

December 20, 2023

To: Office of Academic Affairs & Planning
University of Washington Graduate School

From: Kristi A. Morgansen, Chair, William E. Boeing Department of Aeronautics & Astronautics

Re: Response, Ten-Year Departmental Review Report for 2023

To begin, the department would like to extend our deepest appreciation to professors Lowes, Perkel, Atkins, and Axelrad for the time and effort that they put into the review of the William E. Boeing Department of Aeronautics & Astronautics.

The report prepared by the reviewers is thorough and touches on all aspects of the department operation since our last review 12 years ago. We particularly appreciate the attention given to what is working well, so that we do not inadvertently change positively functioning activities, as well as suggestions for improvement.

The report was shared with both the faculty and our External Advisory Board (EAB) at our fall EAB meeting on November 17, 2023. Responses to each item raised were discussed, and the outcomes of that discussion are detailed below.

Conclusion

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

We appreciate and concur with this recommendation.

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.

Thank you for this assessment and for noting the resource advantages available to the department.

2. There is a strong strategic plan for growth in student and faculty populations. There appears to be plenty of demand for the BS, MSA, 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.

Thank you for this positive assessment of our strategic plan relative to our opportunities and goals and of the outcomes for graduates of the department. Achieving our goals does rely on support from the College and University, and we have been fortunate to have that support for our growth.

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.

Building a positive culture for the entire department has been an intentional and active process, particularly after the disruptions of the pandemic. We greatly appreciate hearing this feedback that our efforts are achieving the desired results.

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.

Thank you for this feedback on the chair. Hearing positive outcomes is always appreciated. We also appreciate hearing the assessment concerning involvement of more faculty in decision making and leadership planning. As part of the department strategic planning, we did provide training for faculty on leadership skills and will continue these opportunities. We have been placing more of the junior faculty into roles such as committee chairs and providing opportunities for them to take ownership of strategic plan task completion associated with their committees. Some of the items noted below also provide options where faculty could be encouraged to step forward. We will specifically perform an assessment of the full range of activities in the department and form a plan for broader ownership.

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.

Thank you for recognizing the positive direction that the department is moving with respect to DEI. We are absolutely committed to increasing our diversity to better align with the general population. Particular actions that are underway are:

- to continue our faculty hiring practices to increase faculty diversity to provide role models for students from all demographics
- to hire staff with rubrics that include the ability to leverage the person's own lived experiences to contribute to positive experiences for everyone in the department
- to recruit, support, and graduate the highest quality students with increasing representation of the general population demographics

A key point with respect to all of these actions is that in order to reach currently underserved demographics, we will need to meet many of these people where they are, not where we expect them to be. In particular, students from underserved demographics need to be identified for their potential with an understanding that they have likely lacked opportunities and resources.

We have already begun building out these plans through our work with the Washington NASA Space Grant Consortium and through modifications to our faculty and staff hiring and support practices. Next steps in these processes will be included each year in our strategic plan review and updating.

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.

Thank you! We appreciate this recognition of the work that has gone into this aspect of our department activities and culture.

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.

Thank you for this feedback! We were fortunate to be able to hire the teaching professor now leading the capstone coursework. He filled a needed technical role in the department and has been doing great work. We also appreciate the specific feedback on benefits of the team size for the capstone projects.

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.

Thank you for this information. The information about course scheduling relative to student preferences and then actual engagement is of particular interest to us. We will be pursuing this particular item as a high priority.

With respect to oversight, we have been planning a departmental oversight committee for this educational program and will accelerate the process to start this winter. The intent is that the committee will be formed of regular faculty, affiliate faculty who have been teaching in the program, members of our external advisory board, and students from the program. Management of the committee would be a great role for one of the more junior faculty to build leadership capacity. We did initiate a cohort assessment of the students last spring via the

College of Engineering Engineering Teaching & Learning unit. We will expand that process to include instructor feedback. We will also work with the college and the other engineering departments to look for opportunities to collaborate on joint best practices, shared curriculum, and college-wide annual reviews.

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.

We have actually already planned to move up our PhD recruiting day from early March (last year) to early February (this year). We are hopeful that this adjustment will help with recruitment. The department does already provide faculty with backup funding to enable multiyear funding offers as we have seen better recruitment outcomes for offers that have as many years of funding as possible (ideally five years). The funding that we are able to provide is primarily via TA positions. In order to leverage this option, our guidelines for many years have been that faculty must provide at least one year of funding from grants that are already awarded or are known to have been selected for funding. We will continue this process. Depending on faculty preferences, we can allow them to use TA positions to double the number of offers if the faculty member has a history of strong funding.

