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Leveraging a Board of Advisors for Continuous Interaction and Improvement: Study of U.S. Military Academy's Environmental Engineering Major*

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An advisory board, often called an Industrial Advisory Board or a Board of Advisors, is generally defined as a group of volunteer external experts that support a program's activities. Many ABET-accredited engineering programs use advisory boards to help ensure that Program Educational Objectives meet the needs of programs' constituencies. The limited published research on advisory boards suggests that many boards are underutilized. Advisory boards can support programs through the following three fundamental functions: advising, mentoring, and assessing. This work shows how an advisory board can be leveraged to (1) advise by improving the curriculum and enhancing compliance with ABET criteria; (2) mentor by developing students' abilities to recognize ethical and professional responsibilities; and (3) assess by providing feedback on students' design and communication skills.

Keywords: advisory board; ABET; engineering ethics; assessment; capstone; curriculum

1. Introduction

1.1 ABET Rationale for Advisory Boards

A perceived mismatch in engineering education and the needs of industry was a key driver in ABET's evaluation of its Engineering Criteria in the early 1990s *cf*. [1]. After several years of examination, ABET promulgated Engineering Criteria 2000 (EC2000) which required, among other things, that ABET-accredited programs have a process based on the needs of the program's various constituencies in which the objectives (Program Educational Objectives, PEOs) are determined and periodically evaluated. These requirements have changed only slightly since EC2000 became effective, notably, explicitly stating that the process *must involve the program constituencies* in periodic review of PEOs *cf*. ABET Criterion 2 [2]. It appears that most ABET-accredited engineering programs created and maintain advisory boards to remain in compliance with this ABET criterion. Several studies have examined the activities, structure, and trends of advisory boards across multiple programs. Results suggest that most programs maintain some form of an advisory board, but that utilization of the advisory board varies significantly [3–8].

1.2 Advisory Board Definition and Composition

An advisory board, often called an Industrial Advisory Board (IAB) or a Board of Advisors (BOA), is generally defined as a group of volunteer external experts that support a program's activities by giving aid and advice [9, 10]. These volunteer experts normally come from constituencies with vested interests in the program and are selected based on their credentials and/or national stature in their respective field [11]. Board members have been reported to come from varying relevant backgrounds including engineering firms, consulting firms, industry, state agencies, academic faculty, and recent graduates, amongst others [12, 13]. Advisory board members contribute their time, expertise, perspective, and experience to better the program they support [10]. Advisory board size varies substantially, but each often contains between six and approximately 20 members. [3, 9].

1.3 Advisory Board Support to Academic Programs

Advisory boards support programs in a variety of

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ways, but each generally engages in activities that foster strong connections between the needs of the profession and future practitioners [6]. Advisory boards often participate in academic activities that help monitor academic program efficacy and provide recommendations to improve the quality of instruction. Examples of such activities include advising curriculum changes, course development, evaluation approaches, and accreditation efforts. Advisory boards also help academic programs keep pace with rapid changes in industry, as well as integrate cutting edge technologies [13]. Beyond academic efforts, advisory boards can help with outreach, networking, and fundraising or financial support, to include assisting with capital development [3]. Maintaining an advisory board with renowned members can help provide prestige, legitimacy, branding, access to data, and additional resources [5]. Advisory boards can further provide academic programs with contacts to businesses, industry, professional associations, and government officials [14]. Advisory boards can also directly support faculty by providing advice on career development, advice on faculty hires, and guidance concerning diversity and inclusion efforts.

1.4 Use of Advisory Boards

Despite the many reasons for having an advisory board, many programs underutilize them. For example, Söderlund et al. [8] reported that many advisory boards, irrespective of discipline, simply focus their efforts on advising on curricula, giving insight into professional trends and practices, and helping with administrative and public relations. Further, according to Lattuca et al. [1, see also 15], when surveyed about the impact of EC2000, program chairs did not consider industry feedback as having a significant, independent influence on curricular change and faculty were likely to attribute changes in curricula to their observations along with, to a lesser extent, student input. It is thought that some programs maintain advisory boards for the sole purpose of remaining in compliance with ABET Criterion 2.

