EC2000 AND ORGANIZATIONAL LEARNING: RETHINKING THE *FACULTY* AND *INSTITUTIONAL SUPPORT* CRITERIA

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Abstract

This paper examines the current and potential affects of the new *EC2000* engineering-accreditation criteria on the roles of faculty and administrators in engineering education. Typically, *Criterion 5 (Faculty)* rates the quality of an academic program's faculty by assessing the qualifications of individuals and their achievements. *Criterion 7 (Institutional Support and Financial Resources)* rates the adequacy of resources to help the faculty carry out their obligations. From this perspective, both criteria assume that the sum of individual faculty achievements meets the course and curricular obligations of the academic unit. This assumption is consistent with the belief that individual autonomy, a hallmark of academic work life, and its variant, academic freedom, are essential to productive scholarship, effective teaching, and many forms of professional service. The formal assessment of faculty work—whether in promotion and tenure decisions or salary allocations—reinforces this belief by focusing on the accomplishments and productivity of each individual faculty member. Our research, however, indicates that the academic unit and institution have responsibilities that transcend the sum of individual faculty achievements. We call these *collective responsibilities*. Further, our research indicates that leadership is as important as the adequacy of resources in ensuring that academic units meet all of their collective course and curricular obligations. This paper offers an alternative view of *Criterion 5* and *Criterion 7*, one consistent with meeting collective obligations and with continuous improvement.

EC2000: ABET's Intent

The *Accrediting Board for Engineering and Technology* (ABET) identifies four overarching objectives for the accreditation of engineering educational programs [1].

- It helps assure that graduates of an accredited program are adequately prepared to enter and continue the practice of engineering.
- It stimulates the improvement of engineering education.
- It encourages new and innovative approaches to engineering education and its assessment.
- It identifies accredited programs to the public.

For purposes of accreditation review, ABET defines an academic program in the context of three integrated components—objectives, outcomes and curriculum. The new ***Criteria for Accrediting Engineering Programs***—a.k.a., *EC2000*—encourages institutions and programs to

define their missions and objectives to meet the needs of their constituents [2]. In theory this process should encourage program differentiation in accordance with the different missions and objectives of distinct types of institutions.

EC2000 emphasizes three additional points in its general philosophy for accrediting engineering programs:

- Emphasizing student outcomes, especially the preparation of graduates for professional practice.
- Specifying educational objectives to meet ABET criteria, and identifying how the academic program will meet these objectives.
- Demonstrating the capacity for continuous program improvement.

These three items represent a significant paradigm shift for ABET and institutions seeking the accreditation of engineering programs under *EC2000*. In theory, *EC2000* shifts the primary emphasis from inputs—i.e., faculty qualifications and resources—toward the effective use of these inputs in producing quality outcomes—i.e., student learning, effective use of resources to achieve curricular goals. The new criteria increasingly emphasize the *collective responsibilities* of academic programs rather than the individual achievements of program faculty.

EC2000: Common Practices

Despite these new ABET criteria, the common practice in assessing *Criterion 5 (Faculty)* remains focused on traditional measures of faculty qualifications [2]:

- the number of full-time-equivalent faculty members associated with the academic program,
- their education,
- the diversity of their backgrounds,
- their engineering experience,
- their teaching experience,
- their ability to communicate,
- their level of scholarship,
- their participation in professional societies, and
- their registration as Professional Engineers.

However, these factors alone will not ensure that members of the faculty possess the motivation to guide the program in its evaluation and development, as intended under *EC2000*. Moreover, these measures do not ensure and may only be marginally related to the goals of encouraging an appropriate learning experience for students and a commitment to CQI-based curricular reform. The current application of *Criterion 5*, in our view, reinforces the current norms of a teacher-centered environment [3] rather than promoting a transformation toward the learner-centered environment envisioned by *EC2000* [4]. In the traditional academic culture, the faculty value their time, which is broadly viewed as a very precious commodity, and intellectual investment by individual faculty members determines commitment to the process [5].

