Report on Undergraduate Alumni Surveys for the Chemical Engineering Department

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1. Introduction and Purpose

The UW-Madison College of Engineering is involved in a long-term effort of evaluation and improvement of its programs during which each department of the college will gather a variety of information about the quality of its programs. The Department of Chemical Engineering (ChemE) and the Department of Nuclear Engineering and Engineering Physics (NEEP) are the first two departments to launch this study.

The primary purpose of this evaluation is to provide the ChemE department with information that can be useful in planning improvements in and changes to the ChemE program. The value of third-party evaluation is that evaluators can come to the data with fewer biases and pre-conceived opinions about the subject under consideration -- and thus can obtain more objective results -- than can those being evaluated. This third-party status requires, however, that evaluators operate without full knowledge of the history and context of their subjects. As a result, this report is intended to identify areas the department may want to explore in greater detail; it is not an attempt to offer a definitive list or description of these areas. Readers are expected to draw on the information in this report in combination with other sources of data to arrive at their own understanding of the issues discussed here. Making personnel or program decisions solely on the basis of the information on the following pages would be a misuse of this report.

This report is based on surveys mailed during June and July 1996 to undergraduate alumni who have been out of school for three, five, and fifteen years. The analysis of the surveys was conducted by LEAD team researchers.

1.1 Methods

In cooperation with the Chemical Engineering department, LEAD researchers designed a survey [see Appendix A] that consisted primarily of open-ended questions. The LEAD team attempted to mail this survey to all students who graduated with an undergraduate degree in chemical engineering three, five, and fifteen years ago, except those with no U.S. addresses.[1] All respondents were assured that their responses would be kept confidential, with access to the surveys limited to LEAD Center staff. The resulting overall return rate was 23%. The breakdown by year is shown in the table below.

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[1] Three-year alumni were defined as those who graduated between December 1992 and August 1993; five-year alumni graduated between December 1990 and August 1991; fifteen-year alumni graduated between December 1980 and August 1981.

Survey Response Rate

ChemE Alumni	No. Of Surveys Mailed	Surveys Received	Percentage of Total
3 years out	89	27	30%
5 years out	64	18	28%
15 years out	104	13	13%
ChemE Total	257	58	23%

In part because of the low response rate, we have also included information from the pilot surveys sent out in early May to alumni who graduated two and fourteen years ago. We received three surveys from two-year alumni and one survey from a graduate of fourteen years ago. The total number of surveys on which this report is based is, therefore, 62 (58 surveys + 4 pilots).

The reasons for the low response rate are not entirely clear, but given the large number of surveys Areturned to sender@ (approximately 25%), it appears that inaccurate or outdated addresses were a large part of the problem. Additional information on the procedures used and the problems that ensued can be found in the process report (to be provided to the ChemE department chair by October 7, 1996.)

Information collected from the open-ended questions allowed evaluation researchers to "get inside of" the experiences of the ChemE alumni. Our data collection methods are as open-ended and subject-responsive as feasible to ensure that the views and the experiences of the ChemE alumni, not the researchers, are reported. Likewise, analysis processes are fundamentally inductive to ensure that the participants' experiences shape the findings. The primary analytical categories that emerge as the researchers process the surveys are apparent in the report's table of contents. Open-ended survey data are half-way between qualitative case studies and statistical analysis, in that they produce more context-sensitive (and thus valid) constructs than scale data, and, being drawn from a large sample, are more reliable than qualitative analyses such as open-ended interviews. This method provides rich information that represents key features of the complex experiences of the study participants.

1.2 Technical Information for Reading this Report

Format: Each section of the report is organized in terms of the views that emerged *from the respondents*. When a direct quotation is used, the number of years the respondent has been out of school is included in parentheses immediately after the quotation. When alumni offered specific suggestions on how to address an issue, we have included these comments in boxes entitled AAlumni Suggestions.@ These suggestions have been included to help provide a full picture of the respondents= views and do not necessarily reflect the views or opinions of LEAD evaluators. When LEAD researchers have inserted their own opinions or suggestions into this report, we have done so in boxes labeled "Evaluators= Viewpoint." Readers should assume that,

with the exception of the "Evaluators= Viewpoint" sections, the material in this report consists of the evaluators' synthesis of respondents' viewpoints.

Use of Verbal Quantifiers: Specific verbal quantifiers are used to denote the relative size of a group of respondents who presented particular perspectives or described particular experiences in the surveys. The quantifiers used in this report are:

"a few":	when up to 30% of those surveyed expressed similar views
"many":	when 30 to 70% of those surveyed expressed similar views
"most":	when 70 to 90% of those surveyed expressed similar views
"virtually all":	when 90% or more of those surveyed expressed similar views

2. Demographics of ChemE Alumni and Survey Respondents

We received a total of 62 surveys from Chemical Engineering graduates, many of whom expressed appreciation that the department was considering their opinions, and virtually all of whom responded thoughtfully and thoroughly. Although the response rate was lower than anticipated, the respondents were representative of the survey pool in terms of both gender and class rank.

Of the 62 surveys, 74% were from men, 26% were from women. The tables below show the gender breakdown of alumni who sent surveys and of all alumni. As these tables illustrate, the percentages of men and women among the survey respondents were comparable to the percentages for the 3-, 5-, and 15-year classes as a whole.

Gender Breakdown of Surveys Received by Year

	3-year surveys	5-year surveys	15-year surveys	all years= surveys
Male	22 (76%)	13 (68%)	11 (79%)	46 (74%)
Female	7 (24%)	6 (32%)	3 (21%)	16 (26%)
Total	29 (100%)	19 (100%)	14 (100%)	62 (100%)

Gender Breakdown of Alumni by Year

	3-year alumni	5-year alumni	15-year alumni	all years= alumni
Male	62 (67%)	48 (74%)	86 (78%)	196 (73%)
Female	30 (33%)	17 (26%)	24 (22%)	71 (27%)
Total	92 (100%)	65 (100%)	110 (100%)	267 (100%)

In addition, the class rank of the respondents accurately represented each class as a whole. Approximately one third of the surveys we received came from the top third of the alumni, one third from the middle, and one third from the bottom.

Class Rank of Survey Respondents

	3-year surveys	5-year surveys	15-year surveys	all years=surveys
Top Third of Class	9 (30%)	8 (44%)	5 (36%)	22 (35%)
Middle Third of Class	11 (37%)	5 (28%)	4 (29%)	20 (32%)
Bottom Third of Class	10 (33%)	5 (28%)	5 (36%)	20 (32%)
Total	30 (100%)	18 (100%)	14 (100%)	62 (100%)

We also compiled data on respondents= employment and post-baccalaureate education. Since we did not have similar information on all alumni, we were unable to determine whether alumni who returned the survey were also representative in these areas.

Over 90% of the alumni who returned surveys are employed. The majority of these ChemE=s work for companies of 1,000 or more employees. Please see table below for details.

Size of Respondents= Employers

Number of Employees	Number of Surveys	Percentage of Total
> 1000 employees	34	55%
100-1000 employees	13	21%
< 100 employees	6	10%
Currently in graduate school	4	6%
Not working or no answer	5	8%

No more than five alumni identified any one company as their employer. See Appendix B for a list of companies and the number of respondents who work for these companies. Of the forty-one respondents who listed their company type, twenty-four (59%) identified themselves as working for a public company, thirteen (32%) work for a private company, and four (10%) for a commercial enterprise. This information should not be taken as exact since three people who worked for the same company identified that company in three different ways. The remaining twenty-one (34% of all respondents) did not identify their company type at all.

Almost one-third (17) of the alumni who responded went on to acquire advanced degrees. Most of these acquired a master=s in chemical engineering, but a few obtained degrees in other fields such as environmental engineering, engineering management, chemistry, medicine, business, finance, and computer science. All but one of these alumni attended a school outside of Wisconsin.

