Assessment Methods for Engineering Programs - Too Many Choices or Not Enough?

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Abstract

When departments begin to prepare for their accreditation visit under the new EC2000 criteria being used by ABET, they usually begin to search for assessment methods that they can readily include in their self-study report. Often the result is that they develop a number of new surveys and then use them to demonstrate their commitment to self-assessment. There are better ways to proceed!

Most programs have had a long history of self-assessment and improvement. However, they may not realize it. And they may have little to document it. In the two years leading up to our accreditation visit, we met and discussed in depth all the myriad ways in which we seek to improve our program. Much to our surprise, we came up with quite a long list of assessment tools for our program, most of which were already in place in some form or other. The main task we confronted was documentation of processes already in place. And while surveys are indeed present, and perhaps the most easily quantifiable, they are probably not the most useful if the goal is actual improvement of the educational process.

This paper will discuss the various assessment tools that our department identified, including the advantages and disadvantages of each. It will also discuss the usefulness of each tool as well as their role in documenting commitment to self-assessment and improvement for the purpose of accreditation by ABET.

Introduction to Accreditation Process

Engineering and related programs in the United States are accredited by the Accreditation Board for Engineering and Technology (ABET). Schools apply to the Engineering Accreditation Commission (EAC) of ABET to seek accreditation for their engineering degree programs. ABET/EAC, in conjunction with the various professional societies, sets the criteria that are used to evaluate programs being considered for accreditation. These criteria have in recent years been revised with the introduction of the EC2000 Criteria[1], which replace the earlier Conventional Criteria. These changes have been the subject of much recent literature[2-15] so only a short summary will be given here.

Six of the eight criteria that make up the EC2000 Criteria correspond roughly to the Conventional Criteria that existed prior to the introduction of the EC2000 Criteria. The criteria are not as stringent as before, allowing more flexibility, but the general intent of the earlier Conventional Criteria are largely included within the new criteria. This intent was, and in part still is, to ensure that the curriculum meets minimum requirements for engineering and science content, that students receive proper advisement, that faculty have appropriate qualifications and that the facilities and institutional support are adequate. All of these items were present in the Conventional Criteria and are still present in the EC2000 Criteria.

The heart of the new approach to accreditation, and what makes it fundamentally different from what existed before, is EC2000 Criteria 2 and 3. Essentially these require that institutions adopt methods to continuously study and improve their program by processes that involve all of their constituencies.

EC2000 Criterion 2 requires each college and each engineering degree program to have first identified their constituencies and to have established educational objectives that address the needs of their constituencies. The objectives must be well publicized to ensure that all constituencies are aware of them. There must also be institutionalized processes for the periodic review and revision of the educational objectives. The processes for this review and revision must specifically involve each constituency. Furthermore, the educational objectives of the program must be in harmony with the objectives of the college and university. Likewise, the curriculum must be suitable for the accomplishment of the objectives, and there must be recognized processes in place for its periodic review and revision.

EC2000 Criterion 2 requires each program to give serious thought to who its constituencies are, what their needs are, how to involve them in improving the program, and how to document that all this has occurred and continues to occur.

EC2000 Criterion 3 requires that each program determine specific desired outcomes from the program, and then to have in place assessment tools that can be used to demonstrate whether or not the desired outcomes are being achieved. Also, the data generated by the assessment tools should be used as part of the continuous improvement process described under the second criterion. EC2000 Criterion 3 also lists eleven specific attributes of engineering graduates ("3a-k"). The list of desired outcomes developed by the program should be consistent with EC2000 Criteria 3a-k, but should also be specific to each program. If the desired program outcomes are achieved, then it should be demonstrable that the EC2000 Criteria 3a-k are thereby satisfied. It does not necessarily follow, though, that if the EC2000 Criteria 3a-k are satisfied then the desired department outcomes are achieved.

The assessment tools must consist of a variety of methods, each of which should be quantifiable. Reasonable targets should be set, and results should be available that indicate whether the targets are being achieved.

