William E. Boeing Department of Aeronautics & Astronautics
Review Committee Report - Submitted 17 November 2023

Review Committee

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Review Process

On October 23-24, 2023, the review committee visited the William E. Boeing Department of Aeronautics & Astronautics, which is part of the College of Engineering at the University of Washington. Committee members reviewed the self-study report produced by the Department in advance of the visit, and during the two-day visit, the Committee members met with Department leadership, tenure-track, research and teaching faculty, affiliate faculty who contribute to the Department's professional Master's degree program, graduate and undergraduate students, Department staff and College of Engineering Advancement staff who support the Department. Additionally, the Committee toured Department facilities, including research and educational laboratories.

Conclusion

The Committee recommends that the next Aeronautics & Astronautics Department review take place in ten years.

Committee Observations and Recommendations

General Observations

1. The Department benefits from its proximity to industry leaders in aerospace and astronautics, a high demand from undergraduate students, a budget that is augmented by a fee-based graduate program, and the ability to recruit excellent graduate students, faculty and staff.

2. There is a strong strategic plan for growth in student and faculty populations. There appears to be plenty of demand for the BS, MSAA, MAE, and PhD programs, and placement of program graduates in suitable career paths is very strong. There is College support for increasing the size of the undergraduate program.

Community and Culture

3. Faculty, staff and students generally report that the Department is a good place to work and learn. With a very few exceptions, students, faculty and staff find the Department a

supportive and welcoming environment in which to pursue their degrees and careers as scholars, teachers, and administrators. People feel respected and that their work is valued.

4. The Department Chair's leadership is highly regarded. She is hands-on and works well with the College and with Department faculty, staff, and students. There are opportunities to engage more faculty in decision making and to develop future faculty leadership. This would allow for a broader delegation of responsibilities among the faculty.

5. The Department has a diverse staff and is devoting these resources to increasing diversity, equity and inclusion (DEI) within the Department as well as to building a sense of community. Representation of women and people from underrepresented backgrounds in graduate student and faculty populations is in line with national averages in AA; however, continued efforts to move towards representation that is proportional to the general population are recommended.

6. The DEI committee members are well-informed about best practices and resources to support the advancement of DEI goals within the Department, and they are actively working to develop and implement new ideas to strengthen the Department community.

Educational Programs

7. The new industry-sponsored capstone program for undergraduates is an excellent addition to the undergraduate program, as is the new teaching professor who is responsible for this program. Particularly valuable is the sizing of capstone teams at 10-12 students per team; this enables teams to tackle complex design tasks requiring organization into sub-system design teams and requires systems engineering and integration.

8. The online professional MS (MAE) program is clearly in high demand and is providing strong financial benefit for the Department. However, there is a significant opportunity for more peer or collegial evaluation/review of the structure and instructional quality of the program. The program would benefit from additional and regular engagement by AA tenure-track and teaching faculty with the affiliate faculty members who serve as the primary instructors for the program, to discuss curriculum and pedagogy. There may also be a role for the External Advisory Board in assessing overall outcomes for MAE degree recipients. One example supporting this recommendation is that while student requests led to scheduling a once-a-week four-hour evening class session, the instructor of this session reports that few students remain online for the entire four hours, preferring instead to watch a recording of the session at a later time. The Department is encouraged to collaborate with the College to develop best practices for managing fee-based programs such as the MAE that are not embedded in the Department; best practices likely include appointing a program director and annual review of the program by an advisory panel that engages instructors and reviews student feedback.

9. PhD student recruiting should be approached more aggressively with offers being made as early as possible to make them more competitive with offers from other schools and with

multiple offers approved for research active faculty, keeping in mind an average yield on offers of less than 50%. This may require that the Department provide backup funding in the event that yield on offers exceed expectations. To protect against over-extending Departmental resources, considerations should be adjusted for faculty who are not able to support current students and are relying on TA appointments.