We believe that the most important factor in determining the level of success and sustainability of the CQI efforts within an academic program envisioned by *EC2000* relate to the faculty's perception of the cost/benefit ratio of their work efforts, as determined by each member of the faculty. Without changing incentives or making appeals to intrinsic motivators, faculty members inevitably focus on the activities visibly rewarded by their institutions and peers [5-7]. Regardless of type of institution, these rewards focus most often on individual performance rather than on collective actions such as curriculum reform [6]. This observation has led us to examine *Criterion 7 (Institutional Support and Financial Resources)* more closely [2]. Traditionally this criterion has focused on the adequacy of resources needed "to assure the quality and continuity of the engineering program." We have found that accreditation teams frequently do not explicitly address the leadership role of academic administrators in promoting a greater collective consciousness among the faculty and in installing the continuous improvement processes envisioned in *EC2000 despite language in the Criterion that encourages such an assessment*.

Below we describe incidents from three case studies that illustrate the need for accreditation teams to adopt a broader perspective in interpreting *Criterion 5* and *Criterion 7*, and to encourage both accreditation teams and faculty and administrators to understand the important linkage between the two criteria in achieving *EC2000* objectives.

The Shortcomings of Conventional Accreditation Perspectives in Promoting Course and Curriculum Improvement

Background Information on the Case Studies

The three case studies that follow illustrate the shortcomings of common practices associated with both *Criterion 5* and *Criterion 7*. These case studies were derived from the collective educational research, institutional service and public service activities of the authors.

To better understand the origin and context of each of these case studies, a brief background statement on each of the authors follows:

- **P. David Fisher** is a Professor (Emeritus) in the Department of Electrical and Computer Engineering at Michigan State University (MSU). He has devoted more than a decade to the reform of engineering education and engineering accreditation. Dr. Fisher has served as an ABET Program Evaluator since 1993 and has conducted three program evaluations under *EC2000*. He also provided college-level, department-level and program-level coordination of activities as MSU sought continued accreditation of its engineering programs during the 1998-99 accreditation cycle under *EC2000* [8]. He has published papers recently on incorporating design in engineering courses [9, 10], and reforming engineering service courses [11-12]. For the past four years he has served as a PI on the GE Fund Project entitled *Reforming the Early Undergraduate Engineering Learning Experience* [14].
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We use these brief case descriptions because they represent well documented case studies discussed and analyzed in past national, state and local workshops moderated by the authors (see *Bibliography* for more details).

Case I—Innovative Course Development

A regional university has an accredited engineering program with less than six full-time faculty members. Teaching loads are relatively heavy. One of the faculty members writes an internal proposal to acquire funds to attend a summer course at a major national university. The faculty member attends the summer course, learns a new topic, and applies the knowledge to introduce a new course in the curriculum. After three years, the faculty member repeats the above process with respect to a second course. Both represent topics seldom covered in a regional university. After six years, the two courses are listed in the university's catalog as regular offerings. Yet neither course is offered today. The faculty member is now actively involved in another scholarship-in-education project. None of the other faculty members feels obligated to teach these two new innovative courses.

The faculty member is rewarded for proposing the new course initiative and for following through on each stage of course development. However, the faculty never agreed *as a collective* that these innovative courses should become core offerings. Consequently, the faculty member moved to a new project that would provide "tangible rewards," relegating continuation of the existing new course to a lower priority. The college dean and department chair were both very enthusiastic about the contributions made by the faculty member but also disappointed that these new—and very innovative—courses weren't currently being taught.

Case II—NSF Funded CRCD Project

A Combined Research and Curriculum Development (CRCD) proposal is submitted to NSF and funded. The principal investigators use NSF and institutional funds to develop a new course, which includes a major laboratory experience. The course is placed in the university catalog. At the end of the funding period, the course is dropped and the faculty members involved move onto other scholarly interests.

In this case the faculty were rewarded for writing the proposal, receiving the NSF award, developing the course, and publishing papers related to the project. There were no tangible rewards for continuing to teach the course or to integrate lessons learned into the curriculum.

Case III—Reforming an Existing Course

Engineering students at a prestigious national research university consistently give low ratings to a core course. The professors who teach subsequent courses in the curriculum agree, saying that the students seem unable to apply what they learned in their classes. A young professor decides to improve this situation by incorporating active learning principles into the course. Rather than simply lecturing, he frames the course as if the students worked in a custom chip manufacturing plant. The professor invested many hours in learning to use group instruction, portfolio assessment, and open-ended design exercises. He found these practices both more time consuming than the traditional lecture/discussion format and more effective in enhancing student achievement. The students responded by rating the course very highly and extolling its virtues to other students. Other faculty members and staff from industry were impressed by the preparation of students and by the quality of their design work. By all accounts, the innovation was a success. Yet the departmental faculty rejected a petition to revise the traditional course format permanently because of the extra time commitment and the belief that such an investment was not important in promotion and tenure decisions. Faculty members carrying the course the next year returned to its traditional lecture format.

