Influences on Engineering Faculty Members’ Decisions about Educational Innovations: 
A Systems View of Curricular and Instructional Change

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It is probably safe to say that while the majority of engineering faculty want to be effective instructors, very few are motivated to develop educational innovations that will be widely adopted beyond their programs or institutions. Our goal, then, is not to persuade all faculty members to become educational innovators, but instead to promote greater adoption of proven innovations by engineering faculty nationwide. Understanding the array of individual, organizational, and extra-organizational influences that potentially affect engineering faculty members’ decisions to adopt, adapt or reject educational innovations will contribute to the development of strategies for achieving this goal.

This paper focuses specifically on factors that influence individual faculty members’ curricular and instructional decisions, but by necessity also considers potential influences both internal and external to colleges and universities that may shape faculty receptiveness to innovative approaches to teaching and learning. This systems perspective on curriculum development and innovation is presented in opening section and also organizes the subsequent discussions of salient factors. The concluding section summarizes these influences and explores their implications for promoting innovation in engineering education.

A Systems View of 
Postsecondary Curriculum and Innovation

The success of any educational innovation and change is affected by the responses of real people (with particular experiences, backgrounds, needs, and desires) engaged in complex and variegated sociocultural and organizational contexts. The interaction of person and context is a dynamic one: individuals both influence and are influenced by the settings in which they live and work, and both individual and setting are shaped by larger social, cultural, and historical contexts. This complex array of interacting influences is depicted in the “academic plan in sociocultural context” model (Lattuca & Stark, 2009) depicted in Figure 1. This model describes an array of influences on curriculum planners as they create and revise academic plans for courses and programs in colleges and universities.1 Intended to inform research and practice in higher education, the model seeks to promote a thorough consideration of factors influencing curricular activities at the course, program, and institutional levels and is thus an aid for inquiries into educational innovation. The model assumes that faculty members are key actors in curriculum development and revision, and that proposed changes to a curriculum – an academic plan – will be understood and judged by faculty in light of existing plans and with reference to salient features of the educational environment.
Figure 1 reveals a broad definition of the term *curriculum* with implications for how we think about educational innovations. The box entitled “Academic Plan” consists of a set of eight elements, or decision points, that are addressed in every academic plan, whether intentionally or not, by faculty as they develop courses and programs. These eight elements include purposes (the views of education that inform a faculty members’ decisions about the goals of a course or program); content; sequence, instructional processes’ instructional resources; and assessment (of student learning) and evaluation (of the course/program). Although some individuals consider instruction separate from curriculum, this definition makes it clear that instruction is a critical element of every curriculum plan. An eighth element, adjustment, represents the changes that instructors make to courses during or after a course is taught (Path A in the diagram).

Specification of these eight elements allows us to examine educational innovations in terms of their impact on particular elements of existing academic plans. Will the innovation require the addition of new course content and the elimination of existing modules; will it entail the use of new instructional techniques; will it require substantial alterations in the ways in which student learning is assessed? How do these changes square with norms for teaching this content in the discipline or field? Focusing attention on what will need to change if an innovation is adopted clarifies 1) how individuals will be affected, 2) the extent to which a given individual is prepared to enact needed changes, and 3) the kinds of information and learning needed for that individual to successfully implement the innovation. Later in this paper, a detailed discussion of the role of individual characteristics, experiences, and motivations sheds further light on the adoption decision process.

In addition to the eight elements that define the academic plan itself, the model makes explicit the many factors that influence the development of academic plans in colleges and universities. First, it
acknowledges the influence of sociocultural and historical factors by embedding the academic plan in this temporal context, recognizing, for example, that curricular changes that might have been radical in one time and place might be commonplace in another. Within this sociocultural context, two subsets of influences, which are particularly germane to a discussion of educational innovation, are apparent: (a) influences external to the institution (such as employers and accreditation agencies) and (b) influences internal to the institution. Internal influences are further divided into institutional-level influences (e.g., mission, leadership, resources) and unit-level influences (e.g., program goals, faculty beliefs, and student characteristics). In a large university, unit-level contexts might include a school of engineering, its departments, and individual academic programs which organize faculty work.

Internal influences interact to create the “educational environment” in which academic plans are created. Educational processes and outcomes are placed outside the educational environment to recognize that many influences are beyond the control of planners. These include, for example, the academic preparation of students who enroll in a course.

Finally, Figure 1 portrays several evaluation and adjustment paths for the plan. Path A, already noted, depicts the adjustment path for a course or program. Path B suggests that the outcomes of educational plans may influence the educational environment itself. Path C reflects the potential influence of external and internal audiences that form perceptions and interpretations of educational outcomes. Engineering employers, for example, generalize about the preparation of new engineers for practice and these opinions shape their feedback to engineering schools and programs.