Several studies have suggested approaches for increasing advisory board contributions. Zahra et al. [5] lists four obstacles that advisory boards face, which should be overcome to increase advisory board effectiveness: (1) lack of information about the overall curriculum, (2) lack of understanding where the specific academic program fits into the overall student curriculum, (3) time and availability of advisory board members, given competing requirements, and (4) board member perceptions regarding their role (i.e., perception that involvement was not part of their job). A program's reluctance to adopt advisory board recommendations or failure to share outcomes of advisory board recommendations can also be considered impediments to successful boards. Genheimer and Shehab [4] concluded that effective boards should have a clear understanding of their role and limitations in impacting the curriculum, engagements with students, active involvement in the accreditation process, and their alignment with the educational goals and objectives. Further, Jones [7] suggests that programs should deliberately leverage advisory boards for more than just annual meetings, but instead boards should directly participate in courses, labs, capstones, student organizations, competitive student events, and faculty development.

For many academic programs, there is more to be gained from leveraging the experience and unbiased perspective of the professionals who participate on advisory boards. However, several recent studies also indicate there is a lack of academic research on the operation, composition, and efficacy of advisory boards [5, 9].

The objective of this work is to describe how advisory boards can support ABET-accredited programs by advising, mentoring, and assessing while providing board members with a sense of fulfilment [10]. Examples of how the West Point Environmental Engineering Program's BOA has been utilized to improve the curriculum, enhance compliance with ABET criteria, develop students' abilities to recognize ethical and professional responsibilities, and provide feedback on students' design and communication skills are described. The experiences and contributions of the BOA presented herein are transferrable and can benefit other programs.

2. BOA Composition

The Environmental Engineering Program at the U.S. Military Academy (henceforth called West Point) produces U.S. Army leaders who have the requisite skills to be competent environmental engineers. Fig. 1 presents the relationship between needs of the program's constituents, West Point mission and goals, ABET criteria and the curriculum. The figure shows that the Program Educational Objectives are aligned with institutional requirements and the needs of the program's constituents, as represented by our BOA. The figure illustrates that our BOA provides input in all areas that are managed by the program. The program constituencies are those public and private organizations or individuals with which our graduates interact. Our constituencies are as follows:

- *The U.S. Army*. Given that all our students are educated and trained to become commissioned

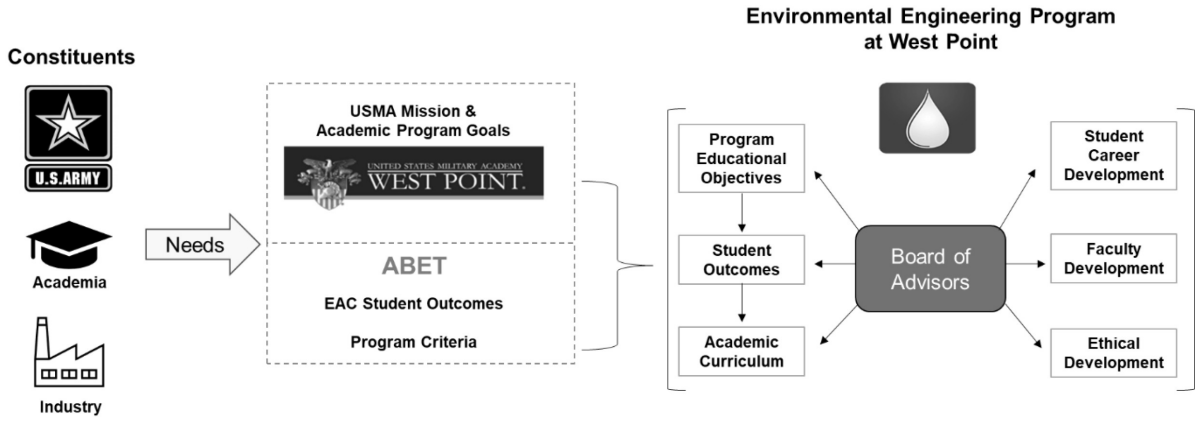

Fig. 1. Relationship between the needs of the program's constituents, the West Point mission and academic program goals, ABET requirements, the West Point environmental engineering program, and our BOA.

officers upon graduation, the U.S. Army is our principal constituency.

