Improving Academic Programs by Capitalizing On Alumni's Perceptions and Experiences

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***Abstract**[*] With the introduction of EC-2000 and its requirement to establish a continuous improvement system with clear objectives and performance measures, there has been considerable interest in obtaining input from alumni on the quality of their education. One means for doing this is a well-designed alumni survey. We discuss our experience with two alumni surveys, developed and tested at Columbia University and the University of Pittsburgh respectively, providing insight into the issues involved with developing and using these surveys. We describe how these surveys can be developed, discuss the cost involved, and give examples of information that can be obtained from them and how they can be used as part of the EC-2000 process.*

Introduction

Driven in large part by accrediting agencies and state legislators, the country's educational institutions are beginning to gather information from key stakeholders regarding the effectiveness of their academic programs and services. This is particularly true for undergraduate engineering education where the Accreditation Board for Engineering and Technology (ABET) has recently mandated that each engineering program obtain input from its relevant constituents on an ongoing basis as part of the implementation of a continuous improvement system. Further, that system must include outcome assessment and formal feedback mechanisms [1].

While there is a great deal of debate over who comprise the relevant constituents, there is little disagreement that one important segment are the program's graduates, and that these alumni can (and should) provide constructive feedback to faculty and administrators. Alumni provide an important perspective for assessing how effectively an institution's academic programs prepare its graduates to be successful contributors to society. In fact, post-secondary institutions have been surveying their alumni to collect evidence on academic effectiveness as part of their overall assessment programs for a number of years [2].

The intent of this paper is to describe the opportunities and challenges might experience as they begin to collect a potential wealth of information from this critical external constituent. Using the experiences of two major universities who have independently developed such surveys, the paper will discuss alumni survey development, cohort and sample selection, frequency of administration, dissemination challenges, and reporting results to the faculty, administration, and the alumni themselves. Our purpose is to provide insight into these issues (in contrast to presenting detailed results) so that institutions in the process of survey design may benefit from our experience

Both the schools of engineering at Columbia University and the University of Pittsburgh are in the process of preparing for their respective EC 2000 accreditation reviews.[†] As part of this process, both are implementing several indicators to aid in the measurement of program outcomes, including the eleven student learning outcomes required by ABET. In particular, both have incorporated alumni surveys into their continuous improvement systems. Indeed, alumni surveys are becoming a popular method for soliciting feedback about the quality of their academic programs and services among engineering programs preparing for accreditation reviews [3]. Typically, these alumni surveys are instruments that measure self-reported perceptions, recollections, and attitudes of former students who have graduated from an academic program. Alumni surveys generally address a number of demographic, academic, and service issues. Typically, they cover such areas as academic, employment, and community service history, educational impressions and outcomes from academic programs, quality of experiences with the institution's services, and participation in past and present institutional activities[‡].

As an assessment tool, self-report surveys are fraught with the many problems that plague all such instruments,

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[†] The University of Pittsburgh School of Engineering is being reviewed under EC-2000 in 1999; Columbia will be reviewed in 2001.

[‡] Copies of the surveys can be obtained by contacting the authors directly.

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including poor recall [4], language misunderstandings [5], and administrative obstacles. In a recent *PRISM* debate, Hazelrigg proposes that "almost always students will not collectively exhibit preferences [on surveys] that lead to a meaningful conclusion" because a group preference does not exist [6]. Hazelrigg also questions the use of arbitrary scoring systems. Granted there are many in academia who are not proponents of surveys and question the validity of their results. As discouraging as this may appear, a well-designed survey and process can serve as a very effective assessment mechanism.

In fact, engineering educators have been finding that surveying "customers' satisfaction" about the education and services they received can yield valuable measures [7]. Many aspects of an engineering education cannot be directly measured (i.e., the institutional culture or ambience). In such cases, "customer" perceptions serve as surrogate process measures and hence provide feedback about the quality of the system. For example, Evans and his colleagues at Arizona State University surveyed alumni (as well as industry respondents and faculty) to evaluate "customer" needs and requirements as part of a comprehensive curriculum assessment process [8,9]. Results of the ASU survey indicated that both alumni and industry respondents ranked problem recognition and solving, communication skills, and ethics and professionalism as the top most desirable attributes of an engineering education. Because the desirable attributes or needs chosen by alumni and industry differed substantially from those perceived by faculty and senior-engineering students, a reevaluation of the engineering curriculum was initiated. One result was the implementation of an integrated freshman curriculum as part of ASU's participation in the Foundation Coalition.

