

Faculty Surveys

Faculty surveys ask the faculty member teaching the course to comment specifically on how well the outcomes were achieved for their course. The faculty member is also asked to comment on the quality of students' prerequisite knowledge, thereby assessing how well prerequisite course outcomes were achieved.

Faculty surveys are administered every year, for every undergraduate course taught. They are administered by the Aerospace Undergraduate Program Committee.

Coursework Samples

The faculty member teaching the course provides a guide to the coursework samples, marking specific test problems, homework problems, etc. as being relevant to a particular course outcome.

Coursework samples are collected from the space-systems capstone design course each year, and from every undergraduate course every six years. Collection of coursework is administered by the Aerospace Undergraduate Program Committee. Annotation of the coursework is handled by the faculty member teaching the course, with oversight by the cognizant faculty member(s) for the course. The cognizant faculty member for a course is the faculty member who is responsible for the leadership in development of the course. He or she provides continuity, since the course may be taught by any of several faculty members in a given semester.

In addition to the annotated and archived samples, the entire faculty assess the work of the students each year in the capstone laboratory course and the capstone space-systems design course. In the first, students hold a poster session that is attended by a majority of the faculty each semester. In the second, the final presentation by the students of their design is open to all faculty. Feedback from the faculty on these two aspects of the curriculum is not archived, but is helpful in keeping the entire faculty abreast of developments in these two important courses.

Student Advisory Committee Input

The Student Advisory Committee provides feedback on how well undergraduate courses are going during that semester. This information, while less structured than the Student Survey data, helps to augment that data with qualitative feedback. The Student Advisory Committee solicits the feedback in open meetings of the student body, and passes it on in a distilled form to the Aerospace Undergraduate Program Committee.

1.4 Program Outcomes Assessment

Assessment of program outcomes makes use of data from

Senior surveys

Alumni surveys

Employer surveys

in addition to the data collected for the course outcomes assessment process. Each of these assessment tools is described below.

Senior Surveys

In the senior surveys, students who have been through nearly the entire program are asked questions about how well the program met its objectives. Student views on how well their first- and second-year courses served them are solicited (Question 2), as well as student views on how well the communications, ethics, environment, teamwork threads contributed to their education (Question 3).

Senior surveys are administered annually by the college, with the data reported to the Aerospace Undergraduate Program Committee.

Alumni Surveys

Each year, alumni surveys are mailed to cohorts of students who graduated 2, 5 and 10 years ago. The alumni surveys provide the department with useful demographics on the careers of our graduates. Questions about graduate degrees obtained, current job title and salary, etc. help in this respect. In addition, alumni surveys are used to get the perspective of past graduates on how well the program achieved its outcomes. In particular, the following question has proven extremely useful.

Please rate how important the following competencies and attitudes have been to you in your professional experience and how well you feel the undergraduate program at the University of Michigan prepared you in these areas?

Circle the appropriate number for A & B using the following scales:

- | | |
|--|---|
| <p>A:</p> <p>5=always necessary</p> <p>4=often useful</p> <p>3=useful</p> <p>2=rarely useful</p> <p>1=never used,</p> | <p>B:</p> <p>5=excellent preparation</p> <p>4=good preparation</p> <p>3=some preparation</p> <p>2=slight preparation</p> <p>1=no preparation</p> |
|--|---|

	A: <u>Importance</u>	B: <u>Preparation</u>
Math, science and engineering skills	5 4 3 2 1	5 4 3 2 1
Ability to design and conduct experiments	5 4 3 2 1	5 4 3 2 1
Ability to design a system, component or process	5 4 3 2 1	5 4 3 2 1
Ability to function on a team	5 4 3 2 1	5 4 3 2 1
Engineering problem-solving skills	5 4 3 2 1	5 4 3 2 1
Appreciation for the ethical values of being a professional	5 4 3 2 1	5 4 3 2 1
Communication skills	5 4 3 2 1	5 4 3 2 1
Understanding of the social, economic and environmental impact of my work	5 4 3 2 1	5 4 3 2 1
Interest and ability to keep up-to-date through continuing education (formal or informal)	5 4 3 2 1	5 4 3 2 1
Knowledge of contemporary issues that affect my work	5 4 3 2 1	5 4 3 2 1
Ability to use modern engineering techniques, skills & tools	5 4 3 2 1	5 4 3 2 1

Alumni surveys are administered by the college, with data reported to the Undergraduate

Program Committee.