- *The Profession of Environmental Engineering*. Since West Point does not send graduates directly to technical engineering positions in industry or the public sector, norms of the engineering profession are applied to ensure that our program is comparable with environmental engineering programs at other high quality civilian institutions. Many of our graduates' work in the environmental engineering discipline following active duty in the Army.
- *Academia*. Most graduates of the Environmental Engineering Program do not go directly to graduate school upon graduation (ca. 1–2 per class receive scholarships and attend graduate school upon graduation). However, all program graduates are expected to pursue advanced degrees at some point in their careers. Typically, our graduates will apply for graduate school between their fifth and eighth year after graduation, when they are mid-grade officers or when they leave from active-duty service. For those who remain on active duty, their attendance at graduate school is typically followed by an assignment, which utilizes the advanced schooling experience the officer has just received. Examples of utilization tours available for mid-career Army officers with environmental engineering graduate degrees are service in a US Army Corps of Engineers Districts or Divisions, instructor at West Point, service with Senior Army staffs, or service with DOD research laboratories. If the graduate has left the Army, then opportunities after graduate school are wide ranging, and include consulting engineering firms, industry, and governmental or non-governmental organizations.

Representatives of our varied constituencies serve as members of our BOA, which is comprised of environmental engineering practitioners, environmental faculty members from engineering schools at other colleges and universities, and Army officers representing branches and services with direct connections to environmental engineering. Board membership is structured as ca. one-third military, one-third practitioners, and one-third faculty members. We have habitual relationships with some entities (e.g., U.S. Army Corps of Engineers New York City District Commander and a senior leader in the Army's Public Health Command), so that when that member leaves the board, they are replaced by another individual from that organization. Board members typically serve at least three-year terms to provide continuity. Genheimer and Shehab [4] reported that advisory boards are typically comprised of white males with strong ties to the institution. A university survey revealed that diversity of board member composition was considered desirable [16]. The USMA BOA has consistently included members from underrepresented groups and members who hail from institutions throughout the continental United States. The cultural, occupational, and geographical diversity of the USMA BOA likely engenders a concomitant breadth of viewpoints that enhance board productivity.

The inaugural BOA meeting was conducted in July 2001 with subsequent face-to-face meetings conducted in fall or spring. Meetings have been conducted in remote mode since 2020 in response to the COVID19 pandemic. In addition, we have continual dialogue with selected BOA members throughout the year e.g., to support capstone projects.

A portion of the BOA's charter describes its purpose as follows: "the BOA shall inquire into the curriculum, instruction, physical facilities, equipment, faculty, fiscal affairs, academic methods, and other matters relating to the delivery of the

environmental engineering curriculum within the academic program of the U.S. Military Academy as directed by the [department head]. Particular consideration should be made to ensure the Department is providing an environmental engineering program that is relevant to the mission of the U.S. Military Academy and meets the requirements of appropriate accreditation bodies such as [ABET].''

3. BOA Functions and Contributions

Our BOA has evolved from an annual meeting to a continual relationship with on-going dialogue throughout the year. Since 2001, the program and BOA have addressed all aspects of the BOA charter except for fiscal affairs. Examples of substantial contributions relating to the fundamental functions, *advising, mentoring, and assessing*, are discussed below.

3.1 Advising

The BOA has been involved in the creation, revision, and review (at least every three years) of the PEOs since they were incepted in 2002, which is a requirement of ABET EAC Criterion 2 [2]. Program (Student) Outcomes were also developed with substantial input from the BOA in 2002 and remained in effect until the BOA recommended that the verbatim version of ABET EAC Student Outcomes (a–k) be adopted in 2010, followed by transition to Student Outcomes (1–7) in 2017 [2].