The surveys asked alumni to identify their current job title or position. As can be expected, alumni provided a wide variety of answers. The most frequently named positions held by alumni included: Process Engineer (16, 26%), Research Engineer or Research Scientist (9, 15%), Manufacturing Engineer (4, 6%), Product Engineer (4, 6%), and Project Engineer (4, 6%). The complete list of job titles can be found in Appendix B. It is important to note here that these are titles used by the respondents (or by their employers) and not categories defined by LEAD evaluators or by the ChemE Department. Eleven (18%) of the respondents indicated that they are working in a position in which they supervise the work of other engineers; four of these were 15-year alumni, four were 5-year alumni, and three were 3-year alumni.

3. Overall Alumni Perspectives on ChemE

In the surveys we asked alumni to rate Ahow well your undergraduate education prepared you for your professional career@ and to comment on how the undergraduate program might be improved. The adjectives we asked students to use in rating the program were: Avery good,@ Agood,@ Afair,@ and Apoor.@ Over half of the alumni rated their education as Avery good.@ We found no substantial difference among the 3-, 5-, and 15-year surveys. The table below gives the breakdown of the responses.

Alumni Rating of the ChemE Program

	Number of Surveys	Percentages of Total
Very Good	32	52%
Good	22	35%
Fair	6	9%
Poor	1	2%
Not Known	1	2%
Total	62	100%

Alumni who rated their preparation as Avery good@ added comments such as:

> *[The ChemE program gave me a] solid background, UW has a world-wide reputation and it is well deserved. Variety of students, professors good. (15 years)*
>
> *I felt extremely well-prepared when I started my career. Though I didn=t know everything, I had an excellent framework for problem solving, self-directed learning, and discipline. (15)*
>
> *The quality of education was excellent. I had a great experience at the Department of ChE-UW-Madison. (5)*
>
> *Good team work skills taught in projects and labs. Summer lab great for industry experience. Internships were invaluable. (3)*

Those students who remarked that their preparation for a career was Agood@ did so with some explanations of what they felt they was missing.

> *I have several of the tools I need to do my job, but the greater ones are communication, teamwork and a general curiousness, which were not developed at the UW. (3)*

I walked into my career confident in my abilities to learn and think, but I felt that I had a huge lack of practical experience. There are so many opportunities within the curriculum to include real life examples, field trips, stuff for the students to hold and look at to help visualize what the text books have problems diagraming. (3)

The few students who rated their preparation Afair@ were not working as chemical engineers or admitted that they *Ashould have studied harder.@ (5)* It would be impossible for the ChemE department to prepare alumni for every possible career, and alumni recognized this. The one student who felt s/he had received Apoor@ career preparation explained that this was because A*My field was environmental engineering. I had to learn a new area.@* This graduate noted, however, that the *Achemistry courses were beneficial to my career.@ (5)*

The vast majority of alumni (86%) felt that they had received a strong and well-rounded education which prepared them well for their careers.

I feel I left with a good understanding of most of the subjects - far more than I have ever needed. (15)

I felt that my undergraduate preparation at UW-Madison was generally superb. However, I was most satisfied with the foundation courses, pre-ChE, and in particular Chem110. (3)

All of the more general courses were very useful, in particular the Materials courses were most helpful because I make extensive use of materials in product development. (15)

All math courses were well taught and provided good basics. (15)

Courses [were] taught very well. Curriculum was very tough, but had to be to learn[ed] well to get good grades. (5)

I have worked with many engineers. I have really noticed an advantage (from a technical standpoint) and a difference in comparison to non-UW graduates. The UW graduates seem more technical than many other school engineering graduates. (15)

4. Curricular Issues

As indicated in section 3, most alumni felt the department deserves its high reputation. The value of this reputation to graduates is evident in their remarks about the program: most offered comments and suggestions in an effort to help the department maintain its high standing, rather than to improve it. In our survey we requested that alumni specifically write about what they saw as strengths and weaknesses of the ChemE curriculum. One weakness of the program that particularly stood out was the need for practical experience. In addition, alumni considered themselves weak in two course areas: statistics and computer science. Alumni considered labs (especially the summer labs), co-ops, and independent studies to be strengths of the program.

4.1 Real-World Connections and Practical Experience

Alumni frequently used the words Apractical experience,@ Ahands-on,@ and Areal-world@ when describing what was lacking in their education. Alumni talked about this deficiency and about the need for the ChemE department to provide more opportunities for students to learn in these ways.[2] This message appeared repeatedly throughout the surveys.

> *[I would have liked more] practical experience - i.e. it was two years into my career before I had seen the inside of a ball value. That=s pretty basic, but there is no reason why simple things such as that are not included in the curriculum. (3)*
>
> *[I had] little experience in applying (or even examples of applying) our knowledge to real life situations. (5)*
>
> *Hands-on experience is necessary; most don=t have [it]. (5)*
>
> *[I would have liked more] practical applications. (15)*
>
> *Can only say from my point of view: Lack of experience in the field. (5)*
>
> *[I had a] lack of practical experiences. (5)*
>
> *[There was] too much theoretical equation-crunching without showing practical applications. Chemical Engineers try applying book equations (too sophisticated) to processes before understanding the full process. ChemE=s need more understanding of analyzing present process in use, whether they are efficient or not, so they can attack problem solving. (3)*

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[2]Donald R. Woods has researched the importance of this hands-on, applied learning style, which he calls Aproblem-based learning.@ In his book, Problem-based Learning: How to Gain the Most from PBL (Waterdown, ON: D.R. Woods Publishing, 1994), he describes methods to implement this approach which he developed over the course of several years in the Department of Chemical Engineering at McMaster University. A selection of articles by Woods and colleagues maybe obtained from Kathy Luker in the dean=s office.

[There was] not enough practical knowledge. (3)

One alumnus/a explained that this Areal-world@ experience is necessary because new graduates

> *are not able to see how their work fits into business planning/future work. Incoming engineers have narrow view of task completion and do not see Abig picture.@ (15)*

Another alumnus/a described why a more practical, less theoretical education is important.

> *UW is a very theoretical school with little focus on what takes place in a business setting. A theoretical base is important, but it is also important to be ready for the business world. (15)*

Alumni suggested that more opportunities to learn in a hands-on way can be provided in laboratory, through models, or case studies. Many alumni commented that co-op experience provided valuable real-life experience. (See Section 4.7 for further discussion of the value alumni placed on their co-ops.)

Alumni Suggestions:
Several alumni suggested specific ways to introduce more real-world training into the classroom.

More applicable types of problems to solve. Many times the problem sets don=t teach you any more than what the professors think is important. Go to industry and request problems to be solved and get project teams together to help the companies solve the problem. (3)

Expand the linkages of ChemE core class with real life current industrial problems (case studies). (3)

I am under the impression that UW-Madison Chemical Engineers are at a deficiency in practical applications. More practical applications. The theory is not important. (3)

Practice with building prototypes and models. Common sense, hands-on experience with non-desk subjects, including presentations. (3)

4.2 The Value of Statistics

Most alumni noted the need for a required statistics course. In response to the survey question that asked Awhat deficiencies do <u>entering</u> Chemical Engineers have?@ graduates frequently mentioned statistics. It was also one of the skills that they wanted to see the ChemE program encourage or improve on. Twelve alumni (half of whom had been out 15 years) explicitly commented on their poor training in statistics and several of these noted statistics as *Athe only area where I was not prepared very well.@*

Statistics is a basic class that could have been very helpful to me from both a standpoint of experimental design as well as data analysis. (3)

In the last 14 years I found myself lacking in [statistics]. As stated earlier, this math is very useful in experimental design and data analysis. When analyzing data I often wonder what other information I could Awring@ out of it if I had a stronger statistical background. (15)

Statistics [would have been useful] for better data analysis and problem resolutions. (5)

[I] could have used a good course in statistics, especially as relates to process control, experimental design and experimental evaluation. (15)

[In] statistics [I was] poorly prepared. [It is] used often in analysis, but only one course taken in college [is] not enough. (15)

Statistics was the only area where I was not prepared very well and would really have benefitted from. Statistics is used heavily in distinguishing significant improvements in product and process changes. (15)

The only area that I thought I was poorly prepared [in was] statistics, particularly related to production and quality control. (15)

Figure 2 in Appendix C shows that alumni Afrequently used@ statistics but felt Apoorly prepared.@ In response to the survey question that asked Awhat would you have liked to study more?@ alumni frequently answered Astatistics.@ Statistics is not currently a required course, but several alumni recommended it be required since many chemical engineers use it frequently on the job, regardless of the type of work they do. Alumni noted the wide array of areas of work that require or could benefit from a strong knowledge of statistics: experimental design, data analysis, problem resolutions, process control, and quality control in manufacturing, the medical industry, and research.

