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Getting in Sync: Faculty and Employer Perceptions from the National Study of EC2000*

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This study compares the changes in programs and courses reported by Chairs and faculty with the assessments of new engineering hires reported by employers in a national study of engineering accreditation. Employers report that new engineers demonstrate adequate competency in foundational science, math, and technical skills—and program Chairs and faculty report little change in their courses and program curricula in these areas. In the areas where employers perceive the need for more attention to skill building, such as communication, teamwork, and use of modern engineering tools, faculty and Chairs report the greatest increases in curricular emphasis.

Keywords: accreditation; student assessment; competencies.

INTRODUCTION AND PROBLEM STATEMENT

IN THE EARLY 1990s, the Accreditation Board of Engineering Education (ABET) and its Accreditation Process Review Committee (APRC) examined existing accreditation criteria and processes, and ascertained the need for substantial change. As Prados, Peterson and Aberle pointed out (2001), the primary reason for reform was the mismatch between industry needs and the skill sets of the engineering graduates [1]. Over a period of several years, engineering employers had delivered this message through the various engineering societies, reports on the state of engineering education, and the local industry advisory councils that provided counsel to engineering schools and programs as well as to ABET.

The engineering community identified a number of concerns about ABET's accreditation criteria. The problems included excessively long and detailed criteria and a complicated and a user-unfriendly accreditation process. For example, ABET criteria were increasingly prescriptive and had grown from less than one page of General Criteria in 1959 to more than 19 pages of smaller type in 1999. More importantly, ABET's rigid accreditation criteria were perceived as barriers to needed change and innovation [2].

ABET's leadership concluded that its accreditation paradigm needed to change to allow change and innovation in engineering education. Prados noted that the paradigm shift required a movement away from assessing engineering programs on the basis of resources, faculty credentials, curricular requirements, and seat time. The new standards, known as EC2000, replace this focus on inputs with an emphasis on student learning outcomes. Undergraduate engineering programs must now set clear educational objectives, collaborate with industry, conduct outcomes assessment, and feed data from these assessments back into their programs in a process of continuous improvement [2, 3].

In 1996 and 1997, ABET piloted the EC2000 standards. After a transition phase, the new EC2000 standards became mandatory in 2001. Criterion 3, which specifies 11 desired student learning outcomes, is expected to stimulate significant restructuring of curricula and instructional practices because programs must align students' educational experiences with the knowledge, skills, and dispositions defined by a–k learning outcomes. Criterion 3 maintains curricular focus on the technical knowledge base of the field (i.e., mathematics, basic science, and engineering science), but also mandates emphasis on particular professional skills. Engineering programs are now expected to build students' capacity in skills such as communication and teamwork, and in knowledge areas such as professional responsibilities and ethics. Ideally, engineering curricula and instruction will integrate technical and professional subject matter so that students will see relationships among those areas from the beginning of their undergraduate programs.

In this paper we explore two related questions. The first is whether EC2000 has had a measurable impact on engineering program curricula. We then ask whether the curricular changes observed are aligned with employers' ratings of the abilities of

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new hires in engineering, that is, are programs making curricular adjustments in areas that employers perceive to be in need of improvement? Alignment would provide the engineering community with evidence that the needs of industry and the actions of the educational community continue to be complementary.

THE IMPACT OF ACCREDITATION ON CURRICULAR CHANGE

The EC2000 accreditation standards encourage engineering programs to align their curricula with the 11 learning outcomes specified in Criterion 3. Some of these learning outcomes, for example, knowledge of basic science and engineering science and problem solving, have long been emphasized in undergraduate programs. Other outcomes established by EC2000, such as knowledge of contemporary issues and understanding of the societal and global impact of engineering solutions, have not received systematic attention. In programs where existing educational experiences do not adequately support student development of the 11 competencies, faculty must redesign courses to help students master the required knowledge and skills. In this paper, we ask whether the implementation of EC2000 prompted these kinds of curricular changes.