The BOA has been involved with all curriculum changes that involve addition or deletion of program courses, which have been numerous over the past 20 years. Table 1 shows a comprehensive list of West Point environmental engineering courses and the influence that the BOA has had on each. Our process for course curriculum changes typically involves providing read-ahead background information prior to the annual BOA meeting followed by a presentation and discussion. We've also formed small working groups to brainstorm and recommend a course of action when many options existed. In 2018, we took this approach and held a vote on potential courses of action following our general discussion. The last step in the process is to close the loop by presenting the final changes during the BOA meeting that follows acceptance of the

Table 1. Major revisions to the West Point Environmental Engineering Curriculum (2015 to 2025 graduating years). Influence from the BOA on each course is listed in the far-right column.

		Graduating Year				
Environmental Engineering Courses		**2015–2018**	**2019–2021**	**2022–2024**	**2025 +**	**Board of Advisors Influence**
EV201	Intro to Environmental Eng. Design	–	–	–	x (4)	Discussed creation and content of course over 4+ years (2018–2022)
EV301	Environmental Science for Engineers	x (5)	x (3)	x (3)	x (3)	Discussed course creation (2005) & movement to sophomore year (2018)
EV388A	Geology	x (5)	x (5)	–	–	Discussed removal of this course from curriculum (2018)
EV396	Environmental Biological Systems	x (6)	x (5)	x (6)	x (6)	Discussed addition of course to curriculum and course content (2005)
EV397	Air Pollution Engineering	x (6)	x (6)	x (6)	x (6)	Discussed major content changes (2005)
EV394	Hydrogeology & Hydraulic Design	x (7)	x (7)	x (7)	x (7)	
EV400	Environmental Engineering Seminar	x (8)	–	–	–	Discussed initial course creation (2000) & replacement with EV491 (2018).
EV401	Physical & Chemical Treatment	x (6)	x (6)	x (6)	x (5)	Discussed major content changes (2005)
EV402	Biochemical Treatment	x (7)	x (7)	x (7)	x (7)	
EV481	Water Resource Planning & Design	x (7)	x (6)	x (6)	x (6)	Discussed movement of course to junior year (2018)
EV488	Solid & Hazardous Waste	x (8)	x (8)	x (8)	x (8)	
EV490	Environmental Engineering Design	x (8)	x (7)	x (7)	x (7)	Discussed this being the first semester of design (2018)
EV491	Advanced Enviro. Eng. Design	–	x (8)	x (8)	x (8)	Discussed creation of this course for additional design (2018)
XS391	Environmental Chemistry	x (5)	x (4)	x (4)	x (4)	Discussed course creation (2005) & movement to sophomore year (2018)
EV489A	Independent Study	Required for Graduation w/ Honors				Discussed addition of more independent study courses
No. of Electives		3	3	4	2	Has varied given curriculum adjustments. All changes discussed with BOA.

Pre-requisite Course		**2015–2018**	**2019–2021**	**2022–2024**	**2025 +**	
CH101	General Chemistry 1	x (1)	x (1 or 2)	x (1 or 2)	x (1 or 2)	Each listed course is a core requirement. Discussed placement of several courses within the 8-semester program. Courses with adjusted terms are reflected in the table.
CH102	General Chemistry 2	x (2)	x (2 or 3)	x (2 or 3)	x (2 or 3)	
EV203	Physical Geography	x (3)	x (1, 2, or 3)	x (1, 2, or 3)	x (1, 2, or 3)	
MA103	Mathematical Modeling	x (1)	x (1)	x (1)	x (1)	
MA104	Calculus 1	x (2)	x (2)	x (2)	x (2)	
MA205	Calculus 2	x (3)	–	–	x (3)	
MA206	Probability & Statistics	x (4)	x (3)	x (3)	x (4 or 5)	
MA364	Engineering Mathematics	–	–	–	x (4)	
MA366	Applied Engineering Math	x (6)	x (6)	x (4)	–	
PH205	Physics 1	x (3)	x (4)	x (4)	x (3)	
PH206	Physics 2	x (4)	x (5)	x (5)	x (4 or 5)	

x = course taught these years. ( ) = semester taught (1 to 8).

curriculum change by the institution. Indeed, for BOAs to be effective, the board must feel like they are part of the decision-making process and programs must follow through on recommendations [11].