A systems perspective on curriculum development and reform suggests that individual faculty members respond to an innovation not only by judging its immediate impact on their work, and in light of their own experiences, but by assessing its perceived alignment with the structures and norms of the institutional settings and professional communities in which they work.

**From the Inside Out: Influences on Faculty Members’ Decision-Making about Educational Innovation**

Situating the faculty member in a complex social system has implications for the study and practice of educational innovation, suggesting a variety of influences that may shape faculty members’ perceptions of educational innovations and their decisions about whether to support, adopt, or reject them. These include individual influences such as personal experiences and characteristics, organizational influences from programs and schools, and influences external to higher education institutions.

**Individual Influences**

In traditional colleges and universities, faculty members (particularly those who enjoy the protections of tenure) have considerable professional autonomy to focus on those aspects of their work that they enjoy most or that yield the greatest rewards. In a book-length study of faculty motivation that included analyses of several large databases, Blackburn and Lawrence (1995) proposed a theoretical framework in which faculty motivations to engage in teaching,
research/scholarship, and service activities are affected “by interest, by self-knowledge concerning their competence and their chances of success, and by the social knowledge they trust with regard to what students, peers, and administrators value and reward” (p. 106). This model acknowledges the influence of individual and organizational features on the faculty experience, and stresses the interaction between the characteristics of individuals and their institutions.

Studies of faculty in higher education support the need for such complex thinking about faculty motivations. Faculty motivations appear neither exclusively extrinsic nor intrinsic (Berman & Skeff, 1988; Eimers, 1999; Johnsrud & Rosser, 2002). In a study of faculty at 20 highly selective liberal arts colleges, Eimers (1999) found that intrinsic and extrinsic motivations appeared to be interrelated, concluding that “intrinsic enjoyment ‘in and of itself’ may not exist without reference to external cues and stimuli” (p. 128). Similarly, a study of research faculty engaged in professional development revealed that interviewees found it difficult to articulate the difference between intrinsic and extrinsic motivators (Serow, Brawner, & Demery, 1999). We can speculate that this occurs because faculty members’ professional and personal identities tend to intertwine, making change a complicated event.

Stark, Lowther, Bentley, Ryan, Martens, Genthon, & others (1990) found that faculty decision making about college-level courses and programs is influenced first and foremost by what faculty members bring to the table – specifically, their (a) personal experiences and backgrounds, (b) their views of their academic fields, and (c) their beliefs about purposes of education. A similar set of influences is likely to affect decisions regarding educational innovations because these are, at heart, decisions about curricula, broadly defined as academic plans. The following sections explore the role of personal and professional experiences in shaping perceptions of and readiness for educational innovation.

The Role of Learning and Early Socialization into the Professoriate

Research on the role of personal experiences on educational planning and change in higher education is limited. Large-scale surveys like the National Survey of Postsecondary Faculty or the Cooperative Institutional Research Program (CIRP) provides reports of how faculty teach, but cannot tell us why some faculty (notably, younger faculty, women, and faculty of color) are more likely to use active and collaborative learning methods (DeAngelo, Hurtado, Kelly, Santos & Korn, 2009). Some faculty appear to bring these approaches with them to their first position while others adopt them as a result of their experiences in colleges and universities. In either case, faculty members have learned to teach in a particular way – either informally, through their educational experiences and observations of others, or formally through professional development opportunities experienced as doctoral students or faculty.

Studies of learning demonstrate that prior experiences and knowledge strongly influences how individuals understand and organize new information and ideas (Bransford, Brown & Cocking, 2000). If we apply this finding to educational innovations, we recognize that faculty will interpret curricular and instructional innovations in terms of what they already know. What an individual faculty member has learned – and put into practice – will shape how he or she thinks about new content or teaching methods or assessment approaches – and presumably his or her willingness to adopt these.
Acknowledging the role of previous learning and experience directs attention to the doctoral experience as a potentially positive influence on educational innovation. Although presently few in number, formal programs designed to prepare doctoral students for the professorate appear to be on the rise. These programs provide aspiring faculty with opportunities to learn about the multiple responsibilities of a college and university faculty member (i.e., teaching, research, and service), and in some cases, arrange supervised practice in teaching. Comprehensive programs are well-aligned with research on learning that demonstrates (a) that all individuals learning new knowledge and skills require opportunities to engage in the practices they will be expected to carry out, and (b) that to learn well, individuals require feedback on their performance (Bransford et al., 2000). 

