Advisory Board Meeting: 8 April 2022

COL Burpo's Remarks:

- Elective offerings are a priority, under constraint that the Army likely won't support additional faculty
- The bioengineering track offers the ability to offer engineering track in-house, and align to core disciplines
- 3 courses won't cover everything (BIO track). How we balance:
  - CH300: brings bio concepts to the ChemEs and the math concepts to the Chem/Life Science cadets
  - CH350: ChemE focused, implementation of a bio process at industrial scale
  - CH450: "Capstone", fully devoted to problem sets and projects that cover industrial and bioengineering processes (*Only class that is codified in curriculum*)
  - CH300 and CH350 are in the process of being codified and hope to be added to course guide in Fall of 2022
  - Research track is now in process, specifically blood rheology and can cover from the 200 through 400 level

LTC Armstrong's Remarks/Program Assessment:

- Dr. Biaglow, treating the off-years serious with annual documentation to provide the accreditation committee eases the review cycle
- Possible challenges to recruiting new majors: COVID, balance of STEM/Lib-Arts at USMA, recruiting effort
- Dr. Biaglow points out that for a 4K Undergrad population school that there is 12 PEVs providing a lot of valuable feedback and guidance
- Program places and emphasis on independent research: intellectual development, application of concepts, publications for grad school applications, wholistic approach. Department averages 150 research cadets per year, panel was "wowed."
- Biaglow: MC311 and M312 are separating to separate fluids and thermodynamics. CH365 (ChemE Thermo) will be more chemical Eng. Focused, ie activity constants, fugacity, etc… Thermo has always been a low score on the FEE, but has since gone up with addition of CH365
- FEE performance: approximately a 10% or 15% jump after CH400 implemented. CH400 has topical review and then deep-dive into ChemE specific topics. Quizzes and WPRs internal with Kaplan review as well.

Cadet Feedback:

- Cadets think the world of the ChemE department. ChemE department knows the cadets better. Socratic method is used: taught the ideas then must apply the ideas to solve a problem. Non-ChemE are large classes and don't get the personal interaction.
- ChemE is very teamwork based and encouraged. Other departments are very individual focused and get points deducted for teamwork.
- ChemE professors help more with regard leader/professional development, vs even TACs.
- There is interest in a survey course, or ability to enter department earlier
- Bio track is well-received; significant cadet interest
- Courses the **cadets** want addressed:
  - PH202/EE301: so much overlap that the cadets feel they're taking the same class twice. Nothing particularly gained from PH202
  - MC311/MC312: generally good classes, but lots of overlap to CH365
  - CH400: add environmental problems
  - CH402: split over two semesters
  - CH484: Add to give more understanding to chemical reaction mechanisms

Future Challenges:

- Future goal (next 5-10 years) is become a top-ten program
- Program director is concerned that the program faculty is limited with admin overhead (CH101/102) and thus limits ability to grow the program/bio-engineering track/minor
- Panel member suggested the larger size isn't the important thing, but rather the quality. Put a cap on the program (36 to 44 cadets) so that we can keep the great instructor-cadet ratio
  - Benchmark for growth: **keep** the **36** registered for **5 years**
  - Outstation suggested receiving additional funding for hiring temporary faculty (over-hire)
- Current ChemEs are the best recruiters/ambassadors for the program
- Future additions of course curriculum:
  - Pharma topics (already part of CH350, but could expand; add pharm rep to advisor board?)
  - Data Science Engineering (already proposed at USMA)
  - Integrate Bio-Engineering (currently resource constrained)
- Integrating faculty and cadet development; not typical to most universities

ABET Review Full Notes (Click Here!)

❖ COL Burpo's Remarks

- USMA has fixed faculty model
- Elective offerings is a priority, under constraint that the Army likely won't support additional faculty
- BioEngineering Track, 3CES, & Minor
- 9 years ago, we offered the first bio-engineering course "Survey Course"
- The bioengineering track offers the ability to offer engineering track in-house, and align engineering track to core disciplines
- Bioengineering minor sits at the interface between two disciplines (chem/life science/engineering) and would allow them to gain cross-discipline knowledge
- Minors are 5-course obligations, but two can be double-counted from the cadet's major core courses (ultimately 3 additional non-major courses)
- 3 courses won't cover everything (BIO track). How do we balance:
  - CH300: brings bio concepts to the ChemEs and the math concepts to the Chem/Life Science cadets
  - CH350: ChemE focused, implementation of a bio process at industrial scale
  - CH450: "Capstone", fully devoted to problem sets and projects that cover industrial and bioengineering processes (*Only class that is codified in curriculum*)
  - CH300 and CH350 are in the process of being codified and hope to be added to course guide in Fall of 2022
  - Caveat to the Caveat: research track is now in process, specifically blood rheology and can cover from the 200 through 400 level
- Memorandums are currently in circulation for approval and identifying the changes needed to implement the CH300/CH350