Statistics [is] not required in ChemE curriculum and [is] very important to maintaining product quality, especially in medical industry. (3)

Statistical analysis was not required when I was an undergraduate, but I did take a class as an elective. Based on my experience, statistics would be very useful in both experimental design and data analysis. (15)

Statistics are constantly used in SPC, etc. and I received no training in this area. (5)
Statistics [is] used extensively [in my field]. (5)

Statistics [should be studied more because of its] usefulness in process control, etc. and general understanding of data significance. (15)

Statistical techniques are becoming more important, especially in manufacturing. (15)

Loathing the subject, I did not take a statistics course; but in my current work I am forced to do a great deal of it. (3)

Alumni Suggestions:
Three alumni explicitly recommended requiring more statistics training.

I highly recommend making statistics mandatory. (5)

Statistics should be a mandatory class (not an elective). I was poorly prepared for experimental design and statistical analysis of resulting data. (5)

In research, it is mandatory that you have an understanding of statistics and experimental design. Statistics is not required at UW, so I didn=t take it. . . . I highly recommend making statistics mandatory. (5)

4.3 The Value of Computer Science
Alumni understand the value of computers and computer science to their field, but most feel that computer science classes need to be updated. Many alumni said that the information they learned in their computer science courses was outdated by the time they were on the job. Many alumni noted, for instance, that Pascal and Fortran are rarely used in industry. Many also indicated that programming is not a skill they use frequently. Overall, many alumni felt the need for more computer classes than they are required to take. Although one might expect 15-year graduates to feel the most need for updated computer training, it was alumni who had been out of school for 3-5 years who commented most frequently on the deficiency of their computer skills. The quotations below illustrate these reactions.

$ Computers are essential, but knowing how to program is not useful.

I use [computer science] on an almost daily basis and a thorough understanding is imperative in consulting for the chemical industry. (3)

Computer Science [is important because] the obvious explosion of information gathering and analysis dictate that the user be able to understand system infrastructure and have a sound general computer understanding. (5)

More computer involvement is needed, they are an essential tool today. (3)

I don=t do any programming, but I do use computers everyday. Using computers in all my classes helped, though we use IBM=s, not MAC=s. (3)

Computer Science [was of] no practical use. Chemical Engineers are not expected to write code [because] programs are available. (5)

Computer Science 302 [could be improved]: Nobody I know does their own programming. I needed a class on computer systems and networks. (3)

[I] would have preferred to learn how to use a computer, not how to program in Fortran (who uses Fortran?). I use PC=s daily, also work with processors and ladder logic. (5)

We were taught Pascal and Fortran and I have not heard of these being used at all at the companies I have worked for. I think this should be an elective and a more useful computer class should be required. I doubt many students get much use of Pascal/Fortran. (3)

Computer Science [was] used mainly in school (Fortran especially). Now [I] use VAX, VMS, PLC and DLS languages and packaged programs. (3)

[The] computer programming taught in CS 302 is not used much in this industry. (5)

$ Class is Outdated

[I] was poorly prepared [in computer science]. This field changes so quickly that courses I took were useless two years later! (15)

Computer Science 302 [was] out of date by the time school was finished. (5)

Although the majority of respondents indicated that ChemE graduates do not use their programming skills, two alumni -- both of whom are in chemical engineering graduate programs -- did mention that they use and need Fortran.

I only had one computer science class that taught Pascal. C or Fortran would have been more useful. (5)

Computer Science - not enough Fortran programming. [I] need to write programs for use. (3)

4.4 The Value of Other Courses

Although few students made comments regarding other courses of the ChemE program, we did ask them to rate their levels of preparation and use in twelve course areas. The results of this

portion of the survey are shown in Figures 1, 3, and 4 in Appendix C. Most alumni stated that they are adequately prepared in physics, engineering mechanics, and ECE, yet one-third to two-thirds of them say that these courses are Anot used.@ Thermodynamics, transport, and energy showed a good match between how well prepared alumni feel and how often they use these courses: most alumni reported that they were felt well prepared in these courses and most said that these courses were Amoderately@ or Afrequently used.@ Virtually all respondents felt Aadequately@ or Avery prepared@ in math, chemistry, materials, and process & design, and the vast majority of alumni use their training in these areas Amoderately@ or Afrequently.@

4.5 Labs

The ChemE degree requires 15 credits of lab spread out over chemistry and chemical engineering courses. We asked alumni to rate the value of this lab-intensive curriculum to their career and comment on why they rated it this way. Alumni rated labs very favorably and offered few suggestions on how to improve them. Even the students who stated that lab was only Asomewhat valuable@ stated that the hands-on training was a great experience. The table below provides the breakdown of ratings by gender and year. Women and 15-year graduates rated labs slightly less favorably than did other alumni, but the reasons why are unclear.

Lab Ratings

Rating	Number of Surveys	Gender	3 yrs/ 5 yrs/ 15 yrs		
Very Valuable	39 (61%)	F=8 M=31	17	14	8
Somewhat Valuable	15 (24%)	F=7 M=8	6	3	6
Of Limited Value	1 (2%)	F=0 M=1	0	1	0
No Answer	7 (13%)	F=1 M=6	6	0	0
Total	62 (100%)	F=16 M=46	19	18	14

Those who rated labs as Avery valuable@ said labs provided practical, real-world experience and pushed them to think in more depth about material they had learned in lecture.

> *Labs prepares you for real life far more than the courses do, because they reinforce the coursework by giving you practical rather than simply book knowledge. (3)*

> *Lab experience is very useful. You develop common sense and practical skills in the lab. (3)*
> *A lot of [the coursework] was not practical. The important part of these labs is that it Apicks@ the students mind and makes him/her Athink,@ rather than Aplug and chug.@ (3)*

The labs demonstrate that Areal world@ experiments are not as straight-forward as theory often implies. Lab reports teach organizational skills as well as reinforcing the lessons of the experiments. (3)

I thought the labs were more valuable than many of the lectures. Lab-type work is what I did for the first 7 years of my career. (15)

Those who felt labs were Asomewhat valuable@ also had positive things to say about them.

Valuable in terms of report writing and some operations exposure. (15)

Very time-consuming at school, but also very good because [it was] hands on. (15)

Basic lab techniques were valuable in early aspects of my career. (15)

Hands-on learning is the best way to learn. (3)

The one respondent who described lab as Aof limited value@ commented that labs seemed more useful in academia than in industry.

Lab courses focus on abstract derivation of constants in equations. This is great if you are going for a Ph.D., but of little value in industry. (5)

Alumni were also asked to rate the value of their summer lab in particular and to comment on why they rated it this way. As can be seen by the chart below, the summer lab was considered Avery valuable@ by over half of the alumni.

Summer Lab Ratings

	Number of Surveys	Percentage of Totals
Very Valuable	35	56%
Somewhat Valuable	13	21%
Of Limited Value	6	10%
No Answer	8	13%
Total	62	100%

Most alumni appreciated the chance to learn and develop skills that they have since used regularly in their work.