This case demonstrates that improving student learning outcomes alone—even when consistent with *EC2000* objectives—does not guarantee making reforms permanent. Here departmental faculty members were influenced more by the labor intensity of the reform than by the success of the innovation.

Summary of Lessons Learned with Respect to These Case Studies

In each of these cases course improvement was left to the individual faculty member as part of his or her job. This approach is consistent with the way academics traditionally view the faculty position within an academic program, that is, as a collection of autonomous individuals whose overall achievement results in the academic unit achieving its collective goals. Yet in each case these efforts failed to result in long-term programmatic improvements or in the type of continuous improvement envisioned by *EC2000*.

Systemic Reform and Continuous Improvement Processes

We define *systemic reform* as the process of periodically and systematically reviewing and modifying the productivity standards and productivity criteria of an academic unit, coupled with the concomitant modifications in structures and policies within the unit needed to effect the desired changes in outcomes. Ideally this process is continuous, integrated into both the academic unit and the institution. The faculty *(Criterion 5)* and the administration *(Criterion 7)* must be properly engaged in this process for the academic unit to fulfill its collective responsibilities—e.g., to demonstrate continuous improvement in the educational programs administered by the unit.

The three case stories indicate that institutionalizing instructional innovations—even for single courses—and transforming academic departments and programs in ways consistent with *EC2000* requires understanding the interrelationships among the array of external, institutional, departmental, and individual factors influencing academic departments, faculty work, and student learning. We developed a theoretical framework for educational reform based on systems theory and principles of learning organizations [18-20], models of faculty work [21-24], and our experiences in the GE Fund Project [14]. We focus on academic departments and programs because they are the focus of the *collective work of the faculty*. The model in Fig. 1 identifies the full array of factors potentially affecting course and curricular reforms. We contrast this model to the more typical assumption that success or failure depends solely on the individual faculty member or, at most, acknowledges some influence by the department and program colleagues.

Strategies to enhance learning and create learner-centered environments based on limited architectural concepts fail for many reasons. Reshaping complex faculty roles requires reorienting institutional reward structures and examining the interrelated components of the institutional structure in which the work takes place [25].Without incorporating a more systemic approach, most change efforts are relegated to the individual level – enhancing learning and learning productivity through improving classroom pedagogy. Weimer's work on effective teaching [26], Angelo and Cross' models of classroom assessment [27], and many other types of instructional development programs focus on improving the individual professor's instructional style without addressing the academic architecture directly. The underlying assumption here is that the academic culture can be transformed from teacher- to learner-centered by the cumulative effects of reforming individual teacher beliefs and classroom behaviors.

Many strategies to improve pedagogy also fail to take into account the complexity of faculty work. Depending on the type of institution, faculty members are expected—in addition to teaching—to carry out research and scholarship, improve curricula, and contribute to institutional, community and public service [28]. Strategies to improve teaching that do not account for the potential effects on other aspects of faculty work are likely to fail. Improving instructional productivity also requires understanding the complex relationships between other types of faculty productivity and how these relationships play out within departments as organizing units [5]. Without a systems perspective, interventions impact singular aspects of complex problems and often result in unintended outcomes unrelated to the actual goal.

The department is the crux of undergraduate educational reform because it forms the nexus between individual faculty work and collective responsibility. Traditional models of faculty work assume that departmental or collective responsibilities can be met by aggregating the efforts of individual faculty members [29]. But this belief is not supported empirically. Instead, meeting many collective responsibilities requires the faculty and department chairs to do more than carry out their individual assignments.