- Patrick Underhill Q: does the sequence have to be taken in order
- COL Burpo: sequencing is difficult due to the course load. Thinking through restructuring prereq's, coreq's or independent courses
- COL Hill: CME excited for the opportunity but acknowledges that making fit for their majors will take some discussions.

❖ LTC Armstrong Intro:

- opens with introducing new ChemE faculty members
- addresses agenda
- thanks ABET advisors
- Milanesa and England alumni highlights
- USMA mission
- COL Burpo highlighting that the Nation's problems will have huge technological challenges that our leaders will have to face
- Program vision, highlighting that the advisory board assisted with refining
- Program mission
- 500 lb Gorilla in the room: ABET 2025-26
- Dr. Biaglow, treating the off-years serious with annual documentation to provide the accreditation committee eases the review cycle

- COL Hill points out the CL2023 down turn in overall majors
- Factor hypothesis of COVID recruiting factor
- Group discussion identifying that could be a real factor and show that ChemE has to be specifically recruited for
- COL Burpo points out general trends between STEM and Lib Arts at the academy and leadership conversations of whether we have the correct balance
- Dr. Biaglow points out that for a 4K Undergrad population school that there is 12 PEVs providing a lot of valuable feedback and guidance
- Spiral cycle as a controls
- Timeline of curricular actions
- Overview of course brief quad charts

- 0920 Break and minuteman change over

- 0935 Reconvene (Program Assessment)
  - Biaglow: MC311 and M312 are separating to separate fluids and thermodynamics. CH365 (ChemE Thermo) will be more chemical Eng. Focused, ie activity constants, fugacity, etc… Thermo has always been a low score on the FEE, but has since gone up with addition of CH365
  - Burpo: how do we link all of the intellectual research and advancement to a cohesive product? Trying to onboard cadets to research activity that can be carried over the summer with research partners then come back to USMA and continue the research. This allows cadets more opportunity to publish and get opportunities to enter higher level academic programs. Average 150 cadets in research program, per semester. (*The panel was 'wowed'*)
  - Armstrong/Biaglow: performance average metrics shown. CH400 is FEE prep, but strongly objective and forces students to apply ChemE principles. MC300 is rated low consistently by the cadets (least favorite), it now is 3-dimensional and has transitioned to being a pretty rigorous course vs a "joke." COL Hill noted it's likely going to stay 3-dimensional and won't deviate too much back to original version
  - FEE performance: approximately a 10% or 15% jump after CH400 implemented. CH400 has topical review and then deep-dive into ChemE specific topics. Quizzes and WPRs internal with Kaplan review as well.
  - BREAK for 1000 Cadet Survey

- Reconvene
  - Cadets think the world of the ChemE department. Cadets like our program more than other engineering programs. ChemE department knows the cadets better. Socratic method is used: taught the ideas then have to apply the ideas to solve a problem. Non-ChemE are large classes and don't get the personal interaction. PH101, PH102, and EE301 give equations, but don't instill the understanding of what the equation is used for (*Plug and chug*). ChemE, very teamwork based and encouraged. Other departments are very individual focused and get points deducted for teamwork.

- EE301: too broad, redundant because of content covered in PH102. Cadets asked for problem-sets to cover programming and circuits.
- ChemE professors help more with regard leader/professional development, vs even TACs.
- Biaglow: other departments have more students with same number of faculty.
- Students know that they're limited in courses, but there's overlap for EE301 to PH102 and ChemE thermo to MC311/312.
- Students wished they could do a survey class or get into the department sooner/earlier. Develop ChemE identity early.
- Process design split over two semesters. Content is packed into one semester that is 'overwhelming.'
- One cadet noted that organic chem – 2 would be useful.
- FEE training (CH400), cadets didn't see environmental training/content in the class but encountered it on the FEE. Suggested dropping MC311 to accomodate.
- Bio engineering classes were very well received. The track appears as a personal growth method and the cadets are extremely interested in it.
- No commentary on CH459 in regards to credit-hours.
- Next year, the panel would like to have the course descriptions/content for each required course.
- Impacts of COVID: this group feels like they dodged a bullet.