The literature on accreditation is sparse, but a few studies have examined the impact of changes in accreditation standards on educational practices. These studies suggest that some curricular change is to be expected in response to a change in accreditation standards. For example, when the American Assembly of Collegiate Schools of Business (AACSB) modified its accreditation criteria in 1993, Mayes, Heide, and Smith surveyed deans of business schools to ask about curricular changes that might result from the change in standards [4]. They found deans assumed only modest changes would be required, primarily in the area of general education. A study of the influence of the change in standards on accounting programs found programs were working to identify the skills and knowledge base required for employment in the field and were developing educational objectives reflecting these skills [5]. Program administrators provided information about how such decisions were made (for example, by curriculum committees or program Chairs, etc.), but did not provide information about particular changes in accounting program curricula that resulted from changes in educational goals.

In engineering, the substantial revision of ABET's accreditation standards has prompted faculty to document processes and share information about their programs [6], but little systematic study of the effects of the change has been conducted. A study by the American Society of Mechanical Engineers (ASME) during the pilot phase of the transition to the EC2000 accreditation standards suggested that the implementation of EC2000 in mechanical engineering programs 'created an environment in which the entire program faculty was involved in the process of establishing program educational objectives and student outcomes and assessment processes' [7]. Several programs reported curricular revisions in preparation for their review (e.g., changing the content and/or sequencing of laboratory courses or changing course prerequisites). ABET, however, accredits more than 1700 engineering programs in many engineering fields across 350 institutions, so a systematic study of the impact of the new accreditation standards on curricular planning processes and curricular change has been needed.

The ultimate goal of EC2000 is to produce engineers who are well prepared for their professional careers. Employer assessments of new hires' knowledge and skills are therefore necessary to evaluate the success of the new accreditation standards. Existing literature indicates that although engineering schools seek feedback from employers to improve curricula, determine the importance of certain skills to graduates' workplace, and evaluate the level of satisfaction with engineering education, there are very few studies focusing on employer perceptions of student/graduates' abilities [9]. This situation can be explained in part by the difficulties associated with the design and selection of nationally representative sample of employers.

EVALUATION FRAMEWORK

The data for this paper were collected as part of the larger EC2000 Study, which examines the impact of the EC2000 accreditation criteria on student learning outcomes in selected fields at a nationally-representative sample of institutions. ABET engaged the Center for the Study of Higher Education at Penn State University to answer the question: 'Are engineers who graduated from programs since implementation of the EC2000 standards better prepared for careers in engineering than their counterparts who graduated before introduction of the criteria?' The research team designed a three-year evaluation, entitled 'Engineering Change: A Study of the Impact of EC2000', which targets 203 programs in seven engineering disciplines at 40 institutions. We selected four engineering fields (chemical, civil, electrical, and mechanical engineering) that produce the vast majority of engineering graduates in any one year, and another three (aerospace, computer, and industrial engineering) were selected for their strong ties to specific employment sectors.

The framework for this study assumes that if EC2000 has been effective, evidence of change in ABET-accredited programs will be apparent both in engineering programs and in student outcomes. The conceptual framework for this project, shown