An example of the BOA's influence on curriculum development is highlighted through the modifications to math courses our students have taken to meet ABET Program Criteria 1.a (i.e., mathematics through differential equations) over the last decade. Prior to 2018, students took MA205 (Calculus 2, 4.0-credits of math) and MA366 (Applied Engineering Math, 3.0-credits, 1.0-credits of which were coded as engineering topics, ET). After in-depth examination of course options, the BOA recommended to pilot a 4.5-credit engineering math course, which ultimately became a revised version of MA366. On-going discussions of the course between the BOA and program leadership occurred between 2018 and 2021 as the revised MA366 was piloted for students graduating after 2019.

3.2 Mentoring

3.2.1 Ethics Case Study Seminar

3.2.1.1 Structure

At all in-person BOA meetings, members are given time, without faculty presence, to interact with the students. Initially, this was structured with an hour long "sensing session" and follow-on lunch to explore the student perspective on meeting topics in greater depth. This was informative but was limited as BOA members did not get the opportunity to "assess" student problem solving or demonstrating competence in the program objectives and outcomes. This approach created a very "transactional" experience for both sides. Consequently, the BOA members expressed a desire to have more direct interaction with the students to gain a better understanding of the student's abilities. Therefore, our program created an ethics case study seminar wherein students and BOA members worked in small groups (ideally dyads) to explore a current environmental problem with ethical considerations.

The environmental program created a meaningful role play scenario predicated upon the student viewing the issue through the lens of an early career staff engineer. This format was adapted from practices used within the West Point Character Development Program that used monthly Leader Challenges to foster small group discussions around professional military ethics issues. The BOA members were partnered to create a more "intimate conversation space" whereby they would role play an engineer with more experience that could represent the viewpoint of different stakeholders appropriate to the scenario (i.e., principal engineer, company leader, government regulator, community member, etc.). In this approach, a current and relevant environmental issue, often of national prominence, was chosen such as:

- The Flint, Michigan crisis [17].
- The West Virginia Freedom Industries MCHM spill [18].
- PFAS in Newburgh, New York [19, 20].

The students and BOA members were provided materials in advance (i.e., mainly newspaper articles, YouTube video, reference article), which provided all participants with a general understanding of the problem. Dyads were given responsibility for a specific perspective (i.e., person who caused the issue; regulator; local community; consultant). The experience was split into four evolutions (Table 2) to help refine the conversation and achieve more depth of analysis. Following each evolution, the faculty moderator steered a discussion with the entire group. The seminar concluded with an evaluation (step 4) via group discussion on important takeaways from each dyad. The fourth evolution also included a post-seminar, short, reflective essay that was completed by the students.

3.2.1.2 Advantages

This approach met the BOA request to have a "more direct interaction with students" through participating in a common professional dialogue. It also supports the guidance outlined in the BOA

Table 2. Structure of the Ethics Case Study Seminar

Evolution	Thematic Goal	Relevant Question
1 (Remember)	Summarize the Scenario	What happened? What action/inaction are we role playing?
2 (Apply)	Articulate Potential Ethical Considerations	What are the ethical implications for our group? Are there interactions with others we should consider?
3 (Analyze)	Structure possible actions	What would you do? Biggest concern?
4 (Evaluate)	Reflect on the case study and discussion (also included a post-seminar reflective essay) What did you identify as the most challenging ethical aspect?	What was the main takeaway for you in terms of ethical decision making? What was one insight you gained from the BOA Member?

charter. During the first three evolutions, the BOA members were able to witness the students' ability to understand an engineering problem, integrate reference material, identify gaps in knowledge (i.e., formulate questions), and communicate their observations and opinions. It is important to highlight that this activity was focused upon creating discussion and sharing insights and not trying to "solve" the problem. This was critical to reduce the burden on the students and BOA members within a very constrained time limit (ca. one hour). The BOA members' direct interaction with students allowed them to make personal observations that could be shared with other BOA members and program faculty. This allowed for a wider discussion amongst BOA members and program faculty instead of the generalizations that were often made from a large group approach, which underscores an advantage of a "distributed" versus "centralized" (i.e., student focus group) approach. BOA members were able to engage with students in more depth than the typical superficial level achieved in group settings. The topic of ethics is very broad and encompasses many facets based upon participant's interest, interpretation, and experience. We focused our discussion on the Acts of Omission framework [21] to specifically identify any "act of omission or willful negligence" by different scenario stakeholders. The BOA members drew on their extensive experience to help students differentiate between a legal consideration versus ethical dilemma. This was a valuable aspect of the seminar because it is often a difficult aspect to integrate into an engineering curriculum. Additionally, the participants could use reference models such as the NSPE Model Rules [22] or the ASCE Code of Ethics [23].