- Future Challenges:
  - Biaglow/Armstrong wants to get to the top-10 list as a program (next 5-10)
  - Armstrong is concerned that the program faculty is limited with admin overhead (CH101/102) and thus limits ability to grow the program/bio-engineering track/minor
  - Glaser: maybe the larger size isn't the important thing, but rather the quality. Put a cap on the program (36 to 44ish) that we can keep the great instructor-cadet ratio
    - Keep the 36 registered for 5 years
  - Glaser: Current ChemEs are the best ambassadors of the program. Biaglow noted they already do that at the open houses.
  - Outstation: increase external funding to support additional faculty (post-docs, etc…). Set up a permanent funding stream for faculty (over-hire?).
  - Highlighting the benefits of the cadet outreach and DCA support

- Effects of COVID:
  - Schedule changes, discussion since 2019 the impact of the addition of study days

- ChemE projection slide
  - ABET requires a list of "actives" published on the website, violation requires correction
  - Cadets that graduate but do not commission
  - Electives discussion

    - Is there a place that cadets can learn about Pharma topics
        - CH350
    - Should there be a Pharma rep on the advisory board
    - Nat'l center of medical intelligence & NJIC (Dr. Biaglow fielded)
    - Data Science Engineering proposed at USMA
    - Integration of Bio engineering is resource constrained
- ABET approval in 2021 was approved with all strengths
    - Fire extinguisher anecdote during 2021 PEV
    - Provide Program Course brief slides to Advisor

- Academic promotions
    - Cadet and faculty development are two pillars that are not typical to all universities

Summary and Minutes of the Chemical Engineering Advisory Board Meeting on 7-8 April 2022

The advisory board is asked to comment on various aspects of the curriculum, the meeting content, and any other issues that they would like to raise. The survey questions are underlined and in bold font below, followed by responses of individual members. A summary in red font appears at the end of each section.

Based on the assessment data or on your personal opinion, is there a course that the program should add to the curriculum?

Dietrich: Several students pushed strongly for organic chemistry 2 as it is very necessary to focus on future chemical engineering. Suggested as an elective. Noted organic 1 was not focused toward chemical engineering for FEE prep. Additional emphasis toward environmental engineering issues. Perhaps a course addition.

Garvey: Not presently. Bioengineering is a huge step.

Glaser: An early (2nd year) survey/overview course on chemical engineering.

Hair: Consider pharmaceutical processing and synthesis as part of a course (we discussed this in the round table). I believe Drs. Yuk and Nagelli may do this or have a way forward. On data science, I have been doing research work in this area and may have some input for R&D projects anyway.

Hill: "The challenges and opportunities of today and tomorrow cannot be addressed by single discipline," Dean's Annual Guidance (AY22). C&ME would like to partner with your team to deliver a high-quality bioengineering minor, and we are appreciative of the collaboration thus far with meeting #1. Consider a 1CH course in their yearling year where they can all meet together as a cohort, learn more about their field, hear about research opportunities, meet the faculty, and do something fun. Why take MC300? Are we sure MC300 topics are on the FE? My guess is they need the ET credits, but perhaps there are more relevant courses that can meet that need.

Krishnamoorthy: I commend you on having a well-rounded curriculum! It appears that you have only one laboratory course (CHE 459 during the Senior year). Do students get adequate opportunities to learn to communicate effectively in oral and written formats in other courses (CHE 400 and 402)? Are students exposed to computing tools or numerical methods anywhere in the curriculum? (MA 206?)

Liberatore: Intro to ChE (and BioE) 1 credit to get students into department earlier. Keep growing / refining bioengineering courses and research options.

Schultz: I think further development in the bio area is a great idea. There were also some areas of redundancy that the cadets identified. Some material is repeated in thermos-fluids and the chemical engineering thermodynamics courses and physics and the EE course that they take. If these redundancies are eliminated it could make room for future courses and, if possible, in the West Point structure to get a course provided to the cadets earlier in the program so they can get started with ChE earlier.