10. Faculty mentoring of graduate students should be reviewed by the graduate committee to ensure that all PhD and MS students are provided appropriate levels of guidance and mentorship supporting their academic progress. Additional support for graduate students could also be fostered by a robust, student-led GSAC that builds connections between students in different labs and creates opportunities for informal peer mentoring about departmental processes and expectations.

11. The department has an excellent plan to modernize and improve the junior undergraduate lab sequence in content, skills, experiment design and conduct, and technical writing.

12. The undergraduate curriculum would benefit from more required instruction in computer programming. Currently only a scientific computing course is required; this course focuses on numerical methods and does not cover fundamental programming skills. Students also need a primary computer programming course covering foundational concepts including selection, iteration, functions, data manipulation and organization, and program design and debugging. A two-course sequence comprising a course that develops fundamental programming skills followed by a scientific computing would also provide the repeated exposure necessary for students to solidify concepts and gain coding practice. Credit limit considerations do not override the critical need for students to gain computing knowledge and practice.

Registered Student Organizations

13. The Department is home to many registered student organizations (RSOs). These RSOs greatly enhance the education and professional development of many AA students as well as many College of Engineering students and students from other colleges (e.g., Department of Physics). These organizations offer students great opportunities to engage in professional societies and hands-on projects throughout their studies. In project teams, students grow from apprenticeship to leadership roles, and creativity is prioritized.

14. The Department devotes substantial TA and facility resources to support RSOs despite only one third of the team membership majoring in AA.

15. RSO team safety and mentorship is provided primarily by TAs trained and supervised by the Department's facilities / machine-shop manager. This offers scalability but also potential increased risk due to oversight by TAs with limited expertise and authority. Peer universities have addressed these challenges with more college-level RSO support including full-time staff and dedicated multidisciplinary facilities.

Facilities and Department Infrastructure

16. The Department's facilities are well maintained. Space is adequate for the current needs of the Department and appears to be adequate to support growth to an undergraduate population of 96 students/year. Accommodating additional aspirational growth to 120 students/year and additional faculty will, however, be very challenging and will necessitate access to additional undergraduate student space, new graduate student office space, and new research laboratory space.

Faculty

17. While the early career faculty members are quite strong, there is a need for a formal mentorship program to help support these individuals as they develop their research programs, seek grant opportunities, develop new courses, improve their teaching, learn to mentor undergraduate, masters and PhD students, and navigate Departmental interactions. Mentors can also play a key role in nominating early career faculty for local and national awards. Monthly lunches for junior faculty members with the Chair are welcome but are currently not sufficient.

18. Currently the Department teaches many graduate courses for PhD and thesis-based MS students once every two years. This results in most faculty members teaching five unique courses over a two year period (i.e. courses A,B,C in yr 1 and courses A,D,E in yr 2). While this is acceptable for senior faculty, it poses a significant challenge for assistant professors who must develop a minimum of five new classes prior to their promotion and tenure review. The Department is encouraged to develop a new less burdensome approach to teaching assignments for assistant professors.

19. Currently the department faculty comprises primarily early career assistant professors and full professors. Hiring at the associate professor level is recommended to create a more uniform career-stage distribution within the faculty. This will enhance mentoring of junior faculty, smooth department growth as incoming associate professors will have well developed teaching, student mentoring and grant-writing skills, and will ensure strong department leadership in future years.

20. Multiple faculty hold leadership positions in various professional associations, several faculty have received multiple awards from professional societies, and six faculty are fellows of prestigious professional organizations, with five being awarded in the last four years. The visibility of the department could be further enhanced by additional faculty seeking out leadership positions and by a consistent effort to nominate faculty, especially junior faculty, for awards.

College Administration

21. The Department is home to many registered student organizations (RSOs) for which the majority of students are not AA students. These RSO provide an incredibly valuable learning experience for all student participants, and the Department devotes substantial staff, TA and facility resources to support these RSOs. This puts an undue burden on the Department;

peer universities have addressed this by providing substantial college-level RSO support including full-time staff and dedicated multidisciplinary facilities.