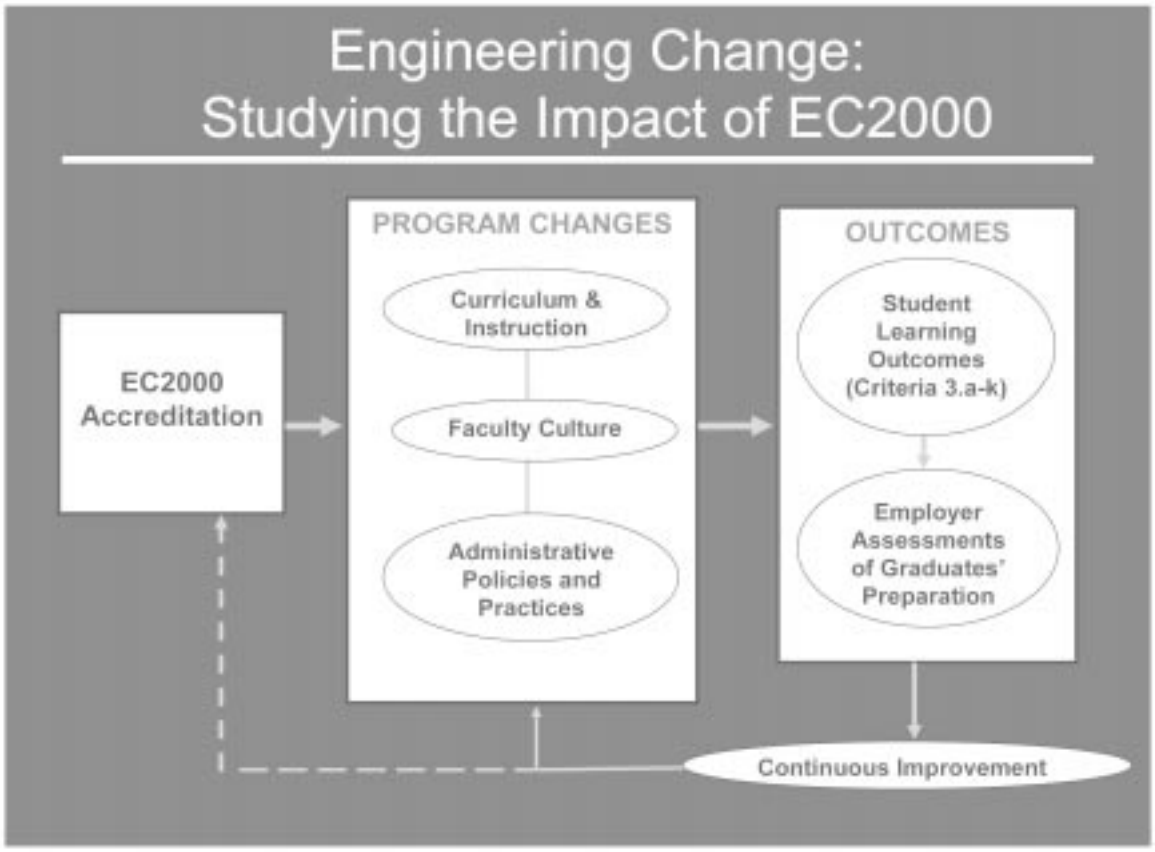

Fig. 1. Conceptual framework.

in Fig. 1, posits that the altered EC2000 accreditation standards influence curricula and instructional practices, faculty culture and attitudes about curriculum planning and student learning assessment, and administrative policies and procedures (such as hiring, merit salary, and promotion and tenure guidelines). The framework assumes that the EC2000 processes and criteria have a direct impact on these program and organizational changes that, in turn, impact student-learning outcomes. These outcomes will be visible not only to faculty, but also to employers, whose assessments of new hires will reflect improvements in the a–k outcomes. This framework also posits that employer feedback and information about student learning outcomes provides the basis for further improvements in curriculum and instruction, as well as in educational and organizational policies and practices. Thus, employer assessments are a dimension of a continuous improvement component of the framework.

The assumptions that are embedded in our conceptual framework are generally supported by the research literature. Several studies have already documented industry and EC2000 impact on faculty and curricula—institutions are developing educational goals and objectives, measurable learning outcomes, and outcomes assessment processes. Moreover, quality assurance, quality control, and improvement are common practices in many engineering fields.

METHODOLOGY

Faculty and Chair surveys

The Program/Faculty component of the EC2000 study, which assesses teaching and learning in engineering programs, collected data through two surveys: one for engineering program Chairs and another for faculty. The Survey of Engineering Program Changes (for Chairs) collects program-level information. The first section of the instrument focuses on changes over time in the emphasis on curricular topics consistent with the EC2000 criteria (such as interpersonal and group communication, teamwork, knowledge of contemporary issues, etc.). Program Chairs are asked to estimate the influence of ABET's EC2000 on any changes they report. They are also asked to estimate the level of faculty support for assessment, curriculum planning, and continuous improvement efforts. Additional sections assess changes in professional development activities, program resources, and collect information on the response to the program's last accreditation review.