Shipe: Currently, I don't think there is an additional course needed. The cadets seem to be having an issue making the connection between the non-ChemE engineering courses and their courses within the

ChemE department. This may be difficult to address as these courses are not controlled within ChemE and are designed to prepare cadets in multiple disciplines, but perhaps the addition of a research elective helping make these connections, or adjusting curriculum in existing courses (such as connecting EE concepts in Controls which was one suggestion) could help bridge the gap between how the fundamental courses connect to the more advanced concepts within the ChemE program.

Tanev: A brief intro to chemical engineering course earlier in the program would be helpful. Some complaints that they don't get much exposure to chemical engineering until cow year. Students also gave negative feedback on EE301 and MC300. They thought that the content wasn't presented as relevant to chemical engineering, and perhaps some chemical engineering projects connecting the concepts to chemical engineering would be helpful.

Underhill: Given the constraints on resources, the plan for the expansion into biochemical engineering is good. I liked the idea of a 1-credit survey course similar to the one described by COL Hill.

Summary: (1) A common theme is that an earlier 1-credit course in chemical engineering is needed. (2) Some method is needed to integrate concepts in EE301 to the overall curriculum is needed. (3) Paull Dietrich has been pushing for a second semester of organic chemistry for some years now.

Do you have any suggestions to improve the advisory board meeting for next year?

Dietrich: Continue with blended (online and in-person) meetings. Expand student interactions with those involved remotely. Need a full course description (paragraph) of courses to refer to when speaking with cadets.

Garvey: If "hybrid" again, perhaps have some sort of curated online Q&A with virtual members and cadets during lunch. Print out one page of course codes and names. In-person experience was great – thanks.

Glaser: Invite several cadets to our pre-meeting dinner.

Hair: The format is excellent. Continue the mix of interaction with board, faculty, and cadets. Perhaps a bit more verbal guidance should be given at the beginning of the board / cadet breakouts. For example, the 1st one was titled "career panel," but we discussed course feedback. Was that the intention?

Hill: I thought this was set up well. Thank you for the opportunity to serve and LEARN.

Krishnamoorthy: This was a very well run and well organized meeting!

Liberatore: Hybrid was very awkward for interacting with cadets. All in-person if possible. I'm happy to do other "teaching" workshops or talks.

Schultz: I like the format, being virtual was a little less than ideal, but was one of the best virtual experiences I would have. I think that nothing replaces in-person. So that one is on me for not being able to make it in-person.

Shipe: I think the board meeting adapted well to the current environment and needs of the board members. I look forward to being able to attend in person next year.

Tanev: Would be helpful to have a "cheat sheet" overview of all chemical engineering courses and course descriptions. This info is incorporated in the slides but would be helpful to have that info consolidated into an appendix.

Underhill: There was some repetition between the meeting with Cows alone and the combined meeting with Firsties and Cows. It would be better if it was clear the difference in goal between those two meetings.

Summary: (1) Hybrid format needs work if this is continued. Hybrid interactions were awkward. (2) Provide a list of course descriptions ahead of time to the board. (3) More guidance is needed on goals of the different parts of the meeting.

Please add any addition comments that you would like to make below.

Dietrich: Consider inviting 1st year cadets to work on projects / experiments with established ChemE cadets with the intent of facilitating the decision to major in ChemE. Consider critical materials ID / confirmation.

Garvey: The USMA ChE department is supremely dedicated to the ABET process. The annual external board meeting and having 12 PEVs internally demonstrates this. Great to see board feedback in action with the bioengineering updates. Thanks!

Glaser: Keep up the great work!

Hair: Most enjoyable. I note that more advisory board professors have been added and I think that has been valuable. Another member like Mr. Shipe who was a cadet and is now in industry could be useful.

Hill: When it comes to your program objectives, is there a reason why "character" or "ethics" are not included? Student outcome 8 - "understand the chemical engineering curriculum..."; any thoughts to changing that to "understand and apply chemical engineering concepts..." I would guess we want our graduates to have the ability to apply what they've learned to solve problems. Back to MC300, perhaps there are opportunities where we can insert a "chemical engineering example" to get your majors excited. Any data on chemical engineering majors staying in the Army after 5 years? I would love to see data as to where they branch.

Krishnamoorthy: Thank you for inviting me this year.

Liberatore: Bioengineering minor and related are well-conceived. All courses are only focused on bio content only, but little about social, global, and especially ethics (lots of questions about bioethics and biowarfare, e.g., releasing viruses, etc.).