Our analysis of data from the *Engineering Change* study, which includes nationally representative sample of engineering faculty, revealed that although only a small fraction of engineering faculty report having participated in any kind of teaching preparation program before assuming their first faculty position, those who had some formal preparation in teaching were significantly more likely to report using active learning techniques and activity-based assessments (Lattuca, Yin, & McHale, 2010). Whether these choices are the result of self-selection into teacher training programs, however, could not be determined and further investigations are needed.

Until teaching preparation programs are mandated by graduate schools and demanded by hiring committees and top administrators, informal socialization into the faculty role will shape the activities of new faculty, and continuing engagement in disciplinary communities will, for many, cement familiar (but often less effective) teaching practices. Based on their comprehensive review of the empirical literature, Smart, Feldman & Ethington (2000) identified a conceptual consensus that a faculty member’s academic discipline is the single greatest influence shaping his or her professional behaviors and attitudes.

With regard to teaching, evidence indicates that faculty in different disciplines assign different levels of importance to different educational goals such as the application and integration of knowledge (e.g., Smart and Elton 1975; Smart and Ethington 1995), and have preferred teaching practices (e.g., Einarson, 2001), as well as varying beliefs about the purposes of education (Stark et al., 1990), curricular goals (Lattuca & Stark, 1994) and the types of knowledge validation strategies students should learn (Donald, 2002). Faculty members’ teaching orientations also appear to be associated with their academic disciplines. Instructors in hard disciplines (e.g., science, engineering) are more likely to report using teacher-focused approaches, while those teaching in soft fields appear more student-focused (Prosser & Trigwell, 1999; Lindblom-Ylanne, Trigwell, Nevgi, & Ashwin, 2006; Lueddeke, 2003; Neumann, Parry, & Becher, 2002). These teaching orientations focus, respectively, on knowledge/information transmission or on student learning and conceptual change or (Kember & Gow, 1994; Trigwell & Prosser, 2004). Instructors who use a transmission approach are primarily concerned with teaching content and focus on how to organize, structure, and present course content in a way that students can understand. Instructors identified as having a student-centered approach see their role as facilitating student learning and knowledge construction or conceptual change. These differences may be related to the characteristics of the fields; hard fields contain many concepts to be learned, whereas soft fields focus more on exploring relationships and ideas.
Findings from another analysis of the *Engineering Change* data set found variations across engineering disciplines in faculty inclinations to focus on particular curricular topics and instructional methods, including topics such as the intersections of engineering practice and societal and ethical issues and the use of active learning techniques (Lattuca, Terenzini, Harper & Yin, 2009). These findings suggest that engineering faculty members’ responses to particular educational reforms have disciplinary (or more accurately, subdisciplinary) roots. Strategies to encourage adoption of particular innovations might thus require customizing strategies for particular groups of faculty depending on their characteristic disciplinary norms. Different groups of faculty might also need different levels and kinds of assistance to develop and implement desired curricular and instructional changes.

**Professional Experiences in Colleges and Universities**

For much of modern U.S. higher education history, the term faculty has referred to full-time, tenured, or tenure-eligible individuals working in not-for-profit colleges and universities. The composition of “the faculty” in U.S. higher education is, however, changing rapidly. Once dominated by tenure-eligible and tenured full-time faculty, the faculty is now increasingly populated by part-time adjuncts and full-time, fixed-term contract faculty. The hiring practices, working conditions, and institutional reward systems for these “contingent” faculty are typically quite different from those of tenure-line faculty, and these differences may have implications for educational innovation and change.

In their study of the use of non-tenure-track faculty in Big 10 universities, Cross and Goldenberg (2009) found that the use of contingent appointments in engineering has increased over time, but at a less rapid rate than in the arts and sciences fields. In engineering schools; the proportion of non-tenure-track faculty to tenure-track faculty in engineering has been constant for the last decade. Cross and Goldenberg warn, however, that while engineering departments have not increased their proportion of contingent faculty, engineering students often take fundamental courses in math, chemistry, physics and writing from instructors appointed in arts and sciences colleges, which are making the greatest use of contingent faculty. Encouraging innovation in foundational courses is thus often out of the control of engineering educators. Engineering deans and others need to consider how to facilitate the adoption of effective innovations among faculty – often contingent faculty – who work in departments outside engineering.