Employer Surveys

Employer surveys are distributed to on-campus recruiters of our graduates by the college's Career Resource Center. The surveys help give us insight into employer's views of the career-readiness of our students.

Employer surveys are administered by the college, with data reported to the Undergraduate Program Committee.

1.5 Course Update Process

The course update process can involve all of the faculty who teach the relevant course, but is led by the cognizant faculty member(s) for the course. Drawing from results of the course outcomes assessment process, changes are made to the course on a continuous basis. Changes that affect only the syllabus of the course need to be approved by the Aerospace Undergraduate Program Committee. More major changes, which result in modifications to the course objectives and/or outcomes, the catalog description, or the distribution of credits, require a more thorough approval process. These changes must be approved by, in order

The Aerospace Undergraduate Program Committee
The Aerospace Faculty
The College of Engineering Curriculum Committee
The College of Engineering Faculty

1.6 Curriculum Update Process

The curriculum update process can be driven by small-scale issues, i.e. changes in particular courses affecting the overall structure of the curriculum, or by large-scale issues, i.e. changes in the educational objectives and desired program outcomes. Minor curricular changes are typically suggested by the Program Advisor, and need only be approved by the Undergraduate Program Committee. Major curricular changes must be approved by, in order

The Aerospace Undergraduate Program Committee
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In addition, the Aerospace Industrial Advisory Committee is kept apprised of major curricular changes.

1.7 Program Outcomes Update Process

The program outcomes update process is driven by the educational objectives that have been chosen in the educational objectives update process. Program outcomes that imply attainment

of the educational objectives are proposed by the Undergraduate Program Committee. The committee also ensures that the program outcomes encompass those specified in ABET's Criterion 3. The Committee evaluates whether or not the program outcomes are adequate and accurate indicators of the achievement of the Educational Objectives and determines additions or modification to the program outcomes that would best serve to guide students and the program to higher attainments.

The Undergraduate Education Committee then draws up proposed, updated program outcomes and reports its findings to the Industry Advisory Committee to obtain a review of the proposed program outcomes from a government and industry perspective. The Committee then recommends updated program outcomes to the department faculty. After discussion, needed amendment and final faculty approval, the updated program outcomes are presented to the College Curriculum Committee. Finally, the updated program outcomes are presented to and voted upon by the College faculty, after which they are formally adopted.

1.8 Summary Data from Course Assessment Process

Because even summary data is fairly detailed, due to the number of courses in the curriculum, this material will be available during the visit, and is not included here.

1.9 Summary Data from Program Assessment Process

Some conclusions that can be drawn from quantitative and qualitative results of the program assessment process are listed below. The full set of data that support these conclusions will be made available during the visit.

1. *An ability to apply knowledge of mathematics, science, and engineering.*

This outcome is a traditional strength of our department. 90% of our alumni state that their preparation in this respect was good to excellent. In addition, feedback from our Industrial Advisory Committee and employers assure us that this is one of Michigan's program's greatest strengths.

2. *An ability to design and conduct experiments, as well as to analyze and interpret data.*

An important part of our capstone laboratory course is the self-designed experiment that students carry out in teams during the second half of the course. 100% of students in this course agreed or strongly agreed on the student survey last semester that they increased their ability to design and conduct experiments. Because the students report on these projects in a poster session open to all faculty in the department, this is an outcome that is assessed very publicly each semester.