Collective responsibility is best portrayed in this more complex systems model than in more minimalist perspectives. We can identify a set of tensions not obvious from more minimalist architectures. On one side we have faculty autonomy, a mainstay of the academic culture. In this culture, highly productive people pick-and-choose how they spend their time, which leads

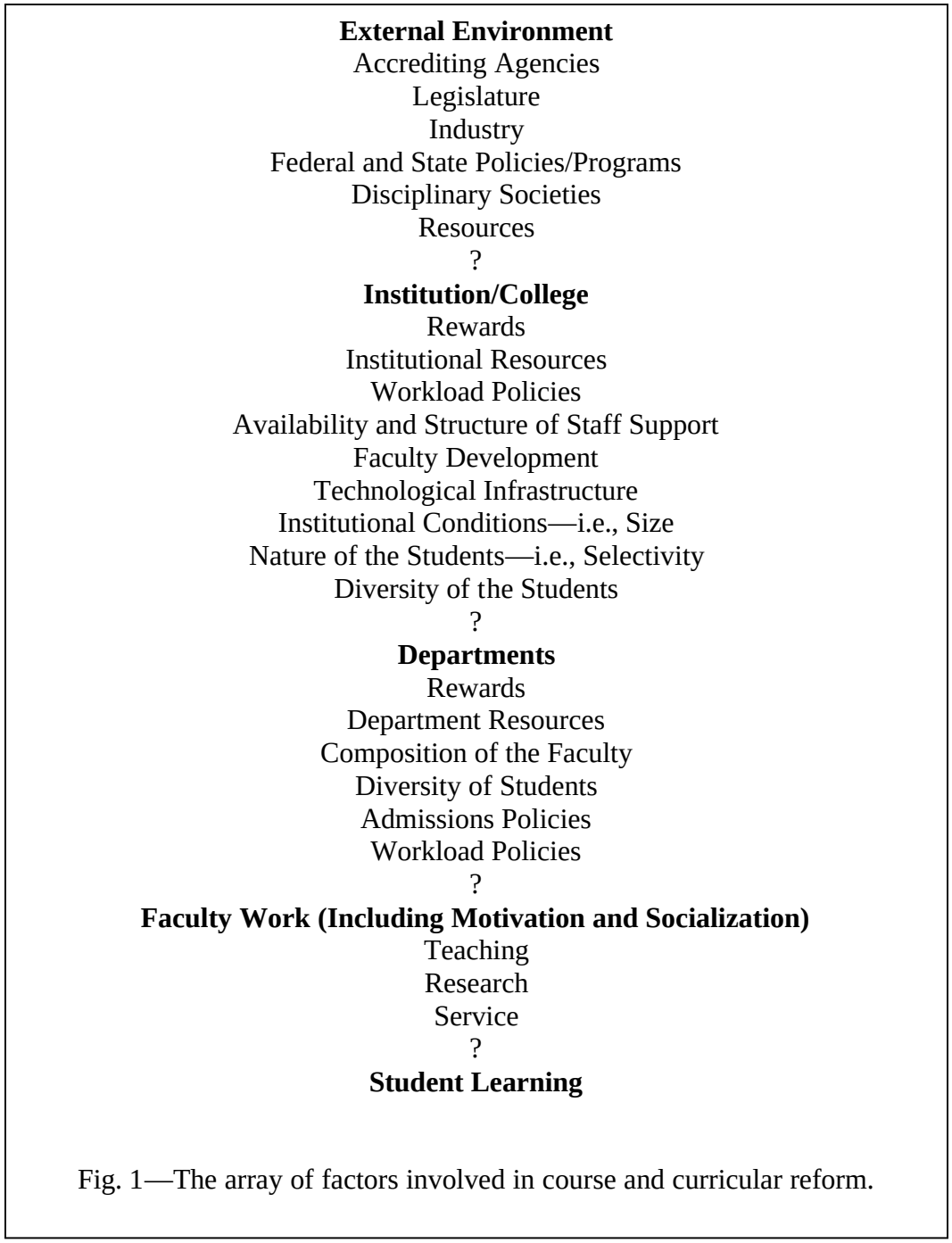

Fig. 1—The array of factors involved in course and curricular reform.

them to optimize on some activities and "satisfice" on others. On the other side we have collective responsibilities that do not easily fit into a faculty role so defined. Here lies the dilemma—or set of tensions—which obstruct a department from satisfying its collective responsibilities. These tensions include the following:

- The tension between collective responsibility and the system of individual faculty rewards;
- The tension between collective responsibility and the boundaries of academic freedom;
- The tension between collective responsibility and the faculty member's desire to maximize his/her autonomy;
- The tension between collective responsibility and faculty collegiality.

Recasting Criteria 5 and 7 to Encourage Continuous Improvement and Promote Collective Goals

In this section we use our systems perspective to broaden the factors typically considered in criteria 5 and 7. These factors are particularly important in promoting the achievement of both individual and collective goals and responsibilities.