An intriguing, if small, body of research examines to variations in faculty members’ work lives, and specifically their learning and scholarly development, at different career stages. Before tenure, Neumann (2009) suggests, work that is central to the employing institutions’ mission will figure most prominently in faculty careers. After tenure, university professors in particular need to engage in “catch-up learning” as they are increasingly asked to take on administrative roles, service, and large-scale teaching (p. 11). Neumann (2009) hypothesized that the discrepancy between the pre-tenure and post-tenure career is largest in research universities and less dramatic in institutions in which faculty have extensive teaching and service obligations throughout their pre- and post-tenure careers. In the post-tenure years, her studies of research university faculty suggest, professors experience a growing workload in which they teach larger and increasingly diverse classes, advise more students, mentor junior colleagues, and take on new research obligations.
An analysis of the data from the National Survey of Postsecondary Faculty offers support for Neumann’s findings: at mid-career, teaching and administration become the largest portions of faculty time (Baldwin, Lunceford, & Vanderlinden, 2005). This study revealed that the proportion of time invested in teaching was greatest among older faculty and those late in their academic careers. It is also worth noting that mid-career was also at the height of research productivity (measured by refereed publications, presentations, and creative work), suggesting that faculty workloads may be especially challenging at mid-career. Baldwin and his colleagues noted that this shift is consistent with models of adult development. Their findings suggest that career stage may influence decision-making regarding educational innovations as faculty members consider how to balance workloads in teaching and research with a desire to try educational innovations that might require significant time to learn and to implement well.

Professional development opportunities may help faculty manage shifts in their work lives. There is a growing body of research on the impacts of instructional development programs in particular, but findings are somewhat mixed due to problems with conceptualization and research design (Stes, Min-Leliveld, Gijbels, & Van Petegem, 2010). In engineering, however, there are some encouraging results. In an evaluation of the National Effective Teaching Institute (NETI) three-day workshops, Felder and Brent (2010) reported that substantial numbers of respondents to the evaluation survey reported incorporating what they had learned at the NETI workshops into their teaching and credited the experience with a moderate or strong influence on their decision to do so. Felder and Brent attributed the success of the workshops to the fact they are designed specifically for engineers, rely on presenters with engineering expertise, and offer suggestions and choice rather than prescriptions for practice.

Another study suggested that instructional development activities that include a strong and consistent emphasis on collaborative reflection on actual practice could positively influence engineering faculty members’ views of teaching and learning (McKenna, Yalvac, & Light, 2009). Changes in teaching approaches appeared to result after faculty engaged in several educational activities, including implementing new teaching strategies, evaluating those interventions, reflecting on findings through publications and peer review, and reiterating the teaching methods in subsequent classes.

Other important insights come from another qualitative study of a year-long instructional development effort for faculty in a variety of disciplines, which revealed that the long-term impact of professional development programs was greatly influenced by the local context in which instructors worked (Stes, et al. 2010). The authors concluded that a lack of consensus among colleagues about the value of an instructional strategy or the difficulty of implementing it with a given group of students were often mentioned as constraints on the application of what was learned in the program. In contrast, enthusiastic students and colleagues were mentioned as facilitating application. These findings regarding the role of the local context are consistent with those of previous research on instructional development (Clark & Hollingsworth, 2002; Trowler & Cooper, 2002), suggesting that innovation will be most successful in engineering programs that cultivate collegial support for faculty who implement new instructional approaches.

A compelling reason to pursue professional development as an avenue for facilitating innovation comes from the Engineering Change study. An analysis of data from faculty, program chairs, and
students in 147 engineering programs nationwide indicated that an engineering program’s climate for continuous improvement, reflected in faculty members’ engagement in professional development and assessment, had a significant, if indirect, effect on student learning: engagement in professional development and assessment activities positively influenced the experiences engineering students had in their courses and programs and this, in turn, positively affected students’ learning outcomes (Lattuca et al., 2006).

This section synthesized theory and research to identify personal and professional experiences that may influence the decisions that engineering faculty make as they consider educational innovations. Disciplinary socialization, beginning in graduate school but continuing throughout the professional career, emerges as a strong influence. A less extensive body of research suggests that professional development and career stage, with its attendant variations in workload, may also influence faculty members as they make decisions about innovations in their courses. The doctoral program is a likely intervention point for teaching improvement activities, but engineering schools should also consider how increased use of contingent faculty to teach fundamental courses required for all engineers affects their educational programs by potentially limiting the implementation of key educational innovations.

**Organizational Influences**

A number of organizational factors may also influence faculty members’ decisions to develop or implement innovative curricula. The following discussion groups these into the broad categories of institutional type and culture. While institutional type, which is discussed first, is fixed, organizational cultures are, to some degree, malleable. Attention to how institutional and unit cultures affect faculty members’ decisions about innovations may thus suggest potential strategies to facilitate innovation.