The Survey of Faculty Teaching and Student Learning collected information from tenure-track faculty in engineering programs (who had been members of their current programs for at least two years). The first section of the survey focuses on a course that the faculty member regularly teaches, capturing changes in curricular emphases and the use of active learning strategies over time. Faculty

respondents are asked to estimate the influence of the EC2000 accreditation standards on the changes they have made in their focal course, and to report on the effects of those course changes on student learning as defined by the EC2000 learning outcomes. Respondents also provide information on their personal engagement in assessment and their perceptions of curriculum planning practices in their programs. Additional sections of the faculty survey collect assessments of graduating seniors' competencies (as specified by EC2000) and comparisons of the learning outcomes of graduating seniors and their pre-EC2000 alumni counterparts.

The faculty and program Chair surveys were administered between Fall 2003 and Summer 2004. Surveys were mailed to all participants; follow-ups were sent by e-mail. The response rate for faculty is 42% (1272 recipients from a sample of 3014). Of these 1272 respondents, 91% are male. The response rate for program Chairs was higher, 72% (147 of 203; 97% male). Several Chairs in the study administered more than one program and were therefore given the option of completing a single survey for multiple programs or responding for each program separately. Most of these Chairs indicated that the separate programs are similar, so they completed one survey for multiple programs, producing a total number of 147 useable program Chair responses than the number of programs.

The faculty responses were examined for missing data. Any case missing more than 20% of its items was deleted from the database. Missing values in the remaining cases were imputed using an expected maximization approach. Due in part to the smaller number of respondents, program Chair data were included in the analysis without deleting cases or imputing missing data.

The employer survey

The employer component of our Engineering Change study collects and summarizes the judgments of employers who are involved in the evaluation of new engineers. As with most surveys, the engineering employer survey balances brevity and completeness. The instrument collects information on respondent demographics, their ratings of recent engineering graduates, and a rating of the importance of each Criterion 3.a–k student learning outcome.

The employer survey was administered in mid-2004 with the cooperation of six professional societies (AIAA, AIChE, ASCE, ASME, IEEE, and IIE) associated with the seven disciplines targeted in the study (aerospace, chemical, civil, computer, electrical, industrial, and mechanical). Each society sent an e-mail message to a subset of its membership whose job titles suggested that they may be involved in the evaluation of new engineers. Society members who met the profile were invited to complete an on-line survey that was pilot tested at 7–10 minutes. If recipients of the invitation did not fit the selection criteria (having evaluated recent engineering graduates for seven years or more), they were asked to forward the invitation to someone in their organization who did fit the profile. The research team also drew upon the large alumni database created for this study, asking those who responded to the alumni survey to complete the employer survey if they met the selection criteria.

The engineering society and alumni survey invitations yielded 1622 useable responses. The characteristics of the responding employers reveal that they are an experienced, highly educated, and occupationally broad group. Over half the employer respondents (56%) have earned degrees beyond the bachelors, and 12% have doctoral or first professional degrees. The vast majority report that they are either senior level engineers or mid-level managers, and 60% of them indicate that they have both management and practicing engineer responsibilities in their organizations.

Responding employers represent every US State and every category of the twenty industry sectors listed on the survey. Approximately six out of ten respondents work in companies engaged in manufacturing or providing scientific and technical services. The respondents also represent a range of company sizes: fewer than 50 employees (25%), 50–499 employees (39%), 500–3000 employees (24%) and over 3000 employees (13%). The majority of respondents (54%) evaluate 2–5 new engineers per year, and 28% evaluate more. About half of these respondents recruit their new engineers at a handful of engineering schools within their state or region, but about one-third of them recruit nationally.

RESULTS

The EC2000 Study asked program Chairs and faculty to provide information about curricular changes in their programs and courses over the last decade, 1994–2004. This ten-year time frame estimates the extent of curricular change between the early discussion and later implementation of EC2000. Both surveys include questions about curricular topics that are associated with the 11 outcomes. Chairs indicated the extent of change in their engineering program as a whole for each topic. The faculty indicated the changes that they made in a particular course that they regularly teach.