3.2.1.3 Challenges

A faculty member is needed to develop and moderate the case study. Identifying case studies and curating information can be time intensive. However, case study development does gain efficiency in subsequent years as the case study *process* does not change dramatically, which results in a return on investment. The most important role of the moderator is to facilitate the case study and manage the time, which is fleeting! This can cause a bit of discomfort in early iterations as there is a natural propensity to want to discuss the technical aspects in more detail than time will allow. We observed that our BOA members became masterful at managing the discussion during their second iteration, so it might be useful to run an abbreviated version to help the BOA members prepare for the transitions between the evolutions. We have small class sizes, so it was easy to create dyads (group of three in extreme cases). This might be challenging for larger programs and there might have to be consideration that not all students get to complete the assignment with a BOA member. In extreme cases, we have considered including other faculty members in the seminar so that group size never exceeds 3–4:1 ratio. This is critical so that each student gets their fair share of speaking time.

3.2.1.4 Evaluation

A comprehensive evaluation of the ethics case study seminar is presented elsewhere [24]. In general, the seminar provided an opportunity for increased interaction between students and "experienced mentors" equally valued by each group. The goal to achieve interactions within the seminar framework positively contribute to student confidence in meeting course objectives and integrating different perspectives into their development (both mindset and skillset). The ethical case study allowed students and BOA members to have constructive dialog and ensure enough turn taking to have a positive experience. As we observed the dyads, one of the most positive experiences was hearing the BOA members empower the students by asking them, "what do you think?"

3.2.2 Order of the Engineer

The Order of the Engineer website states the following regarding its purpose, "The Order of the Engineer was initiated in the United States to foster a spirit of pride and responsibility in the engineering profession, to bridge the gap between training and experience, and to present to the public a visible symbol identifying the engineer [25, 26]. We have been inducting our students into the Order of the Engineer since 2004. Our induction ceremonies have ranged from formal dinners to a short vignette prior to a capstone design course lesson. In 2019, we conducted the Order of the Engineer ceremony immediately after the ethics case study seminar and a member of the BOA discussed significant ethical and professional responsibilities required of each soon-to-be graduate. Coupling of these events made the Order of the Engineer induction ceremony more impactful.

3.2.3 Social Engagements and Course Participation

The program has used a variety of opportunities to connect our students with the BOA. Informal assessment (based on discussions with Cadets and BOA members) revealed that the Projects Day presentations and ethics case study seminars [24] have been the most impactful student-BOA engagements. We have also invited our students (mostly seniors) to closed door sensing sessions (no faculty) with the BOA, where we asked one BOA member to

record meeting minutes while keeping student comments anonymous. We met with the BOA members immediately following the sensing session to discuss the minutes (which were also included in our final meeting minutes). Although some useful information was gained via these discussions, much of the feedback centered on critiques of core and required courses in the major (many outside the program) that could not be addressed. We have found that informal gatherings at lunch, Arbor Day tree plantings, or on our program's Hudson River boat ride provided comparable insights without the loss of an hour of meeting time for a formal sensing session. Noteworthy feedback from these gatherings has been shared in ad hoc discussions later during the meeting and during post-meeting email exchanges.

BOA members have served as guest speakers in our water resources course. Well received lectures were centered on the design of the New York City water supply system and the U.S. Army Corps of Engineers response to disasters such as Hurricane Katrina. The BOA has also been a resource for many of our military faculty who have received outstanding mentorship through countless conversations with senior active-duty officers on the BOA regarding career management during social gatherings. In addition, our faculty have received outstanding advice on course content and potential capstone projects from practicing engineers and academics on the BOA.