The United States is home to a very diverse array of colleges and universities but most of the 4,000 or so not-for-profit institutions pursue, to varying degrees, the activities of teaching, research, and service. The taxonomy called the Carnegie Classification, developed in 1970 to differentiate types of institutions and revised a number of times since, can help researchers, policy makers, faculty, and administrators seeking to understand and foster educational innovation. The basic classification distinguishes six types of institutions: associate’s colleges, baccalaureate colleges, master’s colleges and universities, doctorate-granting institutions, special focus institutions, and tribal colleges (Carnegie Foundation for the Advancement of Teaching, 2007).

Carnegie “types” tend to reflect an institution’s stated mission and degree offerings because they predict specific educational characteristics of an institution, such as teaching responsibilities and research emphasis. They also allow finer-grained analyses of these activities. For example, while the number of hours faculty members devote to instructional activities has been relatively stable since the mid-20th century, it is clear that talking in terms of the “average” faculty member hides important differences in teaching emphasis and workloads. Data from the National Survey of Postsecondary Faculty reveals that the typical faculty member in a not-for-profit college or university spends 60% of her time on instructional duties, 18% on research, and about 20% on service. At two-year associate’s colleges, however, research efforts account for only about 5% of faculty time; teaching accounts for more than 70%. In contrast, faculty in doctorate-granting
institutions spend about 50% of their time on teaching and nearly 30% on research (Schuster & Finkelstein, 2006).

Interestingly, faculty in all types of traditional (not-for-profit) four-year institutions report feeling more pressure to publish (Schuster & Finkelstein, 2006), suggesting one reason why educational innovations will not necessarily be embraced in teaching-oriented institutions despite their espoused dedication to the teaching mission. Other institutional characteristics, such as institutional reward systems, leadership, and faculty cultures – all arguably elements of culture of the larger institution or unit– also create potential incentives and/or barriers to educational innovation.

Organizational culture has been usefully defined as “the way we do things around here.” Understanding why innovations are created, adopted or rejected rests in part on understanding the cultural features of a given engineering school and the ways in which these support or thwart innovation and change. For example, the Engineering Change study was based on a conceptual model that assumed that if the then-new EC2000 accreditation criteria were to be effective, certain kinds of changes would have to occur in engineering programs. For one, faculty would have to change the curriculum to reflect the emphasis on the 11 learning outcomes specified in the criteria. In addition, faculty would have to make adjustments in the delivery of courses, providing students with more opportunities to practice – not simply hear about – skills such as teamwork and communication to ensure graduates could demonstrate their mastery of these professional skills. This might require faculty to learn about different instructional techniques and thus influence their participation in professional development activities (such as workshops or reading the teaching and learning literature). Further, to meet the accreditation requirement for continuous improvement (CI), faculty would also have to engage in assessment, collecting data on student learning and using that data to inform program improvements. Assuming most faculty members are unfamiliar with program-level assessment, at least some would also need to learn about assessment techniques and how to implement them.

In sum, one could argue that the implementation of the EC2000 accreditation standards required engineering programs to make some changes to “the way we do things around here” to ensure their success in accreditation or re-accreditation. The existing faculty culture in an engineering program was thus conceptualized as a potential factor influencing curricular and instructional innovation and change. The aspects of culture most relevant for the Engineering Change study included faculty practices related to curriculum planning, assessment, and professional development – that is, to continuous improvement. Findings from the study suggested that the CI program culture was less common in research universities, where the number of instructors is large and emphasis is on discovery of new knowledge rather than teaching (Harper & Lattuca, 2010). Baccalaureate institutions were more likely to use continuous improvement practices in their curricular planning than research universities. Those programs that were classified as “high CI” programs offered significant benefits to their students. After controlling for student and institutional characteristics, high-CI programs exhibited stronger coupling of student experiences and student outcomes, suggesting that high-CI programs provided more coherent educational programs that connect curricular experiences in-class with out-of-class experiences and with desired learning outcomes. These findings further suggest that institutional type influences program-level cultures.
Faculty cultures that support educational innovation may be purposefully cultivated so that educational innovations are not invariably met with resistance but considered thoughtfully with regard to program needs. The Curriculum Leadership for Undergraduate Education (CLUE) study of planning in academic departments across the U.S. examined the practices of programs known for regular curriculum planning (Briggs, Stark, & Rowland-Poplawski, 2003). The researchers found that the most successful departments exhibited characteristics congruent with those of continuous improvement models. Faculty in these programs view themselves as communities that learn together and share their experiences as they plan (Briggs, 2007). They also have collegial styles of collaboration that emphasize voluntary initiative and flexible participation rather than formal roles and time lines for change. This culture creates a sense of shared ownership of the curriculum, demonstrated in the programs’ problem-solving behaviors. Faculty leaders as well as department chairs in these programs have high expectations for curriculum planning efforts and provide many opportunities for discussion and for collaborative work on instructional materials such as lab manuals, slide collections, course syllabi, examinations, and web-based tools.