EC2000 Criteria 2 and 3 cause the most concern for programs contemplating their first accreditation review under the new criteria. They require that programs give formal consideration to issues that may not have received such attention before. The third criterion,

which requires the identification of specific desired outcomes and appropriate assessment tools, will be the focus of this paper.

The Experience of the NJIT Chemical Engineering Department

The engineering programs at NJIT had their general review this past academic year (2001/2002). The chemical engineering program began its preparations in Fall 1998. As is the case with most programs contemplating their first accreditation review under the new EC2000 criteria, the program realized that it had never formally developed educational objectives or explicitly listed mechanisms by which it sought to improve the education it produced. That is not to say such matters were not considered; of course they were. All responsible people seek ways in which to improve the product they sell. It was just that the issues and mechanisms had not been formalized. Thus during the course of academic year 1998/1999, a group of faculty gathered input from colleagues and from students (both past and present) and developed a tentative list of objectives. Meetings were then held with the department industrial advisory board at which they were reviewed and revised. The objectives were finally discussed and approved at a faculty meeting in Spring 1999.

Attention then turned to the list of specific desired outcomes. Again, input was taken from various sources, and eventually a list consisting of eighteen desired outcomes was produced. They are listed below:

1. Students will acquire basic skills needed for engineering and will learn to work with other engineers.
2. Students will acquire a thorough understanding of basic and advanced chemistry and will learn to work with chemists.
3. Students will acquire the necessary basic knowledge of chemical engineering.
4. Students will gain familiarity with chemical engineering equipment and experience in the solution of chemical engineering problems.
5. Students will develop their critical-thinking and communication skills through repeated and in-depth practice.
6. Students will acquire and practice the computer skills necessary for modern engineering practice.
7. Students will acquire both leadership and teamwork skills.
8. Students will develop an awareness of environmental, safety and pollution prevention issues and be trained to consider them as being an integral part of engineering.
9. Students will be able to listen with comprehension and to write and speak confidently.
10. Students will learn how to describe complex technological issues to non-specialists & to non-technically trained people.
11. Students will learn that the field of engineering is greatly affected by the current business climate.
12. Students will acquire the ability to keep their work and their profession in wider perspective.
13. Students involved in research will observe and take part in the generation of new knowledge.
14. Students who opt for co-op will gain valuable experience related to the profession and begin to develop job contacts.
15. Students will acquire experience by meeting working professionals, will develop job-

interviewing skills, and learn of various career opportunities.

16. Students will maintain a somewhat broader perspective of chemical engineering in the spectrum of career possibilities.
17. Students will gain business and management skills useful for the advancement of their professional careers.
18. Good students will be encouraged to raise their expectations for themselves and their careers, and to consider graduate school.

Each of the eighteen outcomes relates to abilities or attitudes that the program faculty and constituencies felt were important attributes of graduates of the chemical engineering program. Development of this list was surprisingly non-controversial. All of these attributes are fairly well acknowledged, and probably most programs would come up with similar lists, though doubtless different in the details.

For most departments, the more intimidating task is the list of assessment tools. These tools should address all of the desired outcomes, or else there is no way to determine whether each of the desired outcomes is being achieved. Throughout much of this time, there was a general sense that many new surveys needed to be introduced. And indeed, several were introduced or re-introduced. The college was organizing new, general surveys of alumni. The department conducted a survey of local industry. It also did a laboratory survey, asking students for feedback on the quality of all the teaching laboratories. And it also did its own survey of recent graduates of the program, as the college-level survey was not particularly useful at the department level. It had done such surveys previously as well, but never in a systematic or organized way.

Eventually, a realization was reached that much of the information from the various surveys was not news. Seldom, if ever, is anything pointed out that was previously unknown. The strength of feeling about issues, their relative importance, is what one learns from a survey. But there remained a need to generate a list of assessment tools. So a list was made of all the methods by which the program gets feedback on the quality of its processes and products. The list was surprisingly long, and had a variety of mechanisms other than surveys (although they were definitely present). Some of the mechanisms were neither quantifiable nor formalized and were dropped from the list of assessment tools used for accreditation purposes (although such informal tools can be, and are, still used). The amended list was subsequently adopted as the "official" department list of assessment tools.