We have found questionnaires to be an important measurement tool for outcome assessment and obtaining feedback about our academic programs. This paper will demonstrate the use of alumni questionnaires in engineering program assessment and evaluation. In order to compare the design and process that each school applied to the task of collecting valuable alumni input, the following survey elements will be reviewed: target alumni respondents, survey design, administration and follow-up, and subsequent analysis and use of the data collected.

Target Alumni Respondents and Design.

The survey's purpose and sponsorship will, to a large extent, influence the design. The Columbia survey was "dual use;" i.e; it was developed in conjunction with the alumni association and the Engineering School. While this gives the survey an additional sense of legitimacy and importance, compromises in design and validity testing may result. In contrast, the initial University of Pittsburgh instrument was designed as part of a research effort, with minimal involvement from the alumni association.

In particular, Columbia's School of Engineering and Applied Science has graduated 21,710 students since 1864. Of this total, 19,010 are living and 13,841 or 72.8 % are available for solicitation purposes. (That is, we have their current address and they have not requested removal from the School's mailing list. One serious problem in surveying alumni is obtaining current mailing addresses.)

The Engineering School had never conducted a major alumni survey with the exception of limited requests in association with directory updates. In the Fall 1997, the School and the Alumni Association decided that it would be beneficial to survey alumni in order to obtain input on a variety of educational and service areas. Since this was to be the first such survey, it was decided that the majority of "solicitable" graduates would be asked to participate. In February 1998, surveys were mailed to all appropriate alumni – 7,699 undergraduates (domestic and foreign) and 5,222 graduate degree holders (domestic only). By June 1998, the School had received 1517 responses for a response rate of 1216 undergraduate (15.8%) and 301 (5.8%) graduate respondents.

The University of Pittsburgh's School of Engineering is even older, with the first engineering graduates receiving their degrees in 1846. Since then, the School has graduated 23,361 alumni of whom 19,413 are still living. Current addresses are available for approximately 70 percent of these graduates. The first comprehensive alumni survey was sent to 1987 graduates in 1993 (five-year follow-up), as part of a research effort undertaken by the School of Engineering. Questions addressed alumni perceptions of their engineering knowledge, skills, and attitudes. In addition, several open-ended questions asked alumni about what they thought the primary aim of an engineering education should be. A total of 149 surveys were returned. Data from this survey including responses to a number of open-ended questions were analyzed to capture potential product outcomes of the engineering education system.

Using this first survey as a starting point, a more comprehensive instrument was designed, incorporating additional factors cited in the literature and validated through the use of two focus groups [10]. This second questionnaire was then pilot-tested with engineering alumni using verbal protocols [11] and group discussions and revised accordingly. The final instrument contained 135 questions/statements, had a ninth-grade Flesh-Kincaid reading level and took less than 30 minutes to complete. It was then mailed to 1,048 University of Pittsburgh industrial engineering graduates (1970-1995). Of these, valid addressees were available for 850, of which 312 returned their questionnaires. This is a -response rate of 30% for the entire population and 37% for those with valid addresses [12]. See Besterfield for a complete description of this instrument development and analysis.

The Industrial Engineering survey provided the model for a much more comprehensive instrument that was sent to all School of Engineering alumni who graduated between 1987 and 1997. This survey and a follow-up "reminder"

postcard were mailed to 4,308 alumni, of which 699 (16.2 percent) were returned. Assuming that valid addresses were only available for 70% of those surveyed, the adjusted response rate of 23 percent is considered to be acceptable. Certainly these response rates are consistent with those for Columbia and suggest that little was gained relative to return rate by designing a "dual purpose" instrument.