Organizational culture, of course, is multi-faceted. In higher education institutions, the reward system for faculty is a clear manifestation of organizational culture, providing incentives and formal recognition (in the form of promotion, tenure, and merit salary increases) to faculty whose work is consistent with organizational values and priorities and withholding rewards from those who pursue activities that are not valued by the institution or unit. The conceptual framework for the Engineering Change study assumed that if EC2000 were truly having an impact on engineering schools and programs, the faculty reward system would be modified to recognize the increased responsibility that faculty now bear for teaching and learning under the EC2000 accreditation standards.

To explore this, the faculty and program chairs’ surveys therefore asked faculty and chairs to report on their perceptions of changes in the reward system (before and after EC2000). Findings were mixed. Chairs and senior faculty tended to be more positive in their assessments of the value assigned to teaching activities in decisions about promotion and tenure and merit salary awards on their campuses. Chairs tended to see more attention to teaching than faculty, but a greater proportion of both groups perceived no change or a decrease in its emphasis on teaching in the reward system during the decade spanning the EC2000 implementation (Lattuca et al., 2006).

As the earlier discussions of faculty motivation and learning suggest, promoting educational innovation is not be as simple as increasing incentives and rewards for adoption of teaching innovations, but it may be a key component of an overall strategy. Engineering schools and departments must eliminate the risks to faculty who are willing to adopt educational innovations by ensuring that their efforts to improve the educational experiences and learning of students are recognized and rewarded. In research universities especially, but also in other types of institutions that are increasing research-oriented, organizational and unit cultures seem to impede educational innovations. Cultivating a culture in which curriculum stewardship is a valued activity may, however, facilitate curricular and instructional improvements.
External Influences

Educational innovations that respond to external pressures are, to some extent, imposed on an institution and its members. Changes in the way engineering is practiced in industry, for example, press engineering programs to adjust their curricula. Industry and employer needs take on more weight when joined to professional accreditation standards. In professional fields like engineering, where accreditation is a condition of licensure or certification, accreditation is a particularly strong influence that appears to be effective in producing change. The *Engineering Change* study concluded that ABET’s specification of 11 learning outcomes required for all engineering graduates resulted in significant increases in the curricular emphases that engineering programs gave to the knowledge and skills associated with these learning outcomes, and appears to have influenced students’ learning as well (Lattuca et al., 2006).

For the purposes of this paper, the nature of these curricular changes is less important than the source of influence. While nearly 90% of program chairs cited “collective faculty decision” as a moderate to strong influence on curricular changes in their programs, and while nearly half attributed a great deal of influence to such faculty consensus, more than 80% of those chairs also reported that industry and employer feedback had a moderate or a great deal of influence on the changes made in their program curricula over a ten-year period. In contrast, the majority of faculty took personal credit for changes made in their courses: just over one quarter of faculty respondents attributed a moderate or strong influence on changes in their focal courses to ABET or industry (Lattuca et al., 2006).

External pressures may or may not be viewed as legitimate by faculty or be effectively addressed by them. For example, engineering faculties are quite aware of ABET’s requirement for outcomes-based assessment. By 2004, the vast majority of engineering faculty reported at least some involvement in the assessment of students’ learning outcomes, but the actual use of assessment data in decision making in engineering programs appeared to be lag behind (Lattuca et al., 2006). One potential explanation for this discrepancy is that engineering faculty and program chairs adhered to accreditation requirements by conducting assessment but revealed their skepticism of its usefulness through their decision not to act on the information collected. Yet, another reasonable interpretation is that assessment was not effectively implemented because faculty and administrators needed assistance to develop assessment methods and data that were credible, easily interpretable, and thus actionable. While the legitimacy of the accreditation standards was clearly questioned by some, the lack of knowledge of assessment might also have affected the ability of program faculty to effectively collect and use assessment data.

