs. Additionally, for geology, the licensure bodies in New York and California have both contacted ABET to inform us that they are highly in favor of ABET accrediting geology programs. A state licensing body in geology sent an observer on ASAC's first geology program visit this year.

3. How many natural science programs, and what kind of programs (such as chemistry, biology, etc.), have been canvassed to see their level of interest in ABET accreditation, where they are aware of the cost, requirements [self-study, site visit], and other associated resources needed for a successful ABET accreditation process? Has ABET interacted at both the dean level and faculty-member level when seeking information?

ABET has not conducted a canvass of natural science programs to find out the level of interest. Rather, the interest is coming from programs contacting ABET. ABET did send an e-mail out to all the ABET volunteers to inquire regarding value added of ABET accreditation they saw at their universities (if they were faculty) or by their employers if they were in industry. Many of those individuals then contacted the natural science faculties at their universities to canvass interest, providing ABET with contacts at universities where faculty indicated an interest. ABET also sent an e-mail out to the institutions outside the United States that currently have one or more programs accredited by ABET to find out whether they had any interest in accrediting their natural science programs. The response from those institutions has been very rapid and strong, with one institution having submitted its chemistry, physics and biotechnology programs already for evaluation in the 2016-17 cycle. .

The programs that contacted ABET and indicated a serious interest in pursuing accreditation of their natural science programs are: 4 chemistry BS; 5 physics BS; 3 biology BS; 1 pharmaceutical chemistry BS; 1 Advanced Masters in Structural Analysis of Monuments and Historical Constructions (probably more applied science but under the general criteria); 2 math Bachelors; 1 math MS and 1 Statistics and Operations Research; and 1 environmental science program.

When programs inquire about submitting an application for review, staff directs them to the ABET website regarding costs and the process of going through Readiness Review and then accreditation review. The programs are primarily international and so far have not seemed too concerned about the cost.

4. What was the response from the natural science programs and deans (from question 3) regarding their level of interest in obtaining ABET accreditation (never, low, medium, high)?

The response internationally has been significant - particularly with universities in the Middle East and Latin America. Within the U.S., the interest so far is less, but has come from a number of parties. For example, the U.S. Coast Guard Academy and another university inquired about accreditation of environmental science programs. The ABET Academic Advisory Council was very positive to a presentation ABET staff made to them on the subject, some of them asking for more information as well for their own institutions.

5. What interactions has ABET had with professional societies for the natural sciences, such as ACS (the IEEE of the sciences---at least for Chemistry), APS, math societies, etc? What kind of feedback has ABET received from these societies regarding their level of interest in becoming a part of ABET (like ASME, IEEE, etc) knowing the associated responsibilities and investment?

The committee that ABET convened to consider the requests coming in from natural science programs contacted a number of the representative societies for natural sciences, including the American Chemical Society (ACS), the American Physical Society (APS), the Partnership for Undergraduate Life Science Education (PULSE) and through SME-AIME, some of the major societies involved with geology. ACS and APS indicated that they would watch the development of accreditation of natural science programs in their fields in the United States with interest and were leaving the door open for more communications with ABET on the subject. While ACS conducts an evaluation process of programs in the United States (but not accreditation), they do not do so internationally.

The American Physical Society (APS) sent a representative to the ABET Symposium in 2015 and we met with him, along with representatives of PULSE. PULSE has since obtained a National Science Foundation grant and is doing a pilot project for certification/recognition of programs. However, in our meetings with PULSE, it was clear that they had limited resources available to launch something as ambitious as accreditation of all the biology programs in the United States. After their initial efforts in this direction, they may become candidates (as ASSE did, for folding their accreditation endeavors into ABET accreditation).

AAEES is working with their leadership to propose taking on curricular responsibility for environmental science programs and SME-AIME is doing the same for geology programs. We have recently received confirmation that both societies will be willing to do so.

ABET has also received inquiries and visits from the director of the National Professional Science Masters Association. They have invited Larry Kaye, former ABET President, to speak at their annual meeting this fall.

6. Has there been any industry feedback collected regarding possible ABET accreditation of the natural sciences? Has the ABET Industry Advisory Council been involved in this discussion, yet? Would it be good to survey companies such as EM, GE, Proctor & Gamble, McKesson, Dupont/Dow, etc.? (Perhaps even to gather data as a selling point to programs?)