Schultz: It seems like students are very happy with the ChE classes and much less happy with the courses taken outside of the department. They seemed to think those courses were plug-and-chug which made it very hard to see how they would ever be able to apply and use this information. They also mentioned a want to get into ChE earlier and maybe a survey or fun lab course that was just introducing them to ChE but is not content heavy but helping them get their identity as a ChE earlier.

Shipe: It continues to be a pleasure to serve on the advisory board and watch the ChemE program continue to grow and improve. It is certainly different than when I was I the program, and I look forward to where it will go and being able to contribute to its continued improvement.

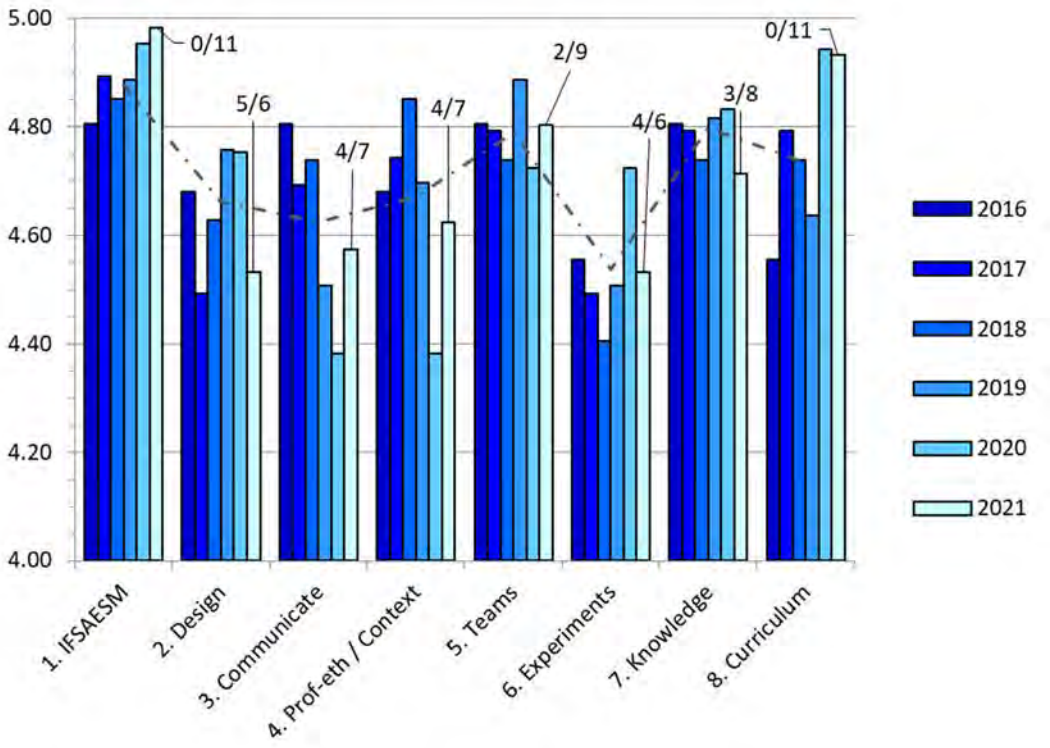
Tanev: Students generally love the program. The faculty and the ChE-specific classes (excluding ChE requirements that are taught out of other departments!). They really appreciate the smaller class sizes, the team collaboration, and the close relationships with faculty.

Underhill: None.

Summary: Comments vary. Some of the comments are echoed in the other sections, such as integrating content from courses in other departments and finding ways to integrate cadet interactions between year groups.

Advisory Board Student Outcomes (SO) Survey Results:

The chemical engineering advisory board is asked to rate performance of cadets on student outcomes (SOs) based on data presented to the board at the advisory board meetings. Advisory board responses for AY2016 to AY2021 are shown in the figure below, including the most recent advisory board meeting on 7-8 April 2022. Data for AY2022 is not available until after the advisory board meeting in spring of 2023. Data labels are response frequencies for responses of 4 or 5 (# of 4s / # of 5s) on the 1-5 Likert scale used in the survey. For example, in outcome 1 IFSAESM, 11 out of 11 board members responded with a 5 and there were no 4's, so the label is 0/11. The five-year average is the dotted line. Relative lows are seen in outcomes 2, 3, and 6. The survey questions are below the figure.