Assessment Tools for the NJIT Chemical Engineering Department

The following is the list of assessment tools that the department arrived at:

1. BEST (Basic Engineering Skills Test)
2. FE (Fundamentals of Engineering) test
3. Alumni survey
4. Graduating students survey
5. Student course evaluations
6. Employer survey
7. HSS (Humanities and Social Science) portfolio

8. Oral presentations of coursework
9. Co-op presentation & co-op supervisor survey
10. Placement data (both employment and graduate school)
11. Course pass rates
12. Retention and graduation rates
13. Laboratory survey

There are also several non-quantifiable assessment methods that are nonetheless vital to continuous improvement of the educational process:

14. Department feedback sessions
15. NCE feedback sessions
16. Advisement feedback
17. IAB (Industrial Advisory Board) feedback
18. Graduate advisor feedback
19. Course supervisor meetings
20. Awards received by department groups and individuals

Each of these twenty assessment tools has been used by the department to evaluate the effectiveness of the program. None were instituted solely for the purpose of meeting the requirements of accreditation under the EC2000 criteria. What the impending accreditation visit did do was to get the department to think about these issues, to document its practices, and to make the whole system work better. Each of the tools will be discussed briefly below. Figure 1 summarizes the relationships between these assessment tools and the desired program outcomes listed earlier.

1. BEST Test

For many years, the college has noted inconsistent performance of its students on the FE exam (which is required as the first step for those seeking their professional license). The college has long tried to get feedback as to which portions of the exam give its students difficulty, but to no avail. In 1999, the college instituted the Basic Engineering Skills Test (BEST). All students will need to take this test before they may register for senior-level coursework. It is designed to assess skills similar to the FE test; that is, engineering physics, chemistry and mathematics, general engineering, engineering economics, and other material that all graduating engineering students should have mastered. The department has set a target of 95% pass rate for students in chemical engineering.

The fact that this is an in-house examination makes it possible to monitor in which areas the students perform unsatisfactorily, both individually and as a group. Individuals are advised to refresh their studies in areas of weakness. If all or most chemical engineering students perform poorly in one or more areas of the exam, then either the curriculum or individual courses may need to be improved.

Figure 1. Relationship Between Assessment Tools and Desired Program Outcomes*
for the NJIT Chemical Engineering Program

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Target
1. BEST test	✓	✓	✓	✓	✓	✓											✓		95% pass rate
2. FE test	✓	✓	✓	✓	✓	✓											✓	✓	80% pass rate
3. Alumni survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	3.5/4.0 average
4. Graduating student survey	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			✓		✓	✓	✓	4.0/5.0 average
5. Student course evaluations	✓	✓	✓	✓		✓	✓	✓	✓										>3.0 in 95% of sections
6. Employer survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		good or better, all items
7. HSS portfolio					✓				✓	✓						✓			100% improve
8. Oral presentations	✓	✓	✓		✓			✓	✓	✓		✓		✓	✓	✓	✓		100% improve
9. Co-op presentation/employer survey	✓	✓	✓		✓		✓	✓	✓	✓		✓		✓	✓	✓	✓		95% effective
10. Placement data				✓			✓				✓			✓	✓	✓	✓	✓	80% placed
11. Course examinations	✓	✓	✓	✓															rate increases 4 out of 5
12. Retention and graduation rates	✓	✓	✓	✓			✓												60% R, 75% 6yr G
13. Lab survey	✓	✓	✓	✓															3.0/4.0 average
14. Department feedback sessions			✓	✓	✓	✓	✓	✓					✓	✓	✓		✓		not quantifiable
15. NCE feedback sessions			✓	✓	✓	✓	✓						✓	✓	✓	✓	✓		not quantifiable
16. Advisement feedback	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	not quantifiable
17. IAB feedback	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓		✓		not quantifiable
18. Graduate advisor feedback	✓	✓	✓		✓	✓	✓					✓	✓					✓	not quantifiable
19. Course supervisor meetings		✓	✓	✓		✓									✓				not quantifiable
20. Department awards							✓										✓		not quantifiable

Program Outcomes

* The list of desired program outcomes is given in the text.