- Identify Appropriate Interventions for Leaders at Distinct Organizational Levels: One key to successful curricular and course reform is to identify the appropriate leadership roles for program heads, department chairs, deans, and central administrators. Department chairs cannot resolve problems resulting from service courses, as one example, because these courses have a college-wide audience, not a departmental one. In this circumstance, the dean is the appropriate administrator to turn to for leadership. Similarly, program heads within large departments cannot solve resource allocation issues without the support of their department chairs.
- Leaders, not Just Administrators: Many department chairs and deans view their jobs as ones of management and administration. These perspectives are useful when the focus is on operations and maintaining ongoing departmental obligations. Promoting and fostering curriculum reform, however, requires deans and chairs to take active leadership roles. Facilitating dialogue, mediating conflict, and introducing future-oriented ideas are important, visible leadership activities. Less obvious but no less crucial is uncovering deeply held (and often tacit) assumptions about curriculum and how it relates to faculty identity, roles, and work. These leadership activities are very time consuming. Effective reform requires a shift in how academic administrators understand their roles and may require reconfiguring administrative tasks to create flex time for leading.
- Values and Rewards: We have observed wide variation in the incentives/disincentives for faculty to teach various courses, to participate in various planning and assessment activities, and to assist the department in meeting its collective responsibilities in certain areas. Consistent with Massy and Wilger [5], most faculty members will not pay sufficient attention to collective responsibilities without some modification in reward structures. Comprehensive reforms involve challenging promotion and tenure criteria, spelling out the relative value of meeting collective obligations. Less radical reforms include giving release time for course preparation and additional conference travel for faculty members involved in educational reforms. In either case, bringing key administrators from each organizational involved in the promotion and tenure into the conversation is crucial.

- Workload Policies: Academic-unit workload policies affect curricular and course innovations directly. Academic units, which count each course taught as a "unit of work," fail to differentiate between the actual load in teach a course with 300 undergraduate students and one with five doctoral students. Academic-unit policies that do not give credit for managing laboratory-based courses increase the actual workload for the faculty members teaching them. Work load policies more conducive to course improvement would give course credit in line with the effort required to teach the course.
- Strategic Planning: Strategic plans can help an academic unit identify collective responsibilities and the faculty member's obligations in meeting those needs. This goal can be accomplished in part if the department (and college) have in place operational strategic plans. These plans should be continuously reviewed and periodically updated. They should be tied in with resource allocation decisions.
- Individual Faculty Planning, Assessment, and Autonomy: An individual faculty member's work has three basic components—i.e., teaching, service, and scholarship. We have found that faculty members, especially those teaching service courses, tend to view their teaching and service commitments as "assignments" made by department chairs or program heads. These same faculty members view the focus of their scholarship as a matter of personal and professional choice, more consistent with autonomy than either teaching or service. We believe that department chairs could reduce the tensions described in the previous section by allocating teaching and service assignments in consultation with their faculties. These assignments could be clearly linked to the overall collective responsibilities of the department, which would enable each faculty member to see how his or her work fit with the whole.
- Course Ownership, Collegiality, and Academic Freedom: The issue of who owns a particular course is an important one. For example, assume that a certain faculty member is the only person who teaches a course for a long period of time. No one feels comfortable asking this person about course content, course learning objectives, or even the suitability of the course in the curriculum. Under what conditions is this situation in the best interests of the department? If some faculty in the department believe that "this isn't his or her course," does this attitude affect the department's ability to conduct its collective instructional obligations effectively? Faculty should discuss and agree on the basic boundaries between collegiality and academic freedom and how interpreting these boundaries affect course quality, program quality, and department efficiencies.

Summary and Recommendation

In summary, sustained curricular improvement in undergraduate engineering education requires systemic reform. An essential part of this reform is moving the focus from individual faculty interest, motivation, and activity to collective ownership and understanding of the reform efforts. Long-term success depends on carefully defining the system in which classroom teaching effects other parts of faculty work, departmental and college operations, and external pressures. Ultimately, successful reform requires re-orienting the roles of faculty members, department chairs, and deans to achieve both individual and collective success. As such, we recommend that ABET review *EC2000*'s *Criterion 5 (Faculty)* and *Criterion 7 (Institutional Support and Financial Resources)* and build these factors into its process of accreditation review.

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Biography

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