External influences on colleges and universities sometimes become internal influences as innovations are filtered through formal and informal leaders and internalized by faculty. The discrepancy between program chairs’ and faculty members’ perceptions of the influences of EC2000 on curricular changes in their programs provides an illustration. Differences in perceptions may reflect different levels of responsibility for accreditation and curricular leadership. The responsibility that chairs felt for ensuring their programs met accreditation standards may have increased their awareness of how local curricular efforts addressed ABET’s 11 learning outcomes.
Multivariate analyses of the *Engineering Change* data permitted further exploration of this discrepancy, as well as the relative importance of each of 12 possible influences, including ABET’s EC2000, on changes in engineering program curricula and instruction. These analyses isolated the unique contribution that chairs and faculty believed each influence had on their curricula and instructional approaches. Controlling for other possible factors, these analyses revealed that both chairs and faculty viewed ABET accreditation as exerting a statistically significant and independent influence on most of the curricular and instructional change scales used in the study. Faculty saw EC2000 accreditation as a significant, independent influence on increased emphasis in their courses on projects skills and on professionalism and societal issues, as well as increases in their use of active learning techniques in the classroom. They also perceived industry/employer feedback as a significant independent influence on these same course and instructional changes. In addition, they viewed their own initiative as a significant influence on these same changes (Lattuca et al., 2006).

None of the significant beta weights for the 12 sources of influence was very large, which suggested that a number of influences, rather than one or two primary ones, drove curricular and instructional changes in engineering programs. Engineering faculty and chairs apparently responded to an array of convergent forces. These findings have an important implication for stakeholders seeking to promote educational innovation in engineering. Aligning the agendas and messages of key stakeholders in engineering education – industry and employers, professional societies, funders, and ABET – may facilitate innovation. Ideally, meritorious external influences align with institutional and faculty interests to accelerate curricular and instructional innovation.

**Lessons Learned:**

**Activating Individual, Organizational, and External Influences on Innovation**

In this paper, I have relied on research and theory to explore the possible influences on engineering faculty members’ decision-making with regard to educational innovations. The overall discussion was informed by a systems perspective on curriculum planning, in which individual, organizational, and external influences are presumed to interact to shape faculty members’ curricular decision making, broadly understood. This perspective leads to several assumptions and conclusions.

First, I argued that faculty members will assess potential innovations in light of what they already know and can do. They are likely to think about proposed innovations in terms of what they mean for their courses and programs: what content must be changed, what new teaching methods are required, how will assignments and assessments need to be altered? Faculty members’ questions about innovations, then, are not necessarily a reflection of their resistance to change. They are, at least in part, a reflection of how humans engage with new ideas and information. When assessing an innovation, faculty will rely on what they know well to make sense of what is unfamiliar.

What is familiar is what has been experienced over time. Faculty members’ ideas about curriculum, teaching, and learning, and their repertoires of instructional behaviors are shaped by their personal experiences as students in engineering programs at the undergraduate and graduate levels and as instructors. Doctoral programs begin to socialize doctoral students, but this process continues into faculty members’ professional lives as they learn and adapt to the norms of their professional and institutional communities. Organizational cultures also express particular values and encourage particular norms for teaching and research, which may also influence the decisions that faculty
members make in their professional lives. In addition, faculty in professional fields such as engineering tend to be cognizant of the needs of the practice communities that they serve. Of course, individuals may vary in the extent to which they view industry and employers’ demands – and accreditation standards that respond to these demands -- as legitimate.

What do these observations suggest in answer to the question of what influences faculty members’ decisions to adopt, adapt, or reject educational innovations developed elsewhere?

With regard to personal experiences, it is logical to assume that since prior experiences shape responses to innovation, preparing doctoral students who intend to enter the professorate for the teaching role may facilitate their understanding of, and readiness to try, curricular and instructional innovations once they are in a faculty position. Doctoral preparation programs should include supervised and mentored teaching opportunities that include opportunities to try and reflect on different teaching approaches. Graduate students should not have to risk the disapproval of their research supervisors to participate in teaching preparation programs and mandating participation for all graduate students will send a message to graduate students’ supervisors, help alleviate graduate students’ fears, and ensure that all graduate students with aspirations to the professorate – not only those interested in teaching – engage in professional experiences designed to help them prepare for their roles as teachers, curriculum planners, and curriculum stewards.

Colleges and departments of engineering that seek to create a culture of openness to innovations and change can make it a priority to hire individuals who have participated in faculty preparation programs and who have demonstrated deep interests and emerging skills in teaching. New faculty with strong interests in teaching (as well as research) but who have not had the benefit of a teaching preparation programs should be provided with opportunities (as well as time and resources) to learn about teaching, curriculum design, and student learning so that they will welcome innovations as they are developed.