[Summer lab] is off the scale! It was absolutely the BEST class I had throughout my undergraduate experience. It was practical. It was hands-on. It was directly applicable to work environment. It made me think. It made me apply what I had learned. There weren=t necessarily right and wrong answers. Overall, it gave me confidence in my abilities. (3)

Summer lab was most valuable of all - forced us to find resources to run our experiments to find the answer - I have to do this every day! (5)

While I hated it at the time, I learned a lot. Creative thinking (informal labs), teamwork (formal labs), machining, time management, etc. (3)

It is a heart stopper! But, I have heard of no other program that compares and there is no other that I brag about more! (5)

This course definitely was what Chemical Engineering is all about - it is very intense, but very useful in teaching the skills required in the world of ChemE. (5)

However, nearly half felt there is still room for improvement. Virtually all of those who felt summer lab was Asomewhat valuable@ commented on the tremendous time involved:

Very valuable in cranking out reports and sharpening one=s work ethic, however, it seemed a bit sadistic at the time. (15)

Mostly, it taught me time management. (5)

The amount of work was overwhelming. I didn=t care if I learned anything, I just wanted to survive. (3)

The two respondents who described labs as being Aof limited value@ felt the intensity spoiled the experience:

This was hazing, not education. I credit anyone who passed, but [I] do not see the value. (15)

Too much [was] thrown at us to really get anything down well and learn to prepare lab reports. (5)

Alumni Suggestions:
Although alumni gave summer lab a generally positive rating, several also had suggestions on how to improve it.

Time would be better spent in a co-op or other summer work experience. (15)

The equipment really needs to be improved/upgraded. (5)

The formal report and data collection requirements limited the exploration possible. The endless report writing experience was a trial (at best), and not an educational experience. (3)

Intense professorial interaction with the student is critical. Must have someone there as a mentor. (3)

The time pressures of the summer lab . . . are too great. Decreasing the work load for the students would provide a more positive and safe summer lab experience. (3)

4.6 Independent Study
Almost half of the respondents to the survey had taken an independent study class. Seventeen of these (56%) stated that it was Avaluable,@ twelve (40%) had said that it was Asomewhat valuable@ and only one said it had Alimited value.@ Alumni mentioned that the professors= presence and direction made the independent study more valuable. They wanted A*more interaction with professor and/or graduate students,@ (15) Amore assistance [from the professor], clear goals and objectives for the project,@ (5)* and *Amaybe a little more direction from the professor.@ (3)* The quality of the independent studies depended heavily on the extent to which the professor was willing to involve the student in meaningful work.

> *Instead of washing beakers and pipette and fetching coffee, the 599/699 courses should be more demanding in terms of workload. (3)*
>
> *I would suggest some sort of third party involvement in ChemE 599 to ensure that students do something rather than just washing dishes! (3)*
>
> *Possibly more written requirements (objectives, theory) - but don=t overdo either! (15)*
>
> *Allow me to add my thoughts to the work. (5)*

One alumnus/a believed that better communication regarding the availability of independent study opportunities was important.

> *Part of the problem with the independent study system is the lack of communication of opportunities. While I was in school there were two ways of finding out about an*

opportunity. One was word of mouth from someone who already was doing one [the other was] by knocking on professor=s doors. (3)

Almost a third of those students who took an independent study course stated that it influenced their career. Whether the influence was positive or negative, students found out what did and did not interest them.

[As a result of my independent study, I] did NOT take research, oriented job. (3)

[It provided] good hands-on work, I went to work in the field for five years. (15)

[My independent study influenced my career] strongly. The area I was studying is the area I tried to get a job (pharmaceutical/biological) and the area I am studying in graduate school (biol. systems). (5)

It strengthened my choice of career. (3)

It was very important in steering me away from a career I thought I wanted. (3)

My course was adhesive science. I am in adhesive manufacturing facility. (5)

[My independent study influenced my career] a lot! [It] convinced me to try to do research in the future. (3)

Three alumni stated that the independent study was the reason they went on to graduate school.

It inspired me to go back to school. (15)

It was one of the main reasons I went to graduate school. (3)

It helped me to make up my mind to do graduate work. (5)

4.7 Co-ops

Twenty of the twenty-two alumni who participated in a co-op or internship noted that it was a Avery valuable@ experience. In fact, the main improvement they mentioned for the co-op experience was to notify students about co-op opportunities sooner and to get more students involved in this valuable work experience. Alumni stated that co-op experiences instilled confidence in their abilities, provided knowledge and valuable skills, and were enjoyable. While on the job, alumni were able to learn what engineers actually do. Below are typical alumni comments.

I was very happy with my co-op experience and wouldn=t have changed a thing. (3)

[Students should] start co-oping sooner. I was only able to do a semester and a summer because I started so late in the co-op program. (3)

[Students would benefit from] finding out about the co-op program sooner. Co-oping is a must! (3)

The co-op experience influenced alumni careers even more strongly than independent studies did. Fifteen out of the twenty-two respondents stated that it influenced their career positively; the other 6 stated they were not influenced by their co-op experience. In the excerpts below, alumni described these influences.

[My co-op] gave me insight into what careers are available. (3)

[My co-op] influenced my decision 100%. Students don=t have any idea what they want to do with their career and the first co-op position you get is what you know and more than likely want to do. (3)

[My co-op influenced my career] 100%. I worked at [an electric company] in the plating/galvanizing department. Now I design the same waste treatment systems I had learned how to run. (3)

YES [my co-op influenced my career]. I enjoyed working in dual areas of process/product engineering and marketing of products. (3)

[My co-op] experience exposed me to [the] ins and outs of process engineering. The co-op experience is the most important factor in my decision to choose process engineering as my choice of career. (3)

[My co-op] confirmed that I wanted a position in manufacturing. (5)

[My co-op influenced my career] very strongly. [It] gave me a good understanding of the type of work I would do. (3)

[My co-op] confirmed my desire to be a chemical engineer. [I] ended up working for the company I co-oped for. (5)

Alumni Suggestions:
Two alumni explicitly suggested requiring a co-op for all students.

A co-op position should be required, maybe even in place of summer lab. Many schools require this and it makes you less green. (5)

[The ChemE Department] should require co-op for all students (could then eliminate summer lab). (5)

Evaluators= Viewpoint:
The value of the co-op experience or other work experiences was heard often enough to prompt us to recommend that the college or the ChemE department consider ways to expand these opportunities for all students.

4.8 The Question of a Combined B.S./M.S. Degree
Only six alumni (10%) thought that a B.S./M.S. degree would be Avery valuable.@ Eighteen people (29%) thought that such a degree was Aof little value.@ The twenty-seven alumni (44%) who said such a degree was Aof some value@ asked what the purpose of such a degree would be and what obtaining it would entail.[3] Below are typical quotations that show alumni=s hesitancy to agree to a combined degree.

> *Be very careful with this! What is the Chemical Engineering College=s objective? To develop and produce R&D candidates or competent engineers who can work in diverse business markets, processes and projects? This question should be answered first. (3)*
>
> *I question what value an MS has over a BS with a couple of years of work experience. (3)*
>
> *More is learned in two years of work than can be taught with a master=s. (15)*
>
> *In some cases an advanced degree can be career limiting in the industry. Companies may feel you are a better match for research. (3)*
>
> *From what I have heard from peers, an advanced degree in Chemical Engineering is not of much value unless you have something in particular you want to limit your career to. A master=s would be more beneficial in some other discipline. (5)*

---

[3]Respondents found this question difficult to answer without additional information on how and why this proposal would be carried out. A suggestion for future surveys would be either to eliminate this question entirely or to give additional information to the alumni concerning the purposes and advantages of a combined degree.