The faculty survey also includes reports on changes in emphasis for the individual curricular topics; in addition, the individual topics are combined into five clusters to permit comparison with employer ratings of new hires' preparedness. The clusters were derived from a factor analysis of 36 pilot items designed to reflect EC2000 Criterion 3.a–k. For example, the cluster named 'Use engineering, math, science, and technical skills' includes five curricular topics associated with four of the a–k learning outcomes: a, b, c, and k. Criterion 3.a is

Table 1. Percentage of program chairs and faculty reporting changes in program/course emphases*

Clusters a–k	Individual survey items	Significant decrease	Some decrease	No change	Some increase	Significant increase
Use engineering, math, science, and technical skills (criterion a, b, c and k)	Foundational math (a)					
	Chair/Program change	0%	3%	77%	18%	2%
	Faculty/Course change	2%	10%	63%	22%	3%
	Basic science (a)					
	Chair/Program change	0	8	74	18	1
	Faculty/Course change	2	7	74	17	2
	Basic engineering science (a)					
	Chair/Program change	0	14	67	16	3
	Faculty/Course change	1	5	68	23	2
	Experimental methods (b)					
	Chair/Program change	0	3	50	40	8
	Faculty/Course change	1	5	59	28	7
	Use of modern engineering tools (k)					
	Chair/Program change	0	0	18	49	33
	Faculty/Course change	0	2	27	49	23
	Engineering design (c)					
	Chair/Program change	0	3	25	49	24
	Faculty/Course change	1	3	41	43	12
Apply problem-solving skills (criterion e)	Engineering problem solving (e)					
	Chair/Program change	0	1	51	38	10
	Faculty/Course change			Question not asked		
Communicate and work in teams (criterion d and g)	Teamwork (d)					
	Chair/Program change	0	0	15	45	40
	Faculty/Course change	0	3	45	36	16
	Verbal communication (g)					
	Chair/Program change	0	0	21	41	38
	Faculty/Course change	1	3	62	28	6
	Interpersonal/group communication (g)	0	0	11	36	53
	Chair/Program change					
	Faculty/Course change			Question not asked		
	Technical writing (g)					
	Chair/Program change	0	1	19	51	30
	Faculty/Course change	0	5	55	31	8
Understand the organizational, cultural, and environmental contexts and constraints of engineering practice, design, and research (criterion f, h, and j)	Professional ethics (f)					
	Chair/Program change	0	1	20	58	21
	Faculty/Course change	0	1	65	30	4
	Professional responsibility (f)					
	Chair/Program change	0	0	30	56	14
	Faculty/Course change	0	1	62	32	5
	Engineering in global and social contexts (h)					
	Chair/Program change	0	1	19	60	20
	Faculty/Course change	0	1	58	36	5
	Knowledge of contemporary issues (j)					
	Program Chair	0	0	40	54	6
	Faculty	0	1	55	37	6
Continue to learn, grow, and adapt as technology and social conditions evolve in unpredictable directions (criterion i)	Importance of life-long learning (i)					
	Chair/Program change	0	1	26	59	15
	Faculty/Course change			Question not asked		

* Percentages may not sum to 100 due to rounding. (Chair n = 147, Faculty n = 1272).

composed of three separate curricular topics: foundational math, basic science, and engineering science. Criteria 3.b and 3.k are each associated with one curricular topic (experimental methods and use of modern engineering tools, respectively). The clusters and their associated curricular topics are presented in Table 1. The EC2000 learning outcome (a–k) to which each curriculum topic corresponds is indicated in parentheses after the topic.

PROGRAM CHAIR REPORTS OF CURRICULAR CHANGE

According to the 147 program Chairs who responded to the survey, there is at least some increase in emphasis for each of the curriculum topics associated with the EC2000 student learning outcomes over the past decade. Table 1 groups chair responses into the five clusters of knowledge and skills described in the previous section.

The first cluster, the ability to use engineering, math, science and technical skills, corresponds to Criterion 3.a, b, c, and k. More than three-quarters of the program Chairs reported that there is no change in emphasis on foundational math and basic science over the last decade and two-thirds reported no change in emphasis on basic engineering science in that same time period. On the other hand, and particularly relevant for EC2000, more than four-fifths report 'some' or 'significant' increase in the attention to modern engineering tools in their program curricula, and almost three-quarters of them report increased emphasis on engineering design. About half report an increase in emphasis on experimental methods.

Although a few Chairs report 'some' decrease in basic science (8%) and basic engineering science (14%), these responses are balanced by a greater proportion of the Chairs that report increases. Thus, it does not appear that the increased EC2000 attention to professional skills has had a detrimental effect on attention to foundational curriculum topics.