3. *An ability to design a system, component or process to meet desired needs.*

This outcome is assessed most directly in the capstone design course, and particularly in the space-systems design course. The final reports generated by each class have been archived in the department for more than a decade. They speak to the design capabilities of the students, as well as their teamwork and communications skills. 96% of students rated this year's offering an excellent course, and 100% agreed or strongly agreed that they increased their ability to design a system. Students' perpetual desire for more design in the curriculum, as evidenced in senior and alumni surveys, is both a testament to how much they enjoy the capstone experience and a suggestion that we are on the right track in adding some design experience to their sophomore year, through Aero 285.

4. *An ability to function on multi-disciplinary teams.*

This has long been emphasized in our curriculum, with measurably positive results. Students' primary team experiences come in their capstone lab and design courses. More than 80% of students in the capstone lab course agree or strongly agree that they improved their team skills; in the capstone design course that number is 88%. Posters from the lab course, and final reports from the design course, convince the faculty of the department that we are doing well in instilling good teaming skills in our students. 70% of our seniors say the emphasis on teamwork is about right in the curriculum, with the remainder fairly evenly divided between thinking the emphasis is too great or too little. Only 8% of our alumni say they left our program with slight or no preparation in functioning on teams.

5. *An ability to identify, formulate, and solve engineering problems.*

As with Outcome 1, this is one of our program's historical strengths. All assessments of this, from surveys and from coursework samples, suggest that our students are doing well in this respect.

6. *An understanding of professional and ethical responsibility.*

This thread is new to our curriculum. The ENG 100 ethics material has been taught and assessed through coursework samples and survey questions. The Aero 245 professional responsibility material has been taught, but assessment tools are not yet in place for it. The upper-level material (in Aero 386 and 481/483) is being developed this summer.

7. *An ability to communicate effectively.*

Communication skills when a student is new to the program are directly assessed in Aero 245, where student reports are graded separately for technical content by an Aero professor and for style by Technical Communications staff. Coursework samples show that students improve their writing skills through their work in Aero 245. The Aero 483 archived reports give a snapshot of students' technical communications skills near the end of the program, showing their improvement through continued work on writing. The Aero 306 posters and the Aero 483 oral reports show students' visual and oral communication skills. 92% of

students agree or strongly agree that Aero 483, in particular, helped them improve their communications skills. 65% of seniors rate the amount of time spent on written communications as about right, with 13% rating our coverage as too much or far too much. On oral presentation skill, 64% rate the coverage as about right. Alumni, 75% of whom rate communications skills as always necessary in their work, feel that even more time could be spent on these skills; 40% rate their preparation as good or excellent. We feel this vindicates our newer approach, which the alumni have not experienced, in which technical communications is spread more evenly throughout the four-year experience.

8. *The broad education necessary to understand the impact of engineering solutions in a global and societal context.*

This is one of the less straightforward outcomes to assess, and we are relegated, to a certain extent, to a transcript analysis showing that our students have taken humanities and social-science courses that broaden their perspectives. Alumni, 75% of whom rate this ability as often useful or useful, rate the Michigan program as giving them some, good or excellent preparation more often than slight or no preparation.

9. *A recognition of the need for, and an ability to engage in life-long learning.*

Also one of the less straightforward outcomes to assess, we can use, in part, the number of alumni who go on to pursue graduate work to measure this. Of our alumni ten years out of school, 41% hold an MS, 19% an M.Eng., and 18% hold some other type of Master's degree. 7% hold Ph.Ds.

10. *A knowledge of contemporary issues.*

60% of alumni rate the program as giving them some, good or excellent preparation in this respect.

11. *An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.*

Over 90% of alumni rate the program as giving them some, good or excellent preparation in this respect.

12. *A knowledge of aerodynamics, aerospace materials, structures, aircraft and rocket propulsion, flight mechanics, orbital mechanics, aircraft stability and control, and spacecraft attitude determination and control.*

This outcome correlates with outcomes 1 and 5 above. Each of the topics listed is heavily emphasized in one course, and receives further attention in another course or two. The student survey results for each course, the faculty survey for each course, and the coursework samples show that this outcome is being achieved by our graduates.