Survey Items

The amount of information solicited will obviously influence the size of the instrument, which, in return, will most likely affect the response rate. Both surveys were "first-efforts" and, although for different reasons, relatively lengthy. As noted, the Columbia Engineering Alumni Survey was designed to serve multiple purposes and constituents. Since this was the first survey sent to a majority of graduates, the School and Alumni Association wanted information in several different areas. Consequently, the survey was designed into five sections: 1) *undergraduate experience*, 2) *further education*, 3) *employment history*, 4) *Alumni Association events*, and 5) *Center for Career Services*. There was also an introductory section requesting general demographic information. In total, the survey was eight pages in length. Undergraduates were sent the full survey. Graduate degree holders were sent only two pages – sections 4 and 5.

The *undergraduate experience* section focused on the alumni's perceptions of the quality of their academic, social, and cultural experiences. Questions inquired about their satisfaction with such factors as faculty quality, campus environment, and preparation for the job market. A major portion of this first section addressed student learning outcomes associated with the EC 2000 Criteria. Alumni rated, on a four-point scale, each learning outcome according to their perception of how well the Engineering School had prepared them in the specific skill area. Respondents also evaluated each learning outcome as to its importance to their career to date. Knowledge and skill areas evaluated included communications, computer skills, creative problem solving, project management, and teamwork.

The *further education* section was comprised of several questions designed to solicit information regarding what, if any, courses and degrees had been attained since graduating from the School. From this information, an educational profile of Columbia's alumni could be ascertained including how many of the respondents had earned higher degrees beyond their undergraduate engineering degree. For example, over 65% of the respondents went on to obtain graduate degrees, with most of these being in areas other than engineering; i.e.; 41% received Master Degrees in Arts, Sciences, and Business Administration; 12% earned PhDs; and 5% and 7% obtained Medical and Law Degrees respectively. While this suggests a strong desire on the part of Columbia's alumni to continue learning, it must be compared with goals set by faculty for advanced degrees.

The *employment history* section focused on the respondents' first and current job. Questions were designed to discover the typical entry position of the sample, as well as their current position. Several survey items asked for the graduates to rate how well their education (and their major) had prepared them for their career. In general, 76% of engineering graduates' first job was in engineering or applied science occupations. However, once in the job market for several years, the diversity of occupations and positions broaden. For example, a review of 260 respondents who graduated in the 1980s showed that 78% of graduates' first job was in an engineering related field. By 1998, 47% were still in engineering. The remaining respondents had moved into positions such as management (23%), finance (10%), medicine (8%), and law (3%).

The final two sections, the *Alumni Association events* and *Center for Career Services*, were designed to elicit information regarding "customer" satisfaction. Finally, several survey questions focused on willingness to participate in future events and activities. For example, over 500 respondents said they are willing to provide career advice to and/or mentoring for engineering students through periodic meetings and/or telephone conversations.

The University of Pittsburgh's alumni questionnaire was specifically designed to measure the alumni's perception of the education they received while attending the School of Engineering relative to specific learning outcomes. In order to develop the pilot instrument, a conceptual model of the undergraduate engineering experience was first hypothesized. The model was based on the assumption that the educational "processes" students experience (i.e., curriculum, in-class instruction, engineering experience, etc.) are directly related to their learning outcomes (i.e.; the engineering knowledge, skills, and attitudes acquired). System processes included: (1) core processes - essential to a student's engineering education, and (2) secondary - either enable individuals to attend school and/or enhance their educational experience. Core processes included elements of the curriculum, the culture of the engineering program, the "in-classroom experience" (how faculty delivered the curriculum), and "learning through experience" (e.g. laboratory experiences, senior projects, engineering internships and cooperative educational experiences). Secondary processes included School of Engineering services (library and computer facilities – hardware and software), co-curricular activities (engineering related and university wide), advising, administrative management (financial aid, registration, etc.), and university services (buildings and grounds, parking, etc). These processes and their elements were derived from the higher education literature and literature specific to engineering education.

Once the model had been developed, a survey instrument was designed to tease out measures for both processes and outcomes. The pilot instrument totaled 135 items spread over seven pages. Following extensive analysis of the pilot

results, the instrument was redesigned with considerable input from each of the School's six departments. Certain statements were modified in light of EC-2000. In an effort to both maximize the response rate as well as achieve a higher level of faculty buy-in, six separate survey instruments were printed on optical scan forms. (Statements were consistent across the instruments to facilitate cross comparisons, with the exception that individual program names were used rather than referring to the "School of Engineering." The printed surveys totaled six pages. Consequently, each department was allowed to "tailor" a seventh page in order to obtain additional ABET related information. The cover page consisted of a letter from the Dean of Engineering that described the survey and its importance as part of the EC-2000 process.