In the remaining four clusters of knowledge and skills—apply problem solving skills; communicate and work in teams; understand contexts and constraints of engineering practice, and lifelong learning—half or more of the program Chairs report 'some' or 'significant' increases in emphasis over the last decade. Chairs report the least change in emphasis on applying problem-solving skills (48%), and the greatest increases in emphasis are in the communication and teamwork skills cluster (teamwork—85%; verbal communication—79%; interpersonal/group communication—89%; and technical writing—81%).

In the cluster associated with understanding the contexts and constraints of engineering practice, the topics of professional ethics (79%) and engineering in global and social contexts (80%) saw the greatest increase in emphasis, but professional responsibility (70%) and contemporary issues (60%) also received considerable attention over the last decade. More than three-quarters of the Chairs report 'some' or 'significant' increases in their programs' emphasis on lifelong learning in this period.

FACULTY REPORTS OF CHANGES IN COURSES

To assess the extent of curricular change at the course level, the faculty survey asks respondents to report on changes they made to a particular course that they regularly teach since the first time they taught that course. Faculty responded to a subset of the topics included on the program Chair survey. (Faculty could choose the category 'not applicable' for each topic since courses would not be likely to include all the topics listed. The tables and text reflect percentages excluding 'not applicable' responses.) As expected, faculty (reporting on a single course) indicated a lesser degree of change in the relevant curricular topics than the Chairs report for the program as a whole. See Table 1 for a comparison of Chair and faculty reports of curricular change at the program and course levels, respectively.

Faculty are even less likely than Chairs to report decreases in emphasis on technical knowledge and skills. Between two-thirds and three-quarters of faculty report no change in the emphasis on these topics in their focal course. Although 6–12% of faculty report some or significant decreases in foundational math, basic science, and basic engineering science, this is offset by the 19–25% reporting either some or significant increases. The other topics in this cluster saw even greater increases in emphasis. Thirty-five percent of the faculty report moderate to significant changes in emphasis on experimental methods, 72% report 'some' or 'significant' increase in emphasis on the use of modern engineering tools, and 55% report increases in engineering design.

On the other items as well, the faculty respondents reporting increases far outweigh those reporting decreases. More than half the faculty report increased emphasis on teamwork in their focal courses, and healthy increases are reported in technical writing (39%) and verbal communication (34%). Nearly a third report 'some' or 'significant' increases in their emphasis on professional responsibility and ethics.

The cluster of items representing a focus on contexts and constraints in engineering practice also reveal moderate change. Between one-third and one-half report changes in emphasis on contemporary issues (43%), global and social contexts in engineering (41%); professional responsibility (37%); and professional ethics (34%). An increased emphasis in these curricular topics is worth noting because many would consider them to be the province of general education rather than engineering courses.

Table 2. Employer ratings of recent graduates

How well prepared are recent engineering graduates	% Inadequately prepared	% Adequately prepared	% Well prepared
To use engineering, math, science, and technical skills	8	44	48
To apply problem-solving skills	20	54	26
To communicate and work in teams	25	53	22
To understand the organizational, cultural, and environmental contexts and constraints of engineering practice, design, and research	48	46	6
To continue to learn, grow, and adapt as technology and social conditions evolve in unpredictable directions	14	55	31

FINDINGS FROM THE EMPLOYER SURVEY

Table 2 shows the employer ratings of engineer preparation for each of the five clusters of skills and abilities emphasized in EC2000. In their assessments of new engineering hires, over 90% of employers rate them as adequately prepared or well prepared to use math, science and technical skills, and about 8 out of 10 employers give them passing marks for problem-solving and for learning, growing, and adapting. Teamwork and communication skills are assessed as at least adequate by 3 out of 4 employers. Since the introduction of EC2000, teamwork and communication skills appear to have improved modestly, along with learning to grow and adapt to changing technology and society. On the other hand, barely half of the employers give an adequate rating to new engineers' understanding of the organizational, cultural, and environmental contexts and constraints of their work.