13. *Competence in the integration of aerospace science and engineering topics and their application in aerospace vehicle design..*

See Outcome 3, above.

1.10 Documented Changes to Improve Program

Course Changes

Course changes are going on constantly, most of them minor changes based on short-term feedback from faculty and student surveys. Because the sophomore curriculum was entirely new this year, careful assessments were done, based on student surveys, faculty surveys and Student Advisory Committee input. This led to improvement of Aero 245 from Fall to Winter, quantitatively in student survey data, and qualitatively in Student Advisory Committee and faculty input. Aero 225, which grew out of Aero 320 and ME 235 in the old curriculum, has proven a more successful course than either of those, as demonstrated quantitatively by student survey data. The relevant data will be part of what is made available at the time of the ABET visit.

Curriculum Changes

The new curriculum was designed based on the process outlined in Figure 1.3 and the supporting text. Changes include the introduction of an ethics thread, implementation of communication across the curriculum, and the introduction of a required case-studies seminar course.

Educational Objectives and Other Program Changes

Over four years ago, the department noted the advent of significant political, economic and technological changes in aerospace affecting the university's role relative to industry and government; changes in graduate prospects for employment; and the changing educational needs of aerospace engineers. These changes, and the Department's need to keep abreast of them, prompted the 1994 Aerospace Engineering Departmental Review. The review lasted five months and involved surveys of our undergraduate students, graduate students, faculty, alumni and industrial contacts, in addition to visits by external consultants. It also involved an extensive gathering and discussion of numerical data by the Review Committee. Having established a body of factual data pertaining to the performance of the Department, the Review Committee made several recommendations. Among these was the need to formulate a long-range strategic plan to guide in a variety of departmental decisions.

In September of 1996, the aerospace faculty held an off-site retreat for strategic planning purposes. The mission statement was written, and five strategic goals were formulated. One of the strategic goals was a total reformulation of the aerospace curriculum. A subcommittee was formed to further flesh out each of the goals. The work of the Undergraduate Education Subcommittee took place from mid-September to early December. That work led to the educational objectives and the resulting new curriculum. The final strategic plan document was composed from the work of the subcommittees, and delivered to the College in January, 1997.

Data collected for the departmental review process also suggested a need to strengthen our ties to industry. We have since taken two very important steps along those lines, as described below.

Our department was one of the first to participate in the Boeing Fellow-on-Campus Program (BFOC). The objectives of the program were to:

Expose students and faculty to current Boeing and Aerospace industry issues in combination with teaching relevant courses.

Advise the Department concerning its engineering curriculum and research directions.

Solicit new ideas in selected areas where Boeing may benefit from student and faculty research and analysis.

The first Boeing Fellow was Ms. Barbara Cosgrove, an experienced design and test engineer with extensive design and supervisory background. Ms. Cosgrove received Boeing management approval to spend the Fall '96 semester serving as a visiting faculty member with our department. Ms. Cosgrove helped teach several design courses and took an active part in our curriculum reform and strategic plan activities. The impact of this involvement on faculty, students, the Department, (and Ms. Cosgrove), were extremely positive.

While it has not been possible for Boeing to sustain the BFOC Program at Michigan on a multi-year basis, a private donation allowed us to set up (as of late April, 1999) an endowment fund to support aims very similar to the BFOC Program. Beginning in the 99-2000 academic year, the income from the endowment will be used to support the participation of U.S. or foreign design experts (in aeronautics or space systems) in the department's teaching and research activities for periods of typically two weeks to one semester for each visitor.

Much benefit has resulted from strengthening our Industry Advisory Committee (IAC). The present IAC was constituted almost three years ago. The composition of the membership shows that the IAC represents both research employers and industrial employers in aviation and aerospace. Automotive and materials companies, both significant employers of our graduates, are represented.