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.

We appreciate this recommendation. Effective and excellent mentoring of graduate students is essential for degree progress and positive career outcomes. The graduate committee began an annual review of graduate student progress this past year. This initial year was intended to build experience with the process. Going forward we will look at options for actions based on the assessment outcomes. We do have a Graduate Student Advisory Committee, and we will work with them to explore options for peer mentoring.

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.

Thank you for this feedback. One of our teaching faculty was tasked with updating the lab sequence and has done a fantastic job assessing the needs, building a sustainable plan, and achieving faculty consensus on the plan. We look forward to launching the new curriculum this winter.

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.

We will task the undergraduate committee with looking at options for incorporating more fundamental computer programming into the curriculum. Our students are currently required to take a course in computational methods, and the learning objectives of that course are the most obvious place to start. We do agree that these skills are essential for a modern curriculum in aerospace engineering. Given capacity constraints in programming courses offered out of schools and departments such as Computer Science and Engineering and Human Centered Design and Engineering, we may have to build the necessary curriculum within the department.

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.

Thank you for your assessment of the importance of the RSO experience for the students. We completely agree with the opportunities presented by these experiences.

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

Thank you for acknowledging the level of resources provided by the department for RSOs and for noting the level of participation from students outside the department. We are actively working with the college to determine more effective, and balanced, approaches to support of the RSOs.

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.

While we are completely in agreement about the usefulness of RSO experiences, because these experiences are largely outside the formal curricula, no pathway has existed for tuition and state funding dollars to track and follow such activities. Specifically, the funding the department receives tracks the course offerings. We have pursued all possible avenues to support our curricula while also providing support to the RSOs. However, as noted, a large number of the students engaged in RSOs affiliated with our department are not actually students in our department.

In order to meet the overall needs, the department's facilities team includes three Graduate Staff Assistants (GSAs). These students work closely with the highly capable Facilities Manager and are deputized to conduct trainings and evaluate safety measures. Each GSA has a set of skills

that adds to the overall offerings and knowledge of the facilities team. The GSAs have been a cost effective way to fill the need for more facilities/machine shop staffing.

The College will begin assessing a program fee for students starting next year. We anticipate that this fee will enable us to add experienced staff to the facilities team. Further, the new Interdisciplinary Education Building will be completed in about a year and will provide facilities specifically for this type of activity. We look forward to working with the College to address equitably supporting multidisciplinary facilities and staffing needs to contribute to both coursework and RSO activities.

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.

Thank you for recognizing the work that has gone into supporting our facilities and for the assessment of where we are relative to goals of increased student enrollment. We will work with the college to plan appropriate resources for 120 students/year.

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.

Thank you for the feedback on the lunches with the chair. We will move forward with planning a more thorough mentoring plan for the junior faculty. We will reach out to colleagues in other departments and universities/colleges as well as the ADVANCE program and similar groups to assess the best practices and how to map them to our specific needs. Very likely there are opportunities for collaboration between the engineering departments and potentially STEM departments more broadly to build out a formal mentoring program both for our faculty as well as those in other departments.

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.

Thank you for the consideration of the many pressures on assistant professors. The courses to be offered each year come from a thorough balancing of how to address degree requirements, student interests, and faculty expertise and needs for domain expertise education of their PhD students. As a small department, we must keep a close eye on how many teaching

assignments can be covered by faculty in a given year and how much funding we have available to hire non-faculty instructors. All faculty are required to teach both undergraduate and graduate courses. Many graduate courses in specialized areas do not have sufficient enrollment to be offered every year. We have put a great deal of thought into partnering with other departments to share courses and enable annual offerings of as many courses as possible. Every effort is made to minimize the number of unique courses assistant professors must teach before tenure review. Department records indicate that no tenure track assistant professor in the past five years has had to develop more than four courses during their time as an assistant professor. We will continue to keep an eye on the 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.

We agree that a more uniform distribution across the ranks is desirable. We are happy to have hired two faculty members at the associate level in the past five years. Because of salary compression across the ranks, hiring at the associate level generally requires that the college or provost's office augment our available department salary funds. We have been in discussion with the dean's office on how to enable hiring at more advanced levels and will continue to pursue all options.

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.