To compare the Chair reports of changes in curricular emphases and employer perceptions of new hires' abilities, we combined the Chairs responses of 'some increase' and 'significant increase.' These percentages are compared with the employer ratings of new hires ('inadequately prepared'). Figure 2 depicts the relationship between these employer ratings of preparation and Chairs' reports of increases in program emphasis on the five clusters of engineering skills associated with EC2000.

Figure 2 reveals that the curricular clusters reported by Chairs as receiving the most and least emphasis are roughly aligned with the areas that employers view as weaknesses in the preparation of new hires. Most employers rate new hires as substantially prepared in four of the five clusters, and the reports by both program Chairs (and

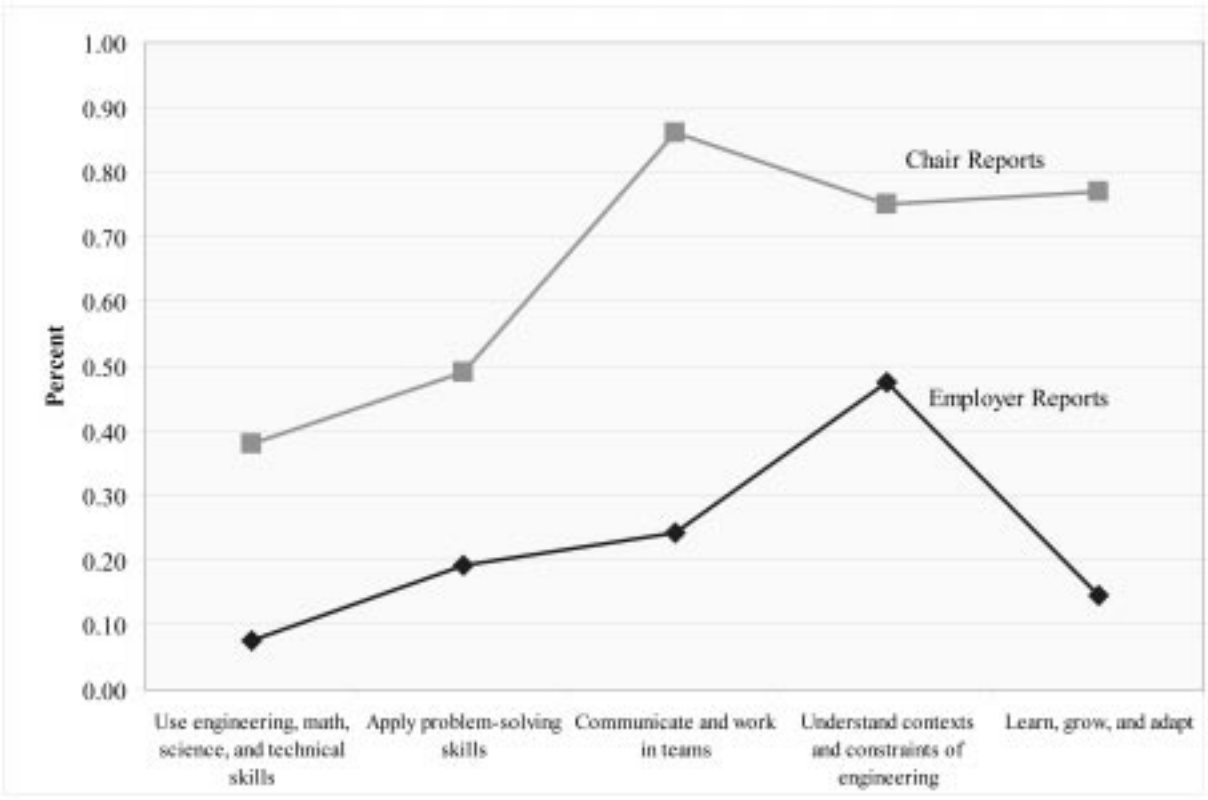

Fig. 2. Chair reports of change in program emphases versus employer reports of inadequate preparation.

faculty) appear to be largely in harmony both with the goals of EC2000 and with the perceptions of employers. Program Chairs and faculty report the greatest increases in emphasis in the communication and teamwork cluster, closely followed by contexts and constraints. A significant number of employers perceive these to be areas that continue to need improvement.