Since the start, we have had meetings every six months, and with each meeting the membership has favored us with increasing energy, enthusiasm and commitment. Last October's meeting featured a very popular IAC "open-house" for students in the FXB Atrium. This involves technology exhibits and hardware displays to interest students in exciting developments on the frontiers of aerospace. It has been resolved by the IAC that this "open-house" event will be repeated annually, in conjunction with the Fall meeting.

In addition, the IAC has provided volunteers from the member's organizations who have served as advisors and "design review board" members for our student design projects. In the last meeting, Ford and NASA committed to providing the Department with semi-permanent industry displays of relevant technologies.

Over the past three years, working through the IAC, we have opened up internship and Co-op arrangements with Boeing, Lockheed Martin, several NASA centers and the Air Vehicles Directorate of AFRL. We have established such relations with some 15 organizations overall. We have also been exploring the opportunities for undergraduate involvement in engineering design projects with Ford, Boeing, the Aerospace Corp. and NASA.

1.11 Materials Available for Review During Visit

The materials available during the visit include:

- Annotated coursework samples from all required undergraduate courses taught this year
- Archived Space-Systems Design course final reports
- Results of faculty surveys
- Results of student surveys
- Results of senior surveys
- Results of alumni surveys
- Results of employer surveys
- Aerospace Department Strategic Plan document

1.12 Policies for Acceptance of Transfer Students

Most of the transfer student acceptance process is handled at the College level, in the Office of Transfer Admissions. The process is described in Part II of this self-study. The Aerospace Program Advisor is involved in decisions on transfer students.

1.13 Procedures to Validate Credit for Course Taken Elsewhere

Credits for basic humanities, math, science and engineering courses are validated at the College level, by the Office of Transfer Admissions. Credits for courses in Aerospace Engineering, or other advanced courses in math, science or engineering, involve the Aerospace Program Advisor.

2. CHEMICAL ENGINEERING

2.1 Undergraduate Program Committee

The Undergraduate Program Committee is a standing committee with broad authority to initiate changes in the curriculum, subject to approval by the faculty. The committee consists of the undergraduate program advisor, three other faculty members appointed by the department chair, one of whom is also involved with the undergraduate laboratories, the undergraduate secretary and student representatives selected by the AIChE student chapter. The members of the committee are appointed annually (September 1 of each year), and there is no limit on the number of years a committee member may serve.

The duties of the Undergraduate Program Committee, as listed in the Committee's charge dated October 2, 1997, include in part: reviewing the curriculum, student evaluations, and advising system annually; recommending changes in course content, curriculum structure or other aspects of departmental policy that affect the undergraduate program; recommending resources that will provide program completeness and continuity; and providing a conduit for the faculty to the college curriculum committee.

2.2 Program Assessment Plan

The committee is responsible for the implementation of the Department's Program Assessment Plan, approved by the Faculty on January 25, 1999 and included as Figure 2.1. This program was implemented for the first time this semester, and plans are to update it to incorporate recommendations of our constituencies. At the end of the term, faculty reflect on their own and the students' performance in the course, and develop a course assessment document, which is reviewed by the committee. A sample document is included as Table 2.1. Assessment information is made available to the instructor teaching the next offering of the course. The committee will use information from these documents to develop recommendations on curriculum changes. This information will also be made available to the advisory board and other constituencies as necessary for them to make a full evaluation of our program and develop recommendations. Information from other constituencies, such as alumni surveys, will also be considered in making recommendations regarding changes in course and department outcomes and objectives for faculty approval. Feedback from our constituents will be reviewed yearly by the committee, and every three years by our advisory board. The undergraduate committee will then work with the cognizant faculty to make recommendations regarding curricular changes. College approval will be sought for major changes, as appropriate.

This year the committee focused on organizing the preparation of course objectives to ensure that program outcomes were satisfied, updating course evaluation documents to include questions regarding the courses' educational outcomes, and reviewing student course evaluations. This year was seen as a learning experience for both the committee and the faculty, to better acquaint them with the new process. Faculty learned that they

must keep better student assessment records, to be able to identify student success in satisfying individual course outcomes.