The first two pages of questions were devoted to eliciting alumni's perceptions about their overall ratings of the processes described previously and the outcomes of their education. Alumni were asked to rate their overall impressions of various educational experiences, as well as their competence as an engineer, at graduation and in their present position relative to a set of outcomes. A five-point reliable scale was used [13] (i.e., poor, fair, good, very good, excellent) to codify perceived competence at the time of graduation and at the present time. Included among these outcomes was a set that mapped directly into the EC 2000 criteria. In addition, alumni were also asked to rate the curriculum, in-class instruction, the culture, and experience.

Pages three through five of the questionnaire elicited more insight into the undergraduate experiences with respect to the primary educational processes. Most of the statements used a magnitude proportional five-point subjective continuum rating scale. Respondents were asked to rate the curriculum with regards to its depth, breadth, relevance to industry practice, the 'state of the art', etc. Asking the extent to which the respondent agreed with a series of statements; e.g., cheating, competitive atmosphere, extent to which teamwork was encouraged assessed certain aspects in the culture process. For the in-class experience, alumni were asked about the atmosphere in the classroom, faculty interaction with students, the use of real world examples, etc. For the "learning through experience" process alumni were asked to rate the effectiveness of laboratory experiences and their senior design project relative to a number of items. In addition, alumni were asked whether they had a pre-graduation engineering work experience (e.g., co-op, internship, and/or undergraduate research experience). Alumni who had such experiences were asked to assess how this contributed to their engineering education.

Page six was comprised of various items related to advising, professional organizations, university services, and mentoring. Page seven contained questions about the individual – both while attending college and after graduation. The questionnaire asked about the alumnus' educational level beyond their bachelor's degree and their post-graduation work experience.

The final page of the questionnaire contained space for an open-ended response as well as items unique to the individual department. Departments invited individuals to provide comments concerning their educational experience. Where an unusual number of negative comments were received, follow-up, structured telephone surveys are being conducted to better identify problem areas and to provide guidance for improvements.

Administration and Follow-up

Columbia's Alumni Survey was sent via first class mail to target respondents in February, 1998. A letter from both the School's Dean and the president of the Alumni Association describing the rationale and content of the instrument, accompanied the survey. A postage paid return envelope was enclosed. The School received about 60 percent of the responses within the two-month time frame and the majority of completed surveys within five months. Thank you post-card was sent to all participating alumni with information on response rates and future updates to be published in the Fall issue of the alumni newsletter.

The School decided not to do further follow-up to increase response rates, primarily because of the additional cost. The costs associated with the printing and shipping of the survey were $11,500, not including professional staff and student time. Professional staff time for the overall design and administration of the survey was estimated as a five percent effort over six months. The costs for data input, analysis, and reporting will be described in the next section.

The costs and effort for the University of Pittsburgh survey were comparable. The instrument was designed to be optically scanned upon completion. This increased both the design time and the cost of printing. Surveys were mailed first class with a stamped (metered) return envelope. A follow-up post-card reminder was sent six weeks after the initial survey was mailed out.

Data Analysis and Use with EC-2000

For Columbia, the analysis and subsequent use of the data for academic planning has been an on-going process. Data was manually entered into a database by a professional service at a cost of $4,500.

Once the data was entered, several macro-level analyses were preformed to ensure timely feedback to all constituents. The first wave of analyses focused on descriptive statistics – means, percents, and frequencies for various demographic and attitudinal data. In addition, a database of names with associated contact information was provided to the Alumni Association and the School. These preliminary analyses were documented and reported at a quarterly Alumni Association Meeting as well as to the Executive Counsel of the School. Early data was also published in the Fall 1999 issue

of the alumni newsletter.

To illustrate the information derived from these responses, here is a selected result taken from an aggregate sample of 500 alumni from 1980 through 1997. When graduates were asked about how well their education prepared them to articulate ideas clearly, both in writing and speaking and rate these skills as to importance to their career, they responded as shown in Figures 1 and 2.