Organizational influences that support educational innovation and change include faculty cultures that include ongoing discussion and evaluation of curricula, teaching, and learning. By establishing a culture of discussion and inquiry, these cultures can surface misconceptions of learning and teaching practices and work to eliminate cognitive barriers to change. Such cultures will also provide support for faculty members who want to try curricular and instructional innovations. Program heads and department chairs, however, may need assistance to develop program cultures that make teaching and learning a priority.

Institutional cultures in which teaching and learning are a priority not only reward faculty for making improvements in their teaching and their students’ learning, but remove disincentives to such activities. Engineering schools can take steps to assure those experimenting with educational innovations will not be penalized if course evaluations are lower than desired as innovations are implemented and refined. Supportive institutions could agree that student evaluations for pilots of innovative courses will be confidential, and include a memorandum of understanding to that effect in promotion and tenure dossiers and annual performance reviews. Valuing publications on the scholarship of teaching and learning in promotion and tenure decisions will further support faculty who wish to publish and share information on their implementation of curricular and instructional innovations.
Professional societies and disciplinary communities, as external influences on engineering faculties, can emphasize the importance of effective teaching and offer their membership high-quality professional development opportunities in which experts effectively explain how students learn and provide information and instruction in teaching strategies that support student learning. Programs for new program heads and chairs, as well as for new faculty, can supplement institutional programs that must serve administrators from many disciplines and which do not address the needs of engineering faculty and programs in particular.

Well-orchestrated, joint efforts by key stakeholders in engineering education – for example, industry and employers, ABET, the National Science Foundation, the American Society for Engineering Education, the National Academy of Engineering’s Center for the Advancement of Scholarship on Engineering Education – may be more effective than individual efforts. Marshaling the knowledge, resources, and reputations of these organizations to design and deliver a well-planned sequence of mutually-reinforcing programs that clearly address the needs of faculty and administrators can build a strong and widespread base of individual and institutional support for proven educational innovations – and pave the way for continued educational innovation and change. Developing a suite of programs that take a systems perspective on educational innovation may slow the process, but the impact of the coordinated effort may result in a significant increase in the emphasis on effective teaching and superior learning in doctoral education, engineering programs, and engineering schools.

References


Lattuca, L. R., Yin, A. C., & McHale, I. M. (2010, November 18). Influences on Engineering Faculty Members’ Teaching and Beliefs about Teaching. Research paper presented at the 2010 Annual Conference of The Association for the Study of Higher Education, Indianapolis, IN.


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i This paper does not address the experiences of instructional staff in for-profit institutions.

ii Research examining the relationship between instructors’ intentions and their actual teaching practice indicates a good but not perfect match (Hativa, Barak, & Simhi, 2001; Martin, Prosser, Trigwell, Ramsden, & Benjamin, 2000).

iii Research on the contingent faculty population suggests that full-time, fixed-term faculty are similar to tenure-track faculty in terms of course-related interactions with students; in contrast, part-time faculty appear to spend less time preparing for class, are less likely to use active and collaborative instruction, and are less likely to challenge students academically (Umbach, 2007). Other research suggests that some individuals self-select into these positions because they prefer to focus their professional lives on teaching (Baldwin & Chronister, 2001).

iv The categories are defined as:

- **Associate’s colleges**: primarily offer associate degree and certificate programs; the few that offer baccalaureate degrees account for less than 10 percent of all bachelor’s degrees awarded.

- **Baccalaureate colleges**: primarily undergraduate colleges that emphasize baccalaureate degree programs, but may also award associate’s degrees and certificates.

- **Master’s colleges and universities**: offer a wide range of baccalaureate programs and are committed to graduate education through the master’s degree at least in selected fields.

- **Doctorate-granting institutions**: offer a wide range of baccalaureate programs and are committed to graduate education through the doctorate. Those with greater emphasis on research are often referred to as research universities.

- **Special focus institutions** (also known as specialized institutions): vary in the level of degrees offered (from bachelors to doctorates) but award at least half of their degrees in a single field of study. Some schools of engineering and technology, and the U.S. military and naval academies, fall into this category of specialized stand-alone institutions.

- **Tribal colleges**: typically tribally controlled, located on reservations, and are members of the American Indian Higher Education Consortium.

v The 12 influences included ABET, industry/employer feedback, student feedback, collective faculty decisions, NSF Coalition participation, shifts in program goals, organizational restructuring, increased resources, decreased resources, decision by the dean or another administrator, research on engineering education, and my own initiative.

vi Control variables for the regression analyses included institutional and program characteristics. Institutional controls were mission (public/private), institutional type (based on Carnegie Classification, 2001), institutional size, and wealth. Program controls were participation in an NSF Coalition, EC2000 review cycle, and engineering discipline.