Chemical Engineers in industry have all the technical training they need. They need the ability to deal with peers and subordinates. (5)

I believe it is more important for a BS graduate to Asee the real world@ before continuing education for MS. (15)

4.9 Credit Requirements

Over half of the alumni expressed the opinion that the number of required credits should not be cut, arguing that all the training they received was necessary in order to be well qualified in their field.[4] A few even noted that additional required courses would have helpful. When asked if credits should be reduced, many alumni responded as below:

NO! If anything, more courses must be required to maintain the quality of UW-Madison graduates. (5)

Stop considering it! What do you intend to cut? It is all important. All of it. Even if I am not using it right now, I may in my next job. (3)

I don=t like it. If anything, I feel it should be expanded to include statistics and people skills (writing would also be a good addition, hint, hint.) More computer background would be beneficial. (15)

I think the number of credits is fine. The best thing to do would be add more variety of ChE electives. (3)

I think the total number of hours should remain the same, but more flexibility should be allowed to substitute for core engineering classes. (15)

I don=t think this would be a good idea, because with only 120 credits you wouldn=t have a well-rounded education; you would only have enough room for necessary courses. (3)

Only nine of the 62 respondents expressed the opinion that credits should be cut. Their primary rationale for this was to ensure that students graduated in four years instead of five or six.

I agree [that credits should be reduced]. It is impossible to finish in four years now. (5)

Good - people will finish in four years. (15)

---

[4]Respondents found this question difficult to answer without additional information on how and why this proposal would be carried out. We recommend that in future surveys that this question either be deleted or additional information be included in the question.

If the goal is to make the program shorter - usually takes 5-6 years to complete, this would help. Could reduce the number of lab hours required. (5)

Although the majority of students expressed the opinion that credits should not be cut, almost all hesitantly suggested one or two courses that could be eliminated. However, there was no consensus on which classes or credits should be cut. Cuts suggested most often were: ECE (Electric Circuits and Electronics), EM (Engineering Mechanics), PChem (Physical Chemistry) and any non-ChemE elective. Courses mentioned more than once were organic chemistry, thermodynamics, physics, summer lab, a math elective, and process & design. Alumni felt that they either did not get anything out of these courses or could learn what they needed on the job. Some alumni comments were:

I guess P-Chem. Most of it is covered in our other courses (although I hate suggesting to cut it.) Trim some of the theoretical-way-too-precise-for-real-life stuff out of thermodynamics to take up the slack. (3)

Physical chemistry. This mirrors ChE 310 to some extent. Engineering Mechanics. Letters and Science electives. Engineering Mechanics is nice to have as background information, but I have never used it. (15)

Physical Chemistry 561, it is almost identical to ChemE 310. EM 214, we are chemical engineers, not structural engineers. (5)

Eliminate: 3rd semester calculus and differential equations, computer science programming, physical chemistry and PChem lab [and] engineering mechanics. (5)

ECE 372 and EA. 241 - both classes provide so little information that they are useless. (3)

Maybe ECE 373 - Physics may cover circuits enough. (3)

I would include ECE372 in Process Control. Saw no real advantage to the ECE class. Most of [my] peers I have talked to agree. Reduce Non-ChE lab hours required (PChem, Chemistry). (5)

ECE course(s) can be reduced or moved into elective ones. (3)

Reduce the required credits of humanities courses. (3)

Alumni Suggestion:
One alumnus/a suggested tying course requirements to students= career paths.

The courses which would be eliminated should depend on the career track the student chooses. I.E. more concentration in explaining the types of jobs out there and establishing career plans would make this decision easier! (15)

Evaluators= Viewpoint:
Given the number of alumni who commented on the need to improve communication skills, see section 5, we strongly recommend against cutting the liberal arts requirements, unless comparable training in written and oral communication can be introduced into the traditional engineering courses.

Advisors may want to work more closely with students to help them make wise choices about electives and to ensure that students understand the value and purpose of each course they take, whether it be an elective or a requirement, and whether it be inside or outside the department.

5. Interpersonal Skills

We asked alumni AWhich skills would you like to see the ChemE program encourage or improve on?@ Graduates frequently mentioned interpersonal skills such as communication, management of one=s own and others= work, and teamwork.

5.1 Need for communication skills (oral and written)

The most frequently mentioned skill alumni would like to see improved is communication. They explained that it is a skill many new engineers lack, and it is essential on the job. Alumni responded that the ChemE Department should encourage:

> *Communication - encourage or force oral presentations. Possibly include oral exams in the undergraduate program. Demand coherent and well written reports. (5)*
>
> *Communication skills (written and oral). (3)*
>
> *Most [entering Chemical Engineers] write very poorly. (15)*
>
> *[Entering Chemical Engineers] can=t write worth a damn, but I don=t think that=s our problem. They should learn it in high school. (15)*
>
> *Communication (writing skills) [are] very important. Many skills are inborn however, or already developed by college age. I think you are already doing a good job. (5)*
>
> *Oral communication. While written communication is also important, no one has time for anything today except a clear statement. (5)*
>
> *I would like to see a course on giving technical presentations designed specifically for engineering students. (3)*
>
> *Writing - it helped me. (3)*
>
> *Grammar, writing skills. (5)*

5.2 Need for managerial or people skills

A few alumni mentioned managerial or people skills as important for new engineers, especially in light of the typical career path for engineers.

> *People skills - while most engineers start in engineering positions, most will move to management positions where people skills (ability to work with people) is critical. (3)*
>
> *Interpersonal skills, managerial skills. Most managerial positions in the Chemical industry are filled by engineers. The University instructs us on how to be an engineer, not a manager. (3)*
> *Management of people (lab technicians). (5)*

Most engineers have little or no interpersonal and supervisory skills. (5)

Managerial/Supervisor skills (more people skills are needed). (15)

5.3 Need for teamwork

A few alumni also listed the ability to work in a team as an essential skill in the workplace.

Working as a team - but more than just with the department. It is important to be able to work in a team of people that don=t know your Alanguage.@ Chemical Engineering students have similar background and speak the same language. It is more important to be able to work with other people. Maybe cross-functional classes? (3)

Working in a team. (3)

6. Advising/Career Tracks

Few alumni described their advising as Avery adequate.@ Over half reported that it was Asomewhat inadequate@ or Avery inadequate.@ Eight percent felt they had received so little career advising that the question was Anot applicable.@

Rating of Career Advising

	Very Adequate	Somewhat Adequate	Somewhat Inadequate	Very Inadequate	Not Applicable	Total
15 years out	1	4	3	6	0	14
5 years out	7	3	5	3	1	19
3 years out	1	8	10	6	4	29
Total	9 (15%)	15 (24%)	18 (29%)	15 (24%)	5 (8%)	62 (100%)

Alumni mentioned three ways that advising could be improved: more involvement of the advisor, more career direction, and more information regarding co-ops.

6.1 Advisor=s Roles

As students, alumni wanted advisors to take an interest in their career directions, and to ask them questions about their long-term goals, not just Arubber-stamp course selection.@[5] Some alumni felt faculty had little time or interest in them because of Aother priorities such as graduate students and research.@ In effect, alumni wanted advisors to act as mentors.

> *Advisors tended to rubber-stamp course selection as long as it demonstrated a progression towards a degree. (5)*
>
> *The advisors should express more interest in the student=s goals, rather than simply making sure that the required coursework and prerequisites are satisfied. (3)*
>
> *[My advising was] mediocre. Advising from a professional (Engineer) woman would have been beneficial to me. (5)*

Some alumni noted that the time allotted to advising is insufficient to allow this type of mentoring relationship to develop.

---

[5]Howard Adams, Director of the Mentoring Institute (GEM) and an expert on college-level advising and mentoring, argues that an advisor has a moral obligation to do more for advisees than simply sign off on course selection. Adams argues that a true mentor will take a measure of responsibility for nearly all aspects of a mentee=s career and life. Howard Adams, ARole of Faculty in the Life of Students,@ talk presented at the Engineering Education Scholars Program, July 16, 1996, Madison, Wisconsin.