We agree that high level awards are beneficial not just to the faculty member, but also to the prestige of the department. We do have a staff member designated to help with putting award packages together which has contributed to these multiple new fellows and other awards in the department. We will work to provide opportunities for training and mentoring in what steps are beneficial toward achieving different types of awards. All faculty are encouraged to pursue steps toward leadership in their professional societies, and we will continue these efforts.

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.

We agree that RSOs provide substantial value to the student experience! We will continue discussions with the College on how to share the support needed for RSOs. Early conversations have included leveraging the new program fee to provide funds for additional staff specifically

for this support. The new Interdisciplinary Engineering Building under construction will also help with the facility needs for the teams.

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.

The College continues to assemble working groups to align efforts for professional programs with new offerings rapidly being proposed. The above-mentioned oversight committee will be charged with creating a plan for continued review of our professional program offerings, including collaboration with College partners, program faculty, and current professional program students.

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.

Thank you for these positive assessments of our staff quality and support and for these comments with regard to appropriate levels of resourcing.

With the change over to Workday to handle financial processes across the university, all resourcing efforts have been set back because the Workday system is not yet mature for our use. Our department is working closely with both the College and other departments within the College to operationalize the new financial processes with current staffing. The extent and urgency of this conversion prevents a clear assessment of what type and quantity of staffing and resource support will be needed for the department in steady state. As soon as processes are formalized, we will determine the actual administrative needs for staffing and/or resource allocation changes.

We recognize that with new growth, our department will need additional staffing infrastructure and resources to support the needs of the department. The department has been actively working with our peer units and the College to explore all mechanisms to assess appropriate levels of support for faculty, staff and students and to allocate resources to meet those levels. In particular, our department has been pursuing opportunities to collaborate with other departments within the College as well as serving as an early adopter of shared services for purchasing, reimbursements, and travel needs. Longer term we anticipate this shared service system to address payroll, grant administration, and IT.

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.

As noted in the response to #19, we will make all efforts to achieve the necessary approvals and resources. We have been able to recently hire two associate professors and have clearly seen the increased readiness relative to earlier career hires.

Committee Responses to Supplemental Questions Posed by the Department

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.

Thank you for these points. Most of the suggestions are addressed in answers to prior questions and will only be briefly addressed here. We do plan to build out a faculty mentoring program and provide additional oversight for student mentoring. An advisory committee for the fee-based programs is being planned and will launch in the next month or so. The External Advisory Board does have many members who are department alumni, and we work actively with that committee to collect feedback and assess activities. Many other alumni are engaged through seminars for students such as the junior seminar. Each of the visits for these groups and individuals also includes meetings with the chair to discuss the department programs and activities. Faculty teaching loads are being actively managed with an eye toward faculty success in all areas. The department strategic plan was developed with engagement from all members of the department and is a living document with annual review and action items embedded in department committees. We will leverage that plan to address research initiatives, faculty leadership training, and center level research projects.

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.

Thank you for the appreciation of the updated junior lab sequence, the stackable masters plan, and the overall viability of the undergraduate curriculum. The undergraduate and graduate committees are charged with oversight of the relevant programs. As noted above, we will leverage the new advisory committee for the fee-based programs to deepen engagement with affiliate faculty (particularly from industry), alumni, and industry.

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.

Thank you for this assessment of our research capabilities and the disciplinary focus areas of the department. We are actively looking to hire more tenure track faculty in the structures area with this year's hiring. We will work to address opportunities in the fluids area and to add avionics and software engineering to the curriculum and faculty expertise.

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.

Thank you for this assessment of our goals for growth and for our success in integrating teaching faculty into the department. We do have a third teaching professor starting next summer who will provide further assistance in the areas of project-based learning, battery systems, structures, and controls. They will be a third year faculty member, so they will bring existing capabilities for teaching as well as industry experience. We believe that we have identified suitable space to support planned growth in numbers of PhD students to support the full faculty of 24 (19 tenure track, three teaching and two research). Current budget projections indicate that we should have sufficient funds for startup packages with a hiring rate of two faculty per year and to support the research-active faculty.

In Summary

We again express our thanks to the members of the review committee for their time, effort, and thoughtful assessment of our program, opportunities, and challenges. We also greatly appreciate the time and effort of the Graduate School for managing the entire process. The process, self assessment, and outcomes have enabled us the opportunity to reflect on how the department has grown over the past decade and how we can best prepare for and enact success in our next decade.