22. As noted in point #8 above, student demand for the Department's online professional MS (MAE) program is high, and the program provides significant financial benefits for the Department. However, there is an opportunity to better ensure the continued quality and demand for the program by providing a more structured evaluation and review process that considers all aspects of the program including structure, curriculum and instructional quality. The new College effort to expand opportunities for professional development provides an opportunity for instituting college-wide best-practices for review and oversight of professional certificate and degree programs.

College and University Administration

23. The staff members in the department are highly skilled and feel well-respected and supported by department leadership and colleagues, and fiscal and HR staff members are able to effectively manage workload through cooperation and cross-training. However, it appears that the effort required to address University administrative requirements and manage changing systems is high for this relatively small department. Staffing to meet rising administrative requirements is likely reducing funding available to support technical staff and to meet laboratory support needs. It is recommended that additional funding for administrative staff, or access to shared staff support, be provided by the College or University to ensure that departmental administrative staffing needs do not diminish staff support for educational programs, including student organization, and research activities.

24. As noted in point #19 above, in the near term the Department would benefit from faculty hiring at the associate professor level rather than at the assistant professor level. The Department and College are encouraged to engage with the University administration to secure approval for this.

<u>Committee Responses to Supplemental Questions Posed by the Department</u>

1. ***How do we best position our department to achieve our vision in terms of catalyzing aerospace education and research?*** Grow smartly, build the strongest possible mentorship and support structure for faculty and students, and prioritize review and strategic evolution of both curricular and research initiatives. Listen to affiliate faculty members and alumni, who offer valuable industry perspectives. Pursue center-level research projects. Make sure faculty teaching load is not too high to allow time for proposal-writing and substantial student mentorship. Work to develop a pool of future departmental leaders.

2. ***Has the curriculum kept pace with and/or is leading developments in the field? Or how can it?*** The review team fully appreciates department efforts to update the junior lab sequence and the challenges associated with modernizing ABET to place fewer barriers to including emerging topics in the curriculum. The review team appreciates the stackable masters program both in its structure and in its ability to meaningfully contribute to department fundraising.

At a high level, the undergraduate curriculum overall looks quite comparable to other AA programs - with all the elements required by ABET and still allowing for some student self-selection of courses. The department has undergraduate and graduate committees that, if not already charged with management and continuous improvement of the undergraduate and graduate curricula, could be charged with these activities. These activities should include engagement of industry possibly via the external advisory board. It is recommended also that the department solicit input more frequently from affiliate faculty, most of whom are alumni with industry experiences that can inform future curricular and research evolution in the department.

3. ***Are the research capabilities in the department suitable for addressing emerging aerospace needs?*** Yes, though there are opportunities for growth and expansion. The department's chosen focus areas are controls, fluids, structures, and plasmas. The controls and plasma groups are productive and appropriately sized with a recent hire bringing new expertise on autonomy and human-machine collaboration. The new teaching faculty member is bringing a stronger systems engineering capability to the department. The structures faculty cohort is small for the breadth of topics covered, and the fluids faculty are encouraged to more aggressively pursue new research topics and center-level projects. Emerging aerospace needs in avionics and software engineering do not appear covered either in the curriculum or in faculty research, but this may be addressed by new hires resulting from the current searches.

4. **Achievement of which Department goals is possible through reallocating existing resources? What goals can only be achieved through additional resources? What are innovative ways to address these needs? (faculty, staff, funding, facilities, etc)**. The department should be able to realize the planned increase to 96 students, but support for 128 student cohorts will require additional faculty. If driven entirely by undergraduate program size, this could be supported strictly with teaching professor hires. The department has been very successful in recruiting enthusiastic and outstanding teaching faculty who are playing key roles in curriculum development, classroom teaching, and undergraduate program leadership. Furthermore, the department has been able to effectively integrate teaching faculty into the department structure and we see mutual respect and collaboration between faculty in tenure track, teaching, and research tracks.

   If the desire for growth extends to the PhD program, then additional resources will most likely be required in terms of lab and office space as well as startup funds to recruit and retain research-active faculty in key disciplines.