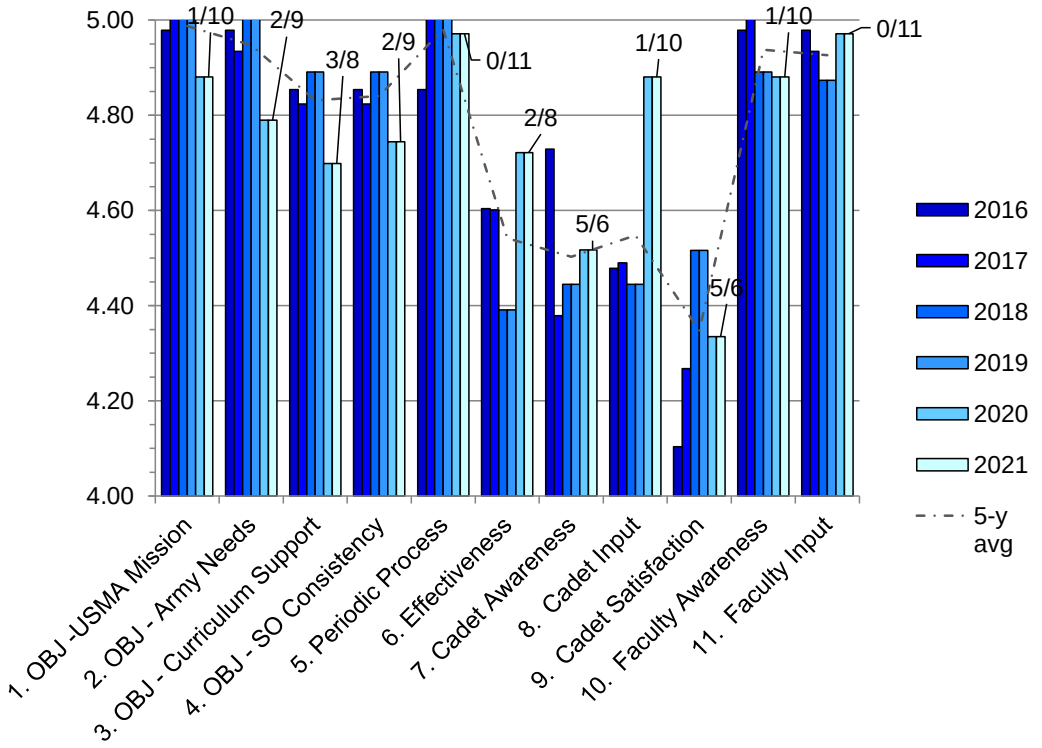


Survey Questions:

1. The cadets in the program are able to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. The cadets in the program are able to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. The cadets in the program are able to communicate effectively with a range of audiences.
4. The cadets in the program are able to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. The cadets in the program are able to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. The cadets in the program are able to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
7. The cadets in the program are able to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions.
8. The cadets in the program are able to acquire and apply new knowledge as needed, using appropriate learning strategies.
9. The cadets in the program have attained a thorough grounding in and working knowledge of the chemical engineering curriculum.

Advisory Board Program Educational Objectives (PEO) Survey Results:

The primary task of the advisory board is to assess the program educational objections (PEOs) of the chemical engineering program. A survey is administered to the board after a series of targeted activities involving the cadets and after a presentation of the PEOs by the program director. Advisory board responses to the program survey for AY2016 to AY2021 are shown in the figure below, including the most recent advisory board meeting on 7-8 April 2022. As before, data for AY2022 is not available until after the advisory board meeting in spring of 2023. Data labels are response frequencies for responses of 4 or 5 (# of 4s / # of 5s) on the 1-5 Likert scale used in the survey. For example, in question 1, which pertains to the consistency of the PEOs with the USMA mission, 10 out of 11 board members responded with a 5 and there was one score of 4, so the label is 1/10. The five-year average is the dotted line. Relative lows are seen in cadet awareness of PEOs and cadet satisfaction with courses.



Survey Questions:

1. The program objectives are consistent with the USMA mission.
2. The program objectives are consistent with the needs of the Army.
3. The program curriculum supports the program objectives.
4. The student outcomes are consistent with the program mission and objectives.
5. The program has a process for periodically assessing the achievement of its student outcomes.
6. The survey methods used by the program are effective.
7. The cadets in the program are aware of the program objectives.
8. The cadets are given an opportunity to provide their opinion about the program objectives.
9. The cadets are satisfied with the courses in the program.
10. The faculty are aware of the program objectives.
11. The faculty are given an opportunity to provide their opinion about the program objectives.