3.3 Assessing

3.3.1 Participation in Projects Day

ABET's Criteria for Accrediting Engineering Programs (2020) requires "a culminating major engineering design experience," sometimes referred to as a "capstone" project, as part of the engineering curriculum described in criterion 5 [2]. In addition, criterion 4 of the same document requires a systematic assessment process to enable continuous improvement [2]. Given the capstone's requirement to build on earlier coursework and its placement toward the end of the curriculum, its assessment is a critical piece of the improvement process for the program.

Our program has leveraged the BOA's extensive professional and academic expertise in capstone assessment (cf. [27] for a capstone example). On several occasions, BOA members have served as independent study mentors or capstone project clients. For example, one BOA member who works for an engineering design firm has mentored 12 students over an on-going three-year period. In this capacity, he has spent countless hours helping students understand the design process, proofreading student products, and enhancing communication skills by providing constructive feedback to student oral presentations. Most recently, students have studied the design and implementation of an anaerobic co-digester capable of receiving food scrap waste, fats, oils and grease (FOG) and wastewater sludge. The implementation of such a digester at our small wastewater treatment facility, which treats ~2.1 million gallons per day (~7950 $m^3\ d^{-1}$), is relatively unique and also offers opportunities for independent research.

In addition, we aligned the annual BOA meeting with our university's "Projects Day," during which the final capstone designs are presented in both a poster session (akin to a conference poster session) and a platform presentation. These briefings and sessions are integrated into the Board's meeting schedule (Table 3) so that each member can view the presentations and ask questions of the students. Board members have provided comments back to the faculty in either a formal completed rubric for each project, or in a more informal fashion. The formal completed rubric applies to the posters, and the average ratings of all board members contribute to 40% of the design group's overall poster grade. The rubrics focus on both the poster itself (content and quality of design) and its presentation – i.e., the ability to communicate the objectives, methods, and results, as well as the ability to "sell" the design.

This initiative has generated useful feedback for the program. Not only does the board get to interact with students on technical topics, but also, they are able to see quantitative results from all seven ABET outcomes – not just design, but communication, teamwork, acquisition of new knowledge, etc. This informs their holistic assessment of the program and their subsequent feedback to the faculty. It also provides an "external review" for the capstone design class, thus enabling its continuous improvement. This feedback from one BOA member on Projects Day sums up its value for the board:

> "The projects were varied and touched on all of the recommendations that the BOA had provided to the [West Point] EV faculty for the potential structure of the capstone course. The BOA served as an external evaluating body for each of the capstone teams, listening to presentations, asking questions, and evaluating students on not only the technical aspects of their work, but their professional presentation skills and their attention to detail regarding customer needs. Thus, the BOA was integrated into the evaluation process in real-time, not simply after the process had been completed. This mode of operating helped to engage BOA members more thoroughly, and also provided students with additional external professional feedback on their efforts. The conversations between students and BOA members also led to follow up conversations that sparked additional projects for future years."

4. Typical BOA Visit

A BOA visit schedule from a recent meeting is presented in Table 3. This two-day schedule represents one of our busier meetings as most of our annual meetings have been conducted during one business day. A substantial benefit of the two-day visit was to allow BOA members to engage directly with students amongst several activities (i.e., ethics case study, Projects Day judges, lunch, boat ride social, etc.). The result was that BOA members developed a deeper holistic understanding of how students were achieving within the curriculum when compared with a one-day visit. This directly translated into BOA members (1) feeling more informed to make recommendations and (2) initiating ideas and topics for further exploration that the faculty had not previously considered. In sum, integrating BOA members in several activities with the students enhanced the impact that they could make in their service as advisors.