There is not enough interaction between the professor and the student. Sometimes it seems there is not much interest from the professor. (3)

[There is a need for] more time from the professor. Some students might require a little more coaching so that means more office visits. (5)

A student can make it through college only seeing an advisor four times for 1/2 hour each session. This doesn=t constitute advising for a lifetime of work. [We] need a short course or forum to address all possibilities and all questions/concerns. (3)

More personnel are required to give students enough attention. (5)

Others believe advising is inadequate because it is not among professors= top priorities.

My faculty advisor did not know Ame@ nor did he make an effort to know Ame.@ There didn=t appear to be an emphasis on undergraduate advising. It was a trivial requirement placed on the faculty. The largest deficiency is a lack of industry experience and an obvious disrespect for industry by many of the faculty. (3)

Professors don=t have time to worry about an undergraduates= schedule. I used to take my schedule in to Professor XX and he would sign off without so much as a comment. You should hire 1-2 full-time counselors to help [in] education planning. (3)

It seemed to me that my advisor and many other professors were caught up in their own Apolitics@ within the department. Their careers were their first concern. (5)

Advisors appear to have other priorities such as graduate students and research. Very little time was available for discussion of careers. (5)

Each undergraduate should make what he/she wants out of advising. But the professors should be more receptive to undergraduates. (3)

Advisor needs to focus on the undergraduates needs. (3)

Whatever the reasons for these inadequacies, many alumni were disappointed by the lack of useful advice they received. This holds true for all classes surveyed.

Most professors do not seem to understand how corporate engineers have to work. Because of this, they can=t explain how any particular course of action helps or hinders you in the long run. (3)

I don=t remember receiving much career advice. (15)

When I first entered chemical engineering as a freshman the Ageneral@ counselor told me (and as I later found out one other person) not to even try because we would never make it. Neither of us appreciated that. The only time I saw my chemical engineering counselor was when I received a letter stating that I would not be able to graduate unless I took the AIntroduction to Engineering@ course. He told me to ignore it and said he would take care of it. Nowhere in my 4 1/2 years did I receive counseling on various career paths, co-oping or if I should focus my studies in one area or another. (15)

I had NO career advising. In addition I was not prepared for how POORLY women are treated in the field-though sexism, discrimination, etc was very apparent at the UW. (15)

[There was] very little contact or interaction. Need better guidance. [For example, an advisor could ask], ADo you think you would like research, project engineer, etc. You may be good at manufacturing because. . .@ (3)

I gradually figured out, through my junior and senior years, that although I was quite good at ChE, I didn=t want to do it for a living. Until after entering ChE, perhaps even later, I thought ChE was Aengineering chemical@ in the same sense that E.E. is Aengineering electronics@ and mechanical engineering is Aengineering machines.@ It took me a long time to figure out ChE had nothing to do with designing and synthesizing custom chemicals - or almost nothing, anyway, perhaps I am dense, though. (3)

I don=t recall using or having had any career advice. (15)

Alumni Suggestions:
Alumni had many suggestions about how to improve advising.

Have alumni come back to give talks on what=s really happening out there. The alumni have considerable insight to actual market conditions. (15)

Advisor needs to find out career goal of a student and then help choosing elective courses that fit this goal. Example: If the student would work as a process engineer, then his/her elective courses would look like: Statistics, Polymer Science, etc. (3)

Bring a wider range of companies in. (3)

Allow the students to meet the staff when they enter the department, find out what specialities they have and select their own advisors from a 1st, 2nd, 3rd list. (3)

Expand services for students and corporations in emerging information technology area. (3)

Inform incoming freshmen or ChE 210 students of Co-op program. I didn=t find out about it until it was almost too late in my college career. (5)

Explain to students what engineers do in the work place. Most students that don=t co-op don=t understand and that hurts them during interviews and on the job. (3)

It would have been helpful to know the types of positions available better. For example, process, design, or other related positions. (15)

6.2 Students wanted more career direction.
Although alumni acknowledged the importance of receiving advice on course selection, many felt getting information on career options was even more crucial. Many had not heard of a particular type of engineer until they were in the working world.

> *I probably could have cut my number of interviews down had I gotten information from an advisor on what it means to be a Project vs. Process engineer, and defined more what I wanted to do for a living. (5)*
>
> *Help the engineer to know if they want to take the path of: R&D, process engineer, product development engineer, or technical sales/service/marketing engineer. (3)*
>
> *It has been too long for me to recall, but from recruiting experience I think that knowledge of what industries do is important. Career fairs help to spread the word. (15)*

Career course with speakers was very useful. I believe each class could have alumni bringing in specific real world problems and it would also give direction with regards to career path opportunity. (5)

What do ChE=s DO. Since they go into such a broad array of fields, this is difficult. (3)

I never knew what a project [engineer], [design engineer], or a process [engineer], etc did when I graduated. (15)

1) A course introducing and exploring various job types (R&D, Sales, process engineer, project engineer, etc) and various industries which employ chemical engineers (paper, chemical, food, pharmaceutical, etc)
2) Regular required meetings with an advisor with one of the objectives being career counseling. (I never met with my advisor other than to get a signature.) (15)

6.3 Co-ops are important for career

As noted in sections 4.6 and 4.7, most alumni described independent studies and co-ops as valuable in helping them identify and understand the career paths open to them. Alumni expect faculty members to have knowledge about independent studies and co-op programs and to pass that knowledge to them in a timely fashion.

The co-op or summer intern program should be stressed more so that students have a better understanding of the various types of jobs. (15)

Getting work experience as early as possible. (3)

7. Executive Summary

Overall, alumni expressed extremely positive views of the ChemE program and its ability to prepare them for their careers, with one saying that the program *Ahas a world-wide reputation and it=s well-deserved@* and another noting that *AI attribute my present success in large part to the ChE department at Madison.@* The majority of the alumni who responded to this survey had suggestions for improving the ChemE program, but most of these suggestions were made in an effort to maintain the quality of an already strong program in order that the ChemE Department be *Awell respected in the years to come,@* not because they saw substantial flaws in the program as it currently exists. As one graduate explained, *Adespite obvious complaints, when I compare my preparation to others, it is superior.@* The comments and suggestions alumni made fall into two major categories: subject areas in which their training could have been strengthened, and approaches to teaching and advising that would have improved their preparation for their careers.

The majority of alumni, when asked for areas in which the department could improve, suggested increasing training in statistics, computer science, and communication skills. Alumni reported that they frequently use information and skills from these areas and that current and future students should be encouraged to seek more training in these subjects. It is important to note that all three of these areas are outside of the core chemical engineering curriculum; that is to say, these subjects are generally taught in departments other than Chemical Engineering. It is possible that useful courses in each of these areas already exist and that students simply need to be steered toward them, either through course requirements or through advising.

Most alumni also mentioned that they would have liked more practical, hands-on experience and more career advising. Graduates were interested in having classes that prepared them for what it would be like to be a practicing chemical engineer, and felt that hands-on approaches frequently gave them the best preparation for the Areal world@ of industry. Alumni also wanted advisors who took students= long-term career goals into account when helping advisees make course selections.

Implicit in the alumni=s comments about teaching and advising is the notion that students attend college primarily as a means to an end, the Aend@ being a job following graduation. As a result, alumni wanted to ensure that the college experience is relevant and useful to students once they are on the job. This attitude should not be seen as a crass interest solely in making money, nor as a lack of interest in the subject matter of chemical engineering. As interested as most students are in their majors, they still must find work with which to support themselves after graduation, and they want to obtain training that will allow them to do well in their chosen field and therefore to continue to enjoy studying and practicing chemical engineering. One graduate explained that *AI love ChE and wish advisors would perhaps help kids choose a direction or goal in their education instead of just an aimless pursuit of credits.@* In other words, by helping students to focus on their <u>future</u> plans, advisors can actually increase students= interest in their <u>current</u> courses by fostering students= commitment to the discipline.

The full LEAD Center report on the surveys of Chemical Engineering Department alumni provides a much more thorough analysis of these points and includes numerous excerpts from the survey responses. These quotations are particularly valuable in bringing the issues discussed in this Executive Summary to life. The ChemE alumni who participated in this evaluation clearly put enormous thought and effort into assessing their alma mater and *Aappreciate[d] the department taking the time to get feedback from engineers in the field.@* One even offered to *Asend a letter with more comments, as I have lots more I=d like to say.@* They eloquently pointed out strengths and weaknesses that can only be hinted at here. These alumni believed that their comments would be taken seriously and used thoughtfully, and LEAD researchers encourage department members in their efforts to do so.[6] In the words of one graduate, *AGood Luck!@*

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[6]One graduate expressed a desire to *Asee the results of this survey if a summary is prepared.@* Distribution of this report is the right and responsibility of the department chair, but LEAD researchers encourage the department to consider distributing this report to graduates, in part because such distribution might increase return rates on future surveys.

APPENDIX A: The Cover Letter and Survey

DEPARTMENT OF CHEMICAL ENGINEERING
1415 ENGINEERING DRIVE
MADISON, WI 53706
TELEPHONE: (608)262-1092
FAX: (608)262-5434

May 31, 1996

Dear ChemE alumni:

The UW-Madison College of Engineering is initiating a survey to its alumni so that we can improve the education that our students receive. This is consistent with our efforts for quality education. The Department of Chemical Engineering is the first to launch this study. Enclosed is a survey that we are sending to ChemE alumni. Presently, we are focusing on our undergraduate programs, so please do not make any comments about our M.S. or Ph.D. programs at this time.

We hope you will take a about fifteen minutes to complete and return the enclosed survey. A stamped return envelope is included. Your response will provide important information that will be used to improve the UW-Madison programs for future engineers. *YOUR VOICE IS IMPORTANT*. All responses will be held strictly confidential. To ensure confidentiality, the UW-Madison LEAD (Learning through Evaluation, Adaptation and Dissemination) Center will analyze the survey. We are requesting that you return the survey by **Wednesday, June 12, 1996**.

We recognize how busy you are and appreciate your time and attention. Thank you for assisting us in our efforts to improve the undergraduate program.

Sincerely,

Sangtae Kim
Professor and Chair of the Department of Chemical Engineering

Enclosures: survey & stamped envelope

CHEMICAL ENGINEERING
UNDERGRADUATE ALUMNI SURVEY
June 1996

Note: We are focusing on our undergraduate program, please do not make comments on our Masters or Ph.D. programs as this time. Please return by Wednesday June 12, 1996.

1. Please complete the following current information about yourself:

Name: _____(Maiden Name:_____)

Address:_____

City, State, Zip:_____

Phone:( )_____e-mail

address:_____ Gender: Male Female

Year began at UW-Madison 19___ Year received B.S. degree 19___

2. If you are *currently enrolled or have earned additional degrees* in a graduate degree program, complete the following:

1) Field:_____
Institution:_____
Degrees earned (circle all that apply):
MS MA MBA MD JD Ph.D.

2) Field:_____
Institution:_____
Degrees earned (circle all that apply):
MS MA MBA MD JD Ph.D.

3. Have you taken continuing education or industrial short courses? Yes____ No____
What subjects have you studied? Why?

4. Are you currently employed? Yes___ No___ **If yes, complete B through E below. If no, complete A.**

a. If you are currently not employed, please specify the reason(s) why.

b. Company name_____

1. Mark the description below that best characterizes your current employer.
less than 100 employees___ 100 to 1000 employees___ greater than 1000 employees___

Public_____ Private_____ Commercial _____ Government_____ Other (Specify)_____

2. How many years have you been with this employer? If less than 1 year enter 0. ___years

c. Current job title or position?_____

d. Please write a short description of the type of work you do in your present position:

e. How long have you been in this position? (Circle one):

Under 1 year 1 to 4 years 5 to 10 years over 10 years

5. Rate how well your ChE undergraduate education at UW-Madison prepared you in the following areas and also rate how useful these areas have been in your career.

	Level of Preparation				Degree of Usefulness			
	Very Prepared	Adequately Prepared	Poorly Prepared		Frequently Used	Moderately Used	Not Used	Courses Not Taken
a. Mathematics (calculus, diff. eq.,)								
b. Statistics								
c. Chemistry (Chem 109 & 110 or Chem 103, 104 & 223)								
d. Physics								
e. Computer Science (CS 302 or CS 110/310)								
f. Electric circuits and electronics (ECE 373 or ECE 376)								
g. Thermodynamics (ChE 310)								
h. Engineering Mechanics (EA. 214)								
i. Process and Design (ChE 210, 424, 450, 470)								
j. Transport (ChE 320, 324, 426)								
k. Energy (ChE 326 and 430)								
l. Materials (ChE 540 or 440)								

6. If you rated your preparation in any of the above topics as "very prepared" or "poorly prepared," please comment on those ratings.

Topic: Comment:

_____

_____

_____

_____

7. If you rated any of the above topics as "very useful" or "not useful" please comment below on why.

Topic: Comment:

_____

_____

_____

_____

8. Do you supervise the work of other Chemical Engineers? _____Yes _____No

9. In your view, what deficiencies do <u>entering</u> Chemical Engineers have?

10. What are the most important qualities or skills that a Chemical Engineer should have? Why?

(For example: working independently, creative thinking, problem solving, time management, communication, working in a team, intellectual curiosity, confidence in field, ethical responsibility)

11. Which skills would you like to see the ChE program encourage or improve on?

12. How do you rate the quality of career advising you received in the College of Engineering?

(Circle one): very adequate somewhat adequate somewhat inadequate very inadequate not applicable

How could it be improved? Be as specific as you can.

13. If you have attended or completed graduate school or are currently in graduate school, please rate how well your undergraduate education at UW-Madison prepared you for graduate study?

Circle one: very adequate somewhat adequate somewhat inadequate very inadequate not applicable

How could it be improved? Be as specific as you can.

14. How well prepared do you believe you are to compete within your field or current area of employment?

(Circle one): very prepared somewhat prepared somewhat unprepared very unprepared

Please comment:

15. How does your undergraduate education compare with that of peers in your field from other schools? (Example: advantages, disadvantages)

16. During your undergraduate study, what subject areas, if any, would you have liked to study more? Why?

17. The college is considering reducing by approximately 12 credits (from 133 to 120 credits), the number of credits required to receive a bachelor degree.

a. What do you think about this?

b. If this change were made, what courses would you eliminate or reduce?

18. Do you think a Chemical Engineering professional program culminating in a combined B.S./M.S. degree would be of value?

(Circle one): Very valuable of some value of little value of no value
Comment:

Answer Question 19 only if you took an independent study course.

19. Did you take an independent study course - ChE 599? Yes____ No_____
If yes, complete questions A through E below.

a. How do you rate the value of your independent study? (Circle one):
Very valuable Somewhat valuable Of limited value Not valuable

b. Why do you rate it this way?

c. How, if at all, could it have been improved? Be specific as you can.

d. In what ways, if any, did your independent study experience influence your choice of career?

e. If you went to graduate school, in what ways, if any, was your graduate school experience influenced by the independent study? Mark here if not applicable_____

20. Did you participate in a co-op experience? Yes____ No____ **If NO, Go to Question 21.**
If yes, complete questions A through D below.

a. How do you rate the value of your co-op experience? (Circle one):
very valuable somewhat valuable of limited value not valuable

b. How, if at all, could it have been improve? Be as specific as you can.

c. In what ways, if any, did your co-op experience influence your choice of career?

d. If you went to graduate school, in what ways, if any, was your graduate school experience influenced by your co-op experience? Mark here if not applicable____

21. The ChE degree requires 15 credits of lab spread out over Chemistry and Chemical Engineering courses. Please rate the value of this lab intensive curriculum to your career and comment on why you rated it this way.
(Circle one): very valuable somewhat valuable of little value not valuable
Comment:

22. Please rate the value of the summer lab in particular and comment on why you rated it this way.
(Circle one): very valuable somewhat valuable of little value not valuable
Comment:

23. Please give an overall rating about how well your undergraduate education prepared you for your professional career.
(Circle one): very good good fair poor
Why do you rate it this way? Be as specific as possible.

24. Please add any comments you feel would be helpful in improving our undergraduate program:

THANK YOU VERY MUCH FOR YOUR TIME AND EFFORT!
Please Return Survey By Wednesday June 12, 1996

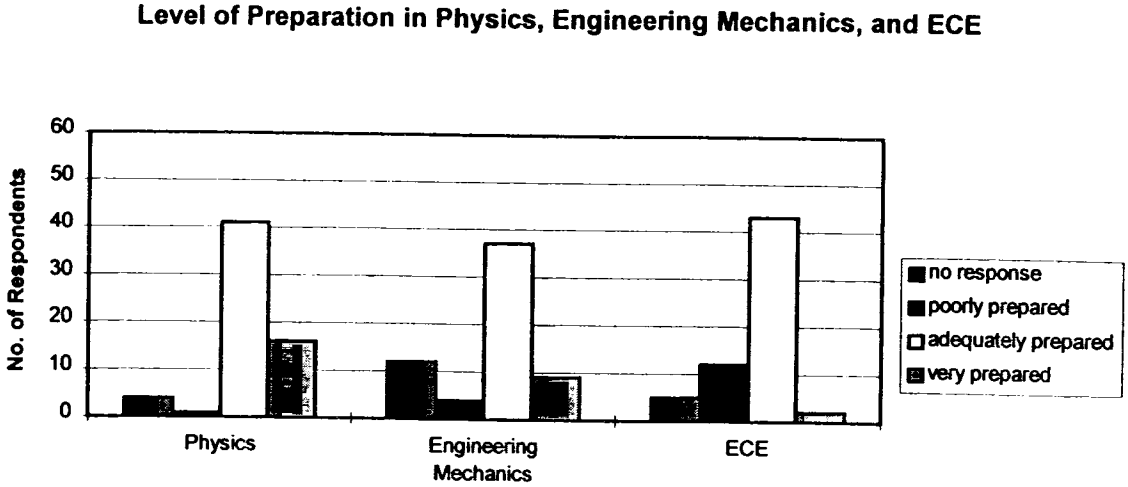
APPENDIX B: Employers and Positions

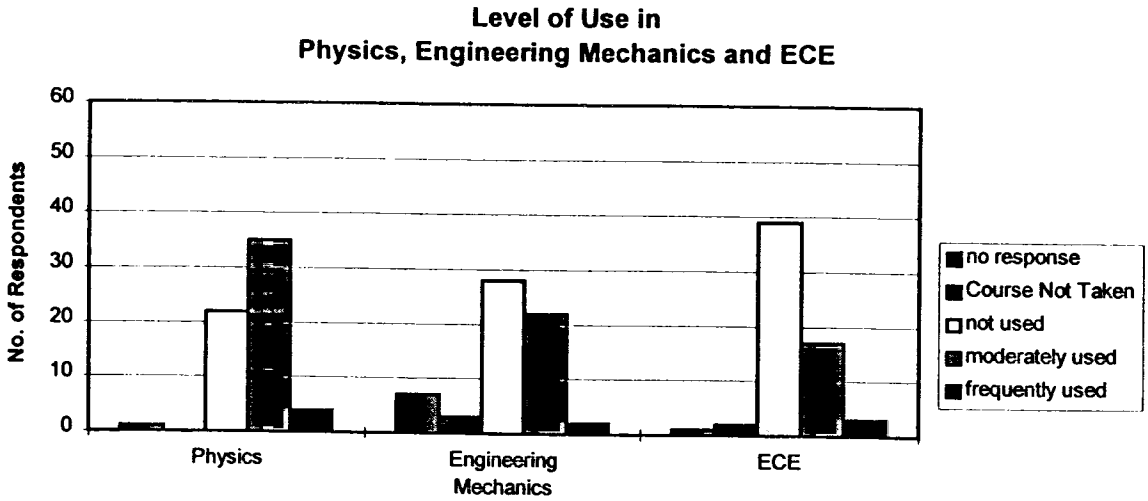
EMPLOYER	
3M Company	5
U.O.P.	4
Kimberly Clark Corp	3
Grace Tec Systems	2
Sunoco-MidAmerica	2
Abbott Laboratories	1
ABB C-E Services	1
Ametek	1
American Wood Fiber	1
Anvil Corporation	1
Ashland, Inc.	1
Allied Signal Lamina	1
Bandag, Inc.	1
Bell Aromatics	1
California Institute	1
Cargill, Inc.	1
Cummins Engine Co.	1
Diatec Environmental	1
Devro-Teepak	1
Enzymed, Inc.	1
Epic Systems Corp.	1
Hutchinson Technology	1
Institute of Paper & Science Technology	1
International Paper	1
Kraft Foods, Inc	1
Marathon Oil Co.	1
McGhan Medical	1
Monsanto	1
Nabisco	1
National Starch & Co	1
Procorp, Inc.	1
Procter and Gamble	1
Quantum Chemical	1
Standish Industries	1
TSR Engineering	1
Wisconsin Electric	1
Wisconsin Analytical	1
State of Wisconsin-DNR	1

JOB TITLE OR POSITION	
Process Engineer	16
Research Engineer	9
Manufacturing Engineer	4
Product Engineer	4
Project Engineer	4
Design Engineer	1
Environmental Engineer	1
Software Engineer	1
Specialist	1
Territory Manager	1
Refining Engineer	1
PCL Engineer	1
Technical Sales Representative	1
Air Management Engineer	1
Technical Service Engineer	1
Database Team Leader	1
Plant Engineer	1

APPENDIX C: Course Usefulness and Preparation

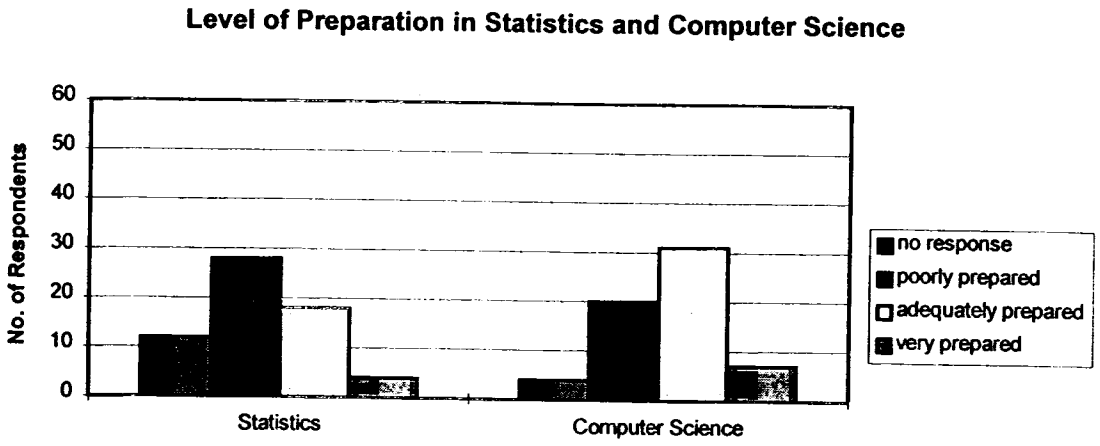
FIGURE 1