2. FE Test

In the past several years, there has been general discussion of the appropriateness of using the FE (Fundamentals of Engineering) test. Its advantage is that it is a national test, and so allows comparisons on a broader basis. However, the college has been unable to get useful information as to who is taking the exam, when they graduated, or on which portions of the exam they do well or poorly. As such, it is not of much utility as an assessment tool, and of even less use if the results are to be used to improve the educational process. The college continues to attempt to get these data, and hopes to be able to use the results in our assessment/improvement process. The department has set as a target an 80% pass rate.

3. Alumni Survey

The department conducts a periodic survey of its recent graduates. The survey is designed to glean information relating to all of the program objectives. However, the survey currently puts more emphasis on certain outcomes, as indicated in Figure 1. The department has set a target average of 4.0/5.0 on the scored questions. The faculty discusses the results of the survey in order to identify weaknesses in the educational program.

4. Graduating Student Survey

The department conducts a survey each semester of its graduating students. The survey is distributed in the Process & Plant Design class each semester. This survey is designed to give particular feedback on some specific outcomes, as shown in Figure 1. The department has set a target average of 4.0/5.0 on the scored questions. The feedback is used to identify problem areas and possible improvements.

5. Student Course Evaluations

Each section of each course offered at NJIT is normally evaluated by means of uniformly administered course evaluations. They are useful for feedback on several of the program outcomes. An average score of 3.0 or better is assumed to represent good teaching. The department goal is to achieve at least a 3.0 average in 95% of all sections taught by department faculty. The forms, together with any comments, are made available in aggregate to the instructors so that they may get feedback on and improve their teaching methods. Faculty who receive low scores are counseled by the chairperson to work on improving their teaching, and may receive additional assistance in doing so.

6. Employer Survey

The department periodically conducts a survey of the employers of its graduates. This survey is designed to give feedback on virtually all of the department program outcomes. The goal is to achieve an average rating of "pleased" or better on all of the listed items. As with the other surveys, the feedback is used to identify problem areas and possible improvements.

7. HSS (Humanities and Social Science) Portfolio

The Department of Humanities and Social Sciences (HSS) is directly or indirectly responsible for almost 20% of the curriculum. In addition to other goals, these courses seek to improve the students' writing and communication skills. To monitor their improvement, the HSS department requires maintenance of a portfolio of the students' work. These portfolios are used to monitor the student's improvement between the freshman and senior years. The HSS portfolio directly addresses several of the desired program outcomes, especially those dealing with critical thinking and communication. As the department also stresses these same skills in several of its courses, the portfolios are expected to show improvement in these skills for all (100%) of its students between the freshman and senior years.

8. Oral Presentations of Coursework

Several department courses also emphasize the importance of both written and oral communication skills. All students are expected to demonstrate the ability to present technical results to an audience that may include people who are unfamiliar with the work being discussed by the end of this sequence. In each of these courses, a separate record of the students' communication skills is kept. These skills are particularly required by many of the desired program outcomes, as shown in Figure 1. The department has as a goal that 100% of its students show improvement in these skill scores between the first course and the last ones.

9. Co-op Presentation & Co-op Supervisor Survey

Although not all of our students engage in co-op employment, a significant percentage does. At the conclusion of each assignment, the student is required to give a written report and an oral presentation of his work before an audience that includes the co-op advisor, and if possible, the co-op supervisor. The co-op advisor evaluates the report and presentation for their adequacy and effectiveness and, after discussion with the co-op supervisor, assigns a grade for them. The department goal is that 95% of its co-op students give effective reports and presentations.

10. Placement Data (both Employment and Graduate School)

The ability of our graduates to secure professional employment and/or to gain admission to graduate study is one measure that applies to several of the desired program outcomes. The department hopes that 80% of its graduates are successfully placed in either professional employment or graduate school within four months of graduation.