Chemical Engineering Department Program Assessment Plan

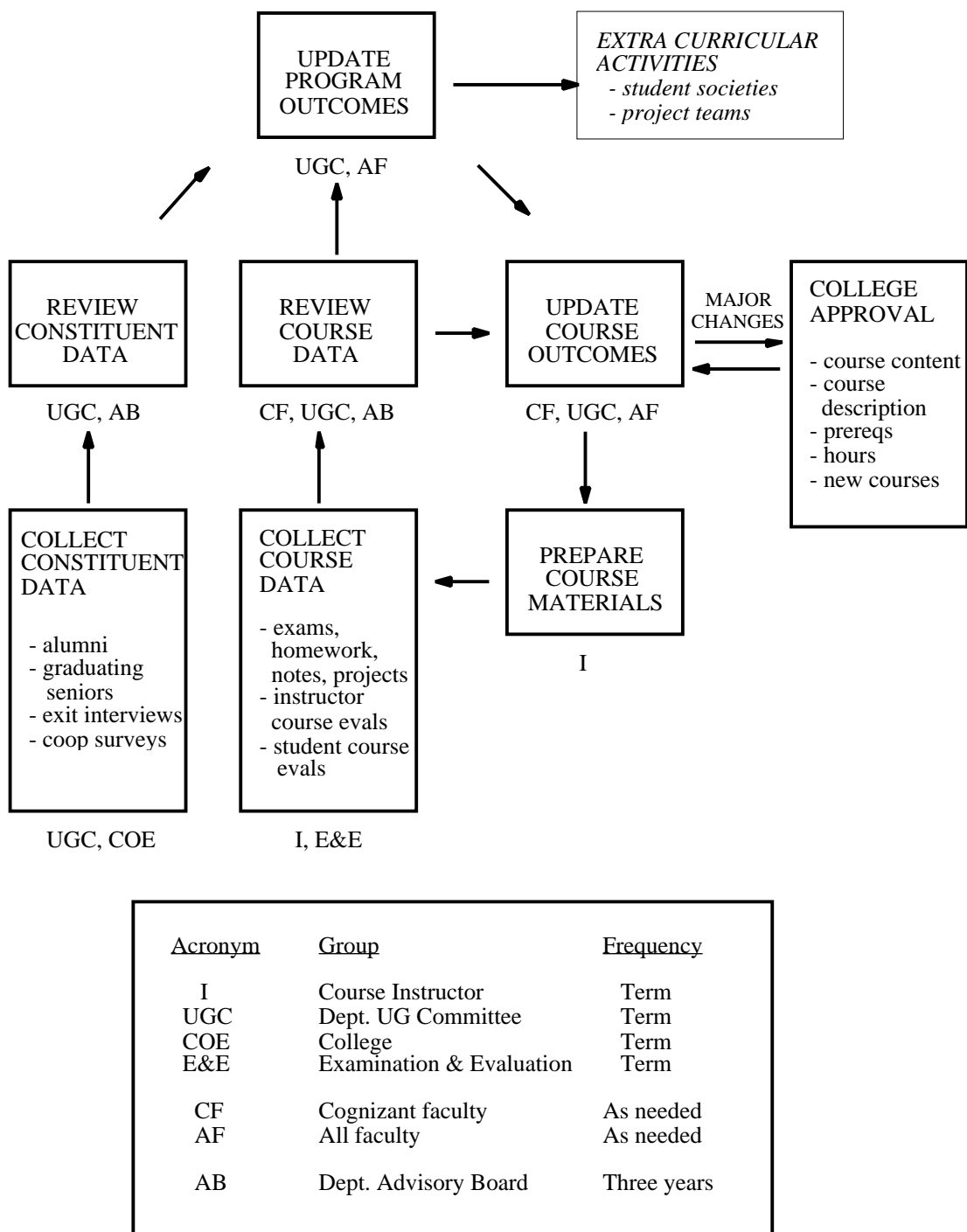


Figure 2.1