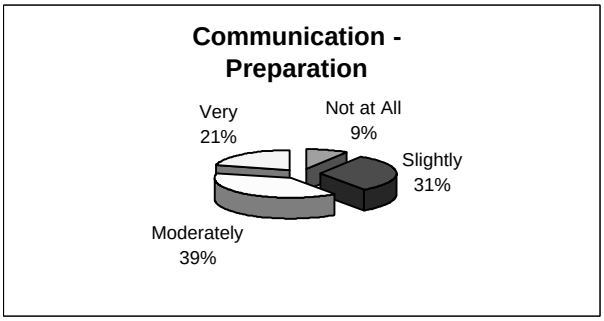


Figure 1. Columbia University's Alumni Responses on Level of Preparation of Communication Skills

As shown, 60 % were moderately to very satisfied with the preparation received during their education at SEAS. Not surprising, an overwhelming majority stressed how important communication skills are to their career. This result clearly demonstrated a need for the School to continue to improve upon the development of communication skills.

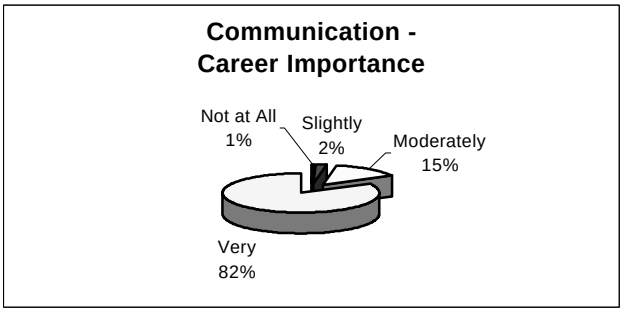


Figure 2: Columbia University's Alumni response on the Career Importance of Communication Skills.

Because the University of Pittsburgh's survey was optically scanned, more effort could be devoted to data analysis. Further, because of the need to prepare for an EC-2000 review for fall 1999, a series of reports was prepared for each department summarizing responses for each item. Further, special reports were prepared that compared response across programs. This was followed by a "strengths and weaknesses analysis" for each department relative to the School as a whole. In this manner, each program's faculty could determine where there were potential problem areas that needed to be addressed.

Figure 3 illustrates one comparison that shows the proportion of alumni from two of the Pitt programs who were dissatisfied with particular aspects of their education, including aspects related to EC-2000 outcomes. Items in bold; e.g.; advising, indicate areas where follow-up is warranted. Because of the relatively poor opinion of advising, a Schoolwide initiative aimed at improving advising was launched. In addition, individual programs formed special ad hoc committees to address advising. As a result, we believe that advising will be substantially improved within the School of Engineering.

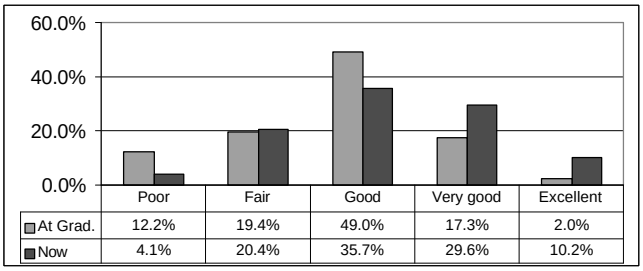
Item	Dept. A	Dept. B
Abilities at time of graduation	**26.9%**	14.3%
In-Class Instruction	**36.5**	13.2
Learning through experience	41.4	29.5
Advising and counseling	**69.3**	**59.2**
Culture, attitude towards students	**33.1**	13.2
Provided foundation for LLL	27.7	17.6
Overall rating of your education	**23.4**	5.1
Basic science and math knowledge	5.5	4.1
Basic Engineering knowledge	**24.8**	10.2
Discipline specific knowledge	20.0	11.2
Computer skills	21.3	**26.5**
Data analysis/experimental design	**27.1**	**25.5**
State of the art knowledge	**44.1**	**41.8**
Problem solving abilities	19.4	16.3
Creative thinking	18.7	13.3
Written communication skills	23.4	13.3
Oral communication/presentation	**38.0**	**25.5**
Teamwork skills	19.5	10.2
Engineering experience	**55.8**	**47.9**
Engineering design skills	**43.4**	**31.6**
Management skills	**53.2**	**42.9**
Ethics and professionalism	**38.6**	12.2
Professional traits	20.0	10.3
Social awareness	23.9	25.5
Knowledge of humanities/SS	31.2	18.6
Place engineering in context	**40.3**	15.5
Knowledge of contemporary issues	**38.8**	22.7
Curriculum - broad education	**31.9**	7.1
Curriculum - fulfilled industry needs	**33.4**	**25.7**
Curriculum - in depth in one+ areas	24.8	9.2
Curriculum - foundation for lifelong learning	21.3	9.2