11. Course Examinations

As students progress through the curriculum, their grasp of the principles of chemical engineering should be steadily strengthening. This should in consequence improve their ability to comprehend the later material. Thus, pass rates on examinations, and by extension pass rates in courses should improve the further into the curriculum. If this is not occurring, then students are being allowed to progress in the program who have small chance of success. This can be quantified by examining the average pass rates for required chemical engineering courses in each

of the semesters of the curriculum: Sophomore I - Sophomore II - Junior I - Junior II - Senior I - Senior II. The department goal is that the overall pass rate should increase in at least four of these five comparisons.

12. Retention and Graduation Rates

The ability of our students to meet the rigorous demands of a curriculum in chemical engineering requires that they learn well the fundamentals of math, physics, chemistry and engineering. Students who do not generally lose interest and/or do poorly with the result that they leave the program. The department does not necessarily want 100% retention of first-time full-time freshmen (FTFTF). Many students make their original declaration of a major with no familiarity with the field. Thus the department goal is an overall retention of 60% (60% of students entering as chemical engineering majors eventually graduate with a chemical engineering degree).

The department also tracks the retention rate of transfer students. Students who enter as transfer students generally are more clear in their academic goals, and so are less likely to change their major. However, many of them have transferred to NJIT at least partly for financial reasons, and thus are more likely to be working while attending classes. The department has thus set a retention rate of 80% of transfer students as its goal.

Many if not most of our students engage in co-op employment. Also, many of our students when admitted are from schools that do not adequately prepare them for college and thus need either remedial or slower-paced courses in the freshman year. Thus a very low percentage of our students graduate in four years. A more realistic measure is the six-year graduation rate for FTFTF (the percentage that graduate within six years of being admitted). The department goal is 75%.

Transfer students enter with a very wide range of backgrounds. Some enter with no transferable credits, while others have two or more years of credit. As such, it is of little use to set a target graduation rate for transfer students.

13. Laboratory Survey

A periodic survey is made of all laboratory classes. The intent is to obtain immediate feedback from the people who use the labs - the students - on their usefulness, current state of repair and other information. Quality laboratory experiences are vital to the production of soundly educated engineers. The department hopes to achieve an average score of 3.0/4.0 on the survey questions.

14. Department Feedback Sessions

The department holds feedback sessions every semester. The department chairperson and the administrative assistant meet with students to hear their concerns. Although the results of such meetings are not quantifiable, they provide invaluable and timely feedback about the department in general and the current semester courses in particular. The department expects that problems noted at any given feedback meeting can be addressed and resolved by the next semester. Typically, the feedback is related to the desired program outcomes as indicated in Figure 1.

15. NCE Feedback Sessions

The dean of engineering also holds feedback sessions at least once every semester. The dean meets with students to hear their concerns. This meeting presents an opportunity for students to express concerns about the department chairperson and/or the administrative assistant. Again, although the results of such meetings are not quantifiable, they provide invaluable and timely feedback. Both the dean and the department expect that problems noted at any given feedback meeting will be addressed and resolved by the next semester. As with the department feedback sessions, the feedback is typically related to the desired program outcomes shown in Figure 1.

16. Advisement Feedback

All students are required to meet with their academic advisor at least once every semester. At each of these meetings, the advisor makes a point of inquiring as to the student's progress and whether there are any specific concerns that the student may have regarding more or less anything. Very often, if there are problems with one of the courses, they will bring it to the attention of the advisor. The advisor will then either investigate, or pass the concern(s) on to the chairperson and/or administrative assistant, or if feasible handle the problem directly. Again, this method is non-quantifiable, but is an extremely important avenue for feedback on the educational process. As with the previous two tools, the department expects that the same problems do not recur from semester to semester. Again, Figure 1 indicates the desired program outcomes to which the feedback is normally related

17. IAB (Industrial Advisory Board) Feedback

The department has periodic (at least once per year) meetings with its industrial advisory board. Usually, the department chair and associate chairs meet with the board to discuss the current state of the department, ongoing initiatives, possible improvements and any other matters related to the future of the department. Feedback from the IAB is highly valued and is used in almost all aspects of the department, and is relevant to all of the program outcomes. However, it is by its very nature non-quantifiable and anecdotal, since the board is comprised of a limited number of individuals. (That is why we do surveys, after all.) IAB feedback is typically related to almost all of the program outcomes.