Past ABET President Larry Kaye did meet with the Industrial Advisory Council in 2015. The IAC conducted a survey of its members to assess whether industry would look favorably on ABET accredited degrees in the sciences; however, the survey was very small. Of the nine respondents, five indicated an accredited degree in natural science would add value. The other four companies indicated that they were not hiring a significant number of individuals with natural science degrees.

ABET has not done larger surveys, as indicated above, either of industry or academe, considering that the first step was to change ASAC's name. Once that has been approved, ABET will conduct a broader canvass of interest in the United States. ABET did conduct a workshop on natural science accreditation at the ABET Symposium, finding through that medium additional interest from universities in the United States.

7. Can ABET explain briefly the history and role of ASAC, including what programs currently are under its purview, to the Board of Delegates? This is a smaller commission and what programs they encompass is not clear to many of us and we are quite unaware of their strategic priorities.

ASAC originally was created as the Related Accreditation Commission in the mid 1980s, initially accrediting surveying programs, with ACSM (superseded by NSPS) as the lead society and ASCE and NCEES as cooperating bodies. Originally, ABET set up a separate structure for RAC through which societies outside the ABET engineering and engineering technology disciplines could apply to ABET to take curricular responsibility and be a lead society without becoming a member of ABET. Under this rubric, the American Industrial Hygiene Association (AIHA) applied to take curricular responsibility for industrial hygiene and similarly named programs. Later, the American Society of Safety Engineers (ASSE) and the Health Physics Society (HPS) applied to take curricular responsibility for safety for health physics programs

respectively. AIHA and ASSE jointly have curricular responsibility for environmental, health and safety programs. AAEE applied to be a cooperating society for IH programs; ANS applied to be a cooperating society for health physics programs IIE applied to become the lead society for industrial management and similarly named programs and later quality management as well. SME applied to be a cooperating body for those programs as well as the American Society for Quality (ASQ).

As noted above, in the early 2000s, RAC obtained ABET Board approval to change its name to the Applied Science Accreditation Commission, in order for the commission to expand its scope beyond just engineering-related programs.

Soon thereafter ABET amended its governing documents and in the course of these changes required that all societies with curricular responsibility for programs must become a member of ABET. AIHA, ASSE, and HPS all became member societies. HPS later terminated its membership in ABET, citing the expense of being an ABET member where so few health physics programs were accredited. HPS entered into a memorandum of understanding with AIHA for AIHA to take over curricular responsibility for health physics programs, with HPS supplying nominees for program evaluators and contributing to AIHA's cost for membership in ABET.

CMAA applied to become a member of ABET in 2013 and took on lead society status for construction management programs. The BS criteria they wrote received final approval from the Applied Science Area Delegation for this year 2016-17 visits. They have now submitted criteria for construction management programs at the master's level.

As noted above, during the period of transformation of ASAC more closely aligning with the other commissions, the Board approved ASAC to accredit programs solely under its general criteria where there were no program criteria for the particular area.

As ASAC began receiving requests for evaluation of programs where there were no program criteria, the ASAC Executive Committee enacted a requirement that any such program wishing to apply must first send their curriculum, program educational objectives and student outcomes to the ASAC Executive Committee for review to ensure they were appropriate to the general criteria. This process has served ASAC and the programs well in weeding out those programs that do not have the prerequisite courses to meet the general criteria before the programs spend the money and ABET's time on a Readiness Review.

8. Would natural-science accreditation focus on the applied nature of selected natural science disciplines and therefore be included in ASAC, as opposed to creating a separate commission for natural sciences?

The proposal embodied in the motion now before the Board of Delegates that was approved in March 2016 by the Applied Science Area Delegation and the ABET Board of Directors is for ASAC change its name to Applied and Natural Science Accreditation Commission so that it is more inclusive.