On the other hand, most employers rate new hires as well prepared in the engineering, math, science, and technical skills cluster. In turn, program Chairs (and faculty) indicate that the emphasis on three of the five items in this cluster (math, engineering science and basic science) has changed little in the last decade. Two curricular topics included in this cluster (experimental methods and use of modern engineering tools) have seen moderate to significant increases in emphasis. The modest attention to problem solving reported by Chairs aligns with the modest number of employers rating their new hires as inadequate in this regard. If there is a misalignment in Fig. 2, it appears in the responses to adapting, learning and growing 'as technology and social conditions evolve in unpredictable directions.' Few employers see weakness here, but most Chairs report this to be an area of increased emphasis. It is important to remember that any reported increases in attention are relative rather than absolute; curricular topics that received little or no attention before EC2000 may be the object of significant attention as a result of EC2000, but the degree to which they are emphasized in the curriculum overall may still be modest.

DISCUSSION AND CONCLUSIONS

This study compares the changes in programs and courses reported by Chairs and faculty with the assessments of new engineering hires reported by employers. The study targets seven engineering disciplines (aerospace, chemical, civil, computer, electrical, industrial, and mechanical) and analyzes the responses from 147 program Chairs and 1272 faculty at 40 representative institutions, and compares them with the responses from 1622 employers. The employers include every industry sector and every US State and Territory.

We expected and found that the changes reported for each program by the Chair generally exceeded the changes reported collectively by the faculty for their particular focal courses. However, the program and course changes alike are generally in sync with the goals of EC2000. For their part, employers (despite their diversity in terms of engineering field, industry sector, geographic location, company size, and organizational rank) are in substantial agreement about the preparation of new engineers. In their assessments, over 90% of employers rate new hires as adequately prepared or well prepared to use math, science and technical skills, and about 8 out of 10 employers give them passing marks for problem-solving and for learning, growing, and adapting. Thus, employers report that new engineers possess adequate competency in foundational and technical skills—and program Chairs and faculty report little change in their courses and program curricula in these areas. In the EC2000 areas where employers perceive the need for more attention to skill building, such as communication, teamwork and use of modern engineering tools, faculty and Chairs report the greatest increases in curricular emphasis.

Changes in engineering practices since the 1980s present a challenge to engineering programs that seek to prepare professionals for a diverse and rapidly changing workplace. The emphasis on engineering science that characterized traditional undergraduate programs produced graduates that were technically proficient, but not well prepared to manage innovation and change. By the 1990s, engineering employers expressed their concerns that graduates lacked creativity and design capability, communication and teamwork skills, and had a narrow view of engineering and related disciplines [9]. ABET sought to expand the range of skills developed in undergraduate engineering programs in the mid 1990s with the development, piloting, and implementation of a new set of accreditation standards (EC2000) that responded to employers' needs for engineers who are equipped with strong technical and professional skills.

The results of this analysis suggest that the interaction between industry, engineering education, and ABET continues. Engineering programs generally are heeding the requests of their industry partners to update and broaden the education they provide to engineering students and ABET is assisting in that process by focusing their accreditation process on the development of student knowledge and skills consistent with the needs of industry. The rough alignment between changes in curricular emphases reported by program Chairs and faculty versus the assessment of new hires by employers suggests the success of this coordinated effort to produce effective engineers for the 21st century. On the whole, engineering programs are increasing the emphasis on those areas of knowledge and skill that employers judge to be the least well developed in new engineering hires. This increased emphasis on the many professional skills required for good practice has been accomplished without substantive decreases in attention to the development of necessary technical skills. Employer judgments about levels of preparation in basic math and science have not declined as a result of the implementation of EC2000.

The EC2000 Study is designed to provide an evaluation model that can be used to study the current state of engineering education as well as replicated in the future when ABET again needs to assess progress toward its goals. The focus on continuous improvement that undergirds the

EC2000 criteria prompted ABET to 'walk its own talk'—that is, to evaluate the impact of the EC2000 standards on engineering programs and student learning. At this point in time, engineering programs and employers generally concur on what needs to be done, and alignment appears to be occurring. If subsequent evaluations reveal less alignment, they will thus signal the need for renewed discussion about the evolving needs of the profession and how these can be addressed through education and accreditation.

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