18. Graduate Advisor Feedback

Some graduates of our department elect to pursue graduate study at other universities. We occasionally get feedback from the other university on the performance of our students. This feedback is less common but highly valued, and impinges on the desired program outcomes as shown in Figure 1. Again, the information is highly anecdotal and non-quantifiable.

Figure 2. Relationship Between Assessment Tools and EC2000 Criteria 3a-k

	EC2000 Criterion											Target
	3a	3b	3c	3d	3e	3f	3g	3h	3i	3j	3k	
1. BEST test	✓										✓	95% pass rate
2. FE test	✓				✓						✓	80% pass rate
3. Alumni survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	3.5/4.0 average
4. Graduating student survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	4.0/5.0 average
5. Student course evaluations	✓	✓	✓	✓	✓		✓				✓	>3.0 in 95% of sections
6. Employer survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	good or better, all items
7. HSS portfolio						✓	✓	✓		✓		100% improve
8. Oral presentations	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	100% improve
9. Co-op presentation/employer survey	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	95% effective
10. Placement data				✓	✓						✓	80% placed
11. Course examinations	✓		✓		✓				✓		✓	rate increases 4 out of 5
12. Retention and graduation rates	✓		✓									60% R, 75% 6yr G
13. Lab survey		✓									✓	3.0/4.0 average
14. Department feedback sessions	✓	✓	✓			✓	✓				✓	not quantifiable
15. NCE feed back sessions	✓	✓	✓		✓	✓					✓	not quantifiable
16. Advisement feedback	✓	✓	✓		✓	✓	✓		✓		✓	not quantifiable
17. IAB feedback	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	not quantifiable
18. Graduate advisor feedback		✓	✓		✓				✓	✓	✓	not quantifiable
19. Course supervisor meetings	✓	✓		✓	✓	✓	✓				✓	not quantifiable
20. Department awards				✓			✓			✓		not quantifiable

19. Course Supervisor Meetings

Beginning in academic year 1999/2000, the department formally instituted periodic meetings between the supervisors and teachers of each course in the curriculum with the supervisor(s) and teachers of all the courses that are prerequisite to that course. The purpose of these meetings is to ensure the close coordination of the various parts of the curriculum, to avoid unnecessary duplication of coverage, and to identify, correct and/or prevent problems as early as possible. Again, the results of these meetings do not provide quantifiable measures, but they are nonetheless important tools in the continuous improvement of the curriculum. Minutes or summaries of these meetings are submitted to the curriculum committee. This mechanism typically provides information about the desired program outcomes as shown in Figure 1. Although these meetings had always occurred informally, the process is now formalized and documented.

20. Awards Received by Department Groups and Individuals

Although this is again a non-quantifiable measure, the department is quite proud of its long history of receiving many awards. They have ranged from national awards to awards that are internal to the college and/or university. All of these accomplishments speak well of the quality of our students, our faculty, the educational process and the research efforts in our department. A fact often overlooked is that positive recognition and feedback is also an essential part of any effort to continuous process improvement.

The last seven of the above twenty assessment tools are not as readily quantifiable as the first thirteen. However, in many respects they are the most important means in place for rapid determination of existing problems and development of solutions. Anyone that has been involved in the administration of an academic program realizes that surveys are not appropriate mechanisms for short and medium-term problems. They can, however, be of great use in longer-range, more substantive changes and improvements to the curriculum. The chemical engineering department at NJIT uses just five surveys among its twenty assessment tools.