5. Discussion

The approach presented herein can be used to overcome the four obstacles to successful advisory boards described by Zahra et al. [5]. For example, obstacles associated with lack of information about the overall curriculum and lack of understanding where the specific academic program fits into the overall student curriculum [5] can be addressed by asking members to participate on the BOA for at least three years. Moreover, our meetings include diverse events (to include interactions with students), which facilitate a high level of engagement and concomitant understanding of curriculum and personnel. Finally, we have found that our BOA members are willing to review read-ahead material (including course catalogs) prior to meetings, which also helps to improve understanding of the curriculum coming into the meeting. Zahra et al. [5] also reported that availability of advisory board members can be limited given competing requirements. To be sure, we typically have a few BOA member absences during our annual meetings. We endeavor to surmount this challenge by maintaining at least nine members on the board and planning meetings at least six months in advance. Moreover, we include a variety of activities [see also, 7], in addition to formal sensing sessions, to encourage member attendance at our meetings. Most importantly, we stive to adopt advisory board recommen-

Table 3. Example U.S. Military Academy Board of Advisor Schedule

Day 1	
Time	**Activity**
Noon – 12:30	Board of Advisor (BOA) Member Reception and Transportation
1:00 – 1:20	**Welcome Session:** Introduce BOA Members and USMA Faculty
1:30 – 2:15	**Session A:** Review of Previous Year's BOA Meeting & Minor Curriculum Changes
2:30 – 3:00	**Session B:** Revised Evaluation Criteria (ABET 1-7) and Resulting Assessment Changes
3:10 – 4:00	**Session C:** Annual Program Assessment & Discussion of FEE Trends (Focus on Math)
4:10 – 4:20	Review of Next Day's Schedule
4:20 – 4:45	Transportation to Hotel
4:45 – 6:00	BOA Personal Time
6:00 – 6:15	Transportation to Dinner
6:15 – 9:00	BOA Dinner with USMA Faculty
Day 2	
Time	**Activity**
7:00 – 7:30	BOA Member Reception and Transportation
8:00 – 8:30	Discussion of Capstone Projects & Independent Studies
9:00 – 11:45	West Point Projects Day & Poster Evaluations
11:45 – 2:00	Projects Day Award Presentation
12:00 – 2:30	Lunch with Cadets
12:35 – 2:45	Group Photo
1:00 – 1:50	**Session D:** Ethical Challenges with Senior Environmental Engineering Majors
2:00 – 2:30	Order of the Engineer Ceremony
2:30 – 2:45	Closing Remarks
2:45 – 3:30	Projects Day Activities as Desired
3:30 – 4:00	Transportation to Hotel
4:00 – 5:15	BOA Personal Time
5:15 – 5:30	Transportation to South Dock
5:30 – 7:30	Boat Ride with Senior Environmental Engineering Majors
7:30 – 8:00	Transportation to Hotel

dations and we always share outcomes of advisory board recommendations, e.g., curriculum changes, which were actioned at the intuitional level. Finally, Zahra et al. [5] found that board member perceptions regarding their role (i.e., perception that involvement was not part of their job) can be an impediment to member participation. We have not observed challenges with respect to this potential obstacle, perhaps because we identify members through our professional networks and participation is strictly voluntary. Genheimer and Shehab [4] reported that effective boards should have a clear understanding of their role and limitations in impacting the curriculum, engagements with students, involvement in the accreditation process, etc. Our BOA charter provides BOA members with a clear understanding of their function and process that integrates BOA and the department.

6. Conclusion

In most cases, the function of advisory boards is to reinforce the positive aspects of the curricular experience in achieving the defined objectives and outcomes. But, in our opinion, the true end state is to inculcate a culture of a ''learning organization.'' We have meetings with our board for at least a full day and we arrange activities to maximize their time including discussing business during meals, even informally. A high level of engagement is promoted because the activities in our BOA meetings are quite diverse. BOA members have commented that there is much to be gained about the effectiveness of the curriculum and the abilities of our graduates through interactions with our students, especially during Projects Day and during our ethics case study seminars. The West Point BOA accomplishes its tasks of reviewing most facets of the program in an active and engaging fashion. In short, our BOA paradigm engages the members in an ''active learning'' environment.

So, are your advisory board members volunteering their time, experience, and insights to solely review curriculum and vote on program changes? Or, more aspirationally, are they an integral partner to create and evaluate the future engineer graduate? We suggest that program advisory boards be leveraged via advising, mentoring, and assessing.

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