Figure 3: University of Pittsburgh Alumni Survey Percent of Respondents Indicating "Poor" or "Fair"

Figures 4 and 5 show the response by alumni from one department relative to two other areas of concern for EC-2000 – Ability to design system, components, or process to meet desired needs? Your ability to place engineering in an appropriate global and societal context now and at the time of graduation? Note that the changes between graduation and

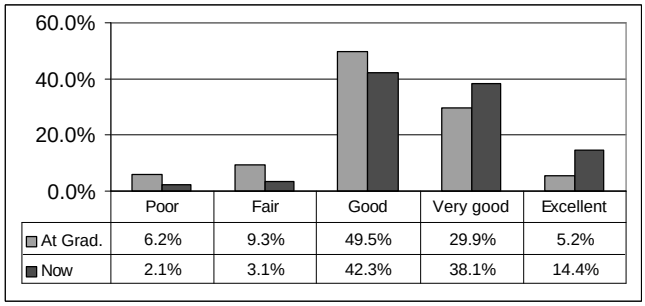
the present in perceived abilities demonstrate to some extent life long learning.

In two programs, issues raised by alumni indicated a need for more extensive follow-up. Consequently, a structured interview format was developed in conjunction with the department chair. A professional staff member then called these alumni to obtain this more in-depth information that was then summarized and presented to the faculty. To also corroborate the extent of certain concerns, follow-up focus groups were conducted with graduating seniors.



	Poor	Fair	Good	Very good	Excellent
At Grad.	12.2%	19.4%	49.0%	17.3%	2.0%
Now	4.1%	20.4%	35.7%	29.6%	10.2%

Figure4: University of Pittsburgh Department X: Ability To Design System, Components, Or Process



	Poor	Fair	Good	Very good	Excellent
At Grad.	6.2%	9.3%	49.5%	29.9%	5.2%
Now	2.1%	3.1%	42.3%	38.1%	14.4%

Figure 5: University of Pittsburgh Department X: Rate your ability to place engineering in global/societal context?

Lessons Learned

In general, we found that alumni can provide a wealth of information to the School, and surveying alumni is an effective method for gathering information regarding perceptions relative to job preparation, skill development, and program effectiveness. Further, alumni are in a unique position to reflect on their education in relation to their current and past career experience. Surveying alumni provides a vehicle for faculty to obtain information about the knowledge and skills that are required for practicing engineers today and the future. Academic departments can receive information on the gaps between a skill's importance to career success and level of preparation provided by the curriculum in a specific program. In additional, these knowledge, skills, and abilities can be looked upon across the stages of an engineer's career.

The ABET accreditation process as well as other academic reviews provide the primary opportunities to gather external information regarding academic program effectiveness. One important mechanism for gathering information is an alumni survey. These surveys enable faculty to learn the degree of perceived relevancy of past curricula from the alumni's unique perspective. However, it is important to design the survey so that a department can solicit information regarding specific program objectives and outcomes. A "one size fits all" approach will provide only limited information on program effectiveness.

Soliciting feedback from alumni should be an ongoing process to learn more about how our academic programs and services can become increasingly effective. The most important part of the process is that listening to alumni results in actions to improve the overall quality of engineering and applied science education. As part of the design of any survey process, how the results will be used should be well defined. The formal design process must include who will receive final reports and what types of decisions can be handled based on the results provided, plans for follow-up actions and timelines for these future actions.

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