Discussion and Recommendations

The chemical engineering department at NJIT spent a considerable amount of time trying to decide upon new assessment tools that could be devised to satisfy the requirements imposed by the new EC2000 criteria. This time and effort was largely wasted, and other programs should be cautioned against this approach.

In the end, the department did what it should have done at the outset, namely it identified the assessment tools that were already being used. Those tools that were either not formalized or not regularly occurring were made so.

As an example, the department had long recognized that students should be having less difficulty, not greater, the further they progress into the curriculum. If this is not the case, then there is a problem somewhere (perhaps with the advising process, or the teaching of one or more

courses, or the curriculum, or somewhere else). This long-standing observation had never formally been analyzed, however. Thanks to the self-study required by the accreditation process, this observation has now been quantified and appears as assessment tool number eleven. As with many assessment tools, the tool does not necessarily indicate where the problem is, just that there is one somewhere since some of the desired outcomes are not being achieved.

For most programs, the most difficult outcomes to assess are those related to EC2000 Criteria 3d (ability to function on multi-disciplinary teams), 3f (understanding of professional and ethical responsibility), 3h (broad education necessary to understand the impact of engineering solutions in a global and societal context) and 3i (recognition of the need for, and an ability to engage in, life-long learning). To a lesser extent, 3g (ability to communicate effectively) and 3j (knowledge of contemporary issues) can be difficult to assess as well. Figure 2 shows the direct correlation between the twenty assessment tools used by the chemical engineering program at NJIT and the EC2000 Criteria 3a-k.

Surveys are indeed a key factor in assessing these more difficult items, but they are not the only ones. Oral presentations in courses, both technical and non-technical, address some or all of these. This is also true for presentations based on cooperative work experiences. Even placement data can be used to assess some of these items, especially if it is detailed (for instance, as to type of job function) and complete (for instance, includes those pursuing graduate school).

Virtually all programs have numerous mechanisms in place to ensure that the desired objectives of the program are being achieved. However, not all of these mechanisms are suitable for use as quantitative assessment tools. In the list of twenty tools given above for the chemical engineering program at NJIT, only thirteen are truly quantitative measures. The subset of quantitative tools should cover all of the listed program objectives. Mechanisms that are qualitative can be quite important as well, especially if they are formalized; this is the case for the remaining seven of the twenty tools. In practice these mechanisms are probably the best and most rapid indicators of the current state of the program.

This brings out the key difference between assessment and accreditation. Programs must continually do assessment as part of their normal operations, regardless of whether they seek to be accredited or not. For this, the qualitative mechanisms are usually the most commonly used and are relied upon for the day-to-day operation of the program. The accreditation process, however, seeks to be more objective and therefore requires that quantitative measures also be in place in addition to (not instead of) the qualitative measures.

The title of this paper poses a question – are there too many choices of assessment methods or not enough? For the chemical engineering program at NJIT the answer was ambiguous. There were too many assessment methods, as the list had to be reduced. Some surveys that the university had initiated, for instance, were not really useful for the chemical engineering program, at least not for accreditation purposes. But other assessment methods that were useful and necessary were not being used enough. Surveys needed to be conducted more regularly, and other types of data needed to be gathered and analyzed on a more regular basis.

Conclusions

The new EC2000 criteria have forced engineering departments that wish to be accredited to reexamine their operations. A system must be in place that leads to ongoing self-assessment and improvement. A vital part of this system is a variety of assessment tools that can be used to determine whether the educational objectives in general, and the desired program outcomes in particular, are being realized. These tools should consist not just of surveys, but a variety of other tools as well. Indeed, if most programs are like the chemical engineering program at NJIT, they already have a number and variety of such tools already in place. Surveys are useful, but can not address on their own all of the assessment needs of a program. Programs should carefully consider what assessment tools they already have – even if they have not before considered them to be assessment tools – and how they can be improved or put to better use. Then, and only then, should they consider how many new surveys and other tools they need to devise and implement. If they are sufficient for their needs for self-study and improvement, then they should also be sufficient to satisfy the new accreditation criteria.

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