We view adding natural science to the same commission as applied science as the best course of action in order to emphasize the applied nature of the selected natural science disciplines. To be accredited by ASAC the programs must have a curriculum culminating in comprehensive projects or experiences based on the cumulative knowledge and skills acquired in earlier course work, as well as meet the student outcomes that emphasize an ability to apply knowledge of mathematics and applied and/or natural sciences to areas relevant to the discipline; an ability to design and conduct experiments, or test hypotheses, as well as to analyze and interpret data; an ability to formulate or design a system, process, procedure or program to meet desired needs; an ability to function on multidisciplinary teams and an ability to identify and solve technical or scientific problems.

We believe this to be consistent with ABET's history of accrediting programs leading to a professional practice. The APPM defines what programs ASAC accredits as follows:

Programs accredited by ASAC are those leading to professional practice utilizing science and mathematics along with engineering concepts as a foundation for discipline-specific practice, including the recognition, prevention, and solution of problems critical to society. Including this emphasis for natural science programs is consistent with ABET's solution of problems critical to society.

9. What are the costs to ABET to integrate a new program so different from engineering/engineering tech/computer engineering? What resources/who would do this (ASAC)? How does this change the number of members in Board of Delegates and Board of Directors in the near term as well as governing logistics overall in the long term if this is wildly successful?

Regarding the first part of the question, ASAC's programs have always been different from engineering and engineering technology. As for computing sciences, when ABET was originally discussing with CSAB to bring their accreditation processes into ABET, one of the suggestions was to simply fold it into ASAC, as computing sciences can be seen by some as an applied science.

Regarding costs to ABET, during the initial period they would be low since it is a small grouping of programs, and those programs are paying the costs for their visits. As noted, ASAC's Executive Committee already does

an initial review so that programs that don't come under the general criteria, don't waste their time to applying for a readiness review, or more. Given most of the programs that are considering applying do not have other programs accredited by ASAC, a large portion of them are required to submit for readiness review, which costs them $1,000. That will require that ASAC grow and we add more commissioners. In the meantime, we do ask the member societies of ABET to assist with providing program evaluators. Currently these requests are minimal. Once we get to the point where we may be successful in attracting new professional societies to join and take curricular responsibility, ABET will have both the money and personnel from those societies to cover the discipline.

It is also worth noting that due to the length of our process (18-20 months for accreditation, and several more for establishing assessment plans) we have a significant amount of time to prepare for any growth in these new areas. As a result, we would not be "caught by surprise" by a sudden demand for accrediting natural science programs.

10. Is the market seen as mostly inside or outside the US?

Both, but the initial market is outside the US. However, there has been enough interest expressed domestically from the small efforts we have made to reach out to programs to indicate that the natural science accreditation can develop in the United States, particularly among disciplines such as geology and environmental science.

11. What is the expected return on investment (ROI) and what are the specifics in how this is determined? A timeline of milestones and targets for ABET decisions on investment may be useful to the governing bodies.

The expected return on investment is to expand the ABET influence into all categories of STEM education and to continue the strategic growth of ABET as a gold standard of accreditation internationally. ABET has for at least a decade been in discussion with the major geology societies and SME-AIME about accrediting geology programs. When we began canvassing interest in natural science accreditation, we immediately had our first geology program apply for accreditation.

Our first step is to get the name change approved. The second step is to gain official recognition of AAEES and SME-AIME as taking curricular responsibility for environmental science and geology respectively. The third step is then to submit minor amendments to the ASAC general criteria and at the same time conduct a more thorough canvass of natural science and mathematics programs for interest in ABET accreditation. The fourth step is to engage industry in discussion of the benefits of ABET accreditation in the natural science arena. As we gain a growing number of

requests for evaluation we proceed to re-contact the professional societies in those disciplines which have exhibited the greatest interest. We will seek to once more engage them in discussion of joining with ABET in the accreditation.

12. What if this fails - that is, ABET takes this on and puts it in place and few/no programs sign up? What is the potential PR and credibility cost for ABET?

We are starting this initiative cautiously, so that if we end up not generating enough interest to build it out into a major component of ASAC, we will have minimally expanded the number of programs under our general criteria, increased ASAC's profile to the public, expanded our international reach and developed a stake in geology and environmental science programs in the US. ASAC's position as the fourth commission of ABET has provided it leeway for experimentation and reach that is less possible for EAC and ETAC with regards to scope of whom they accredit. We do not see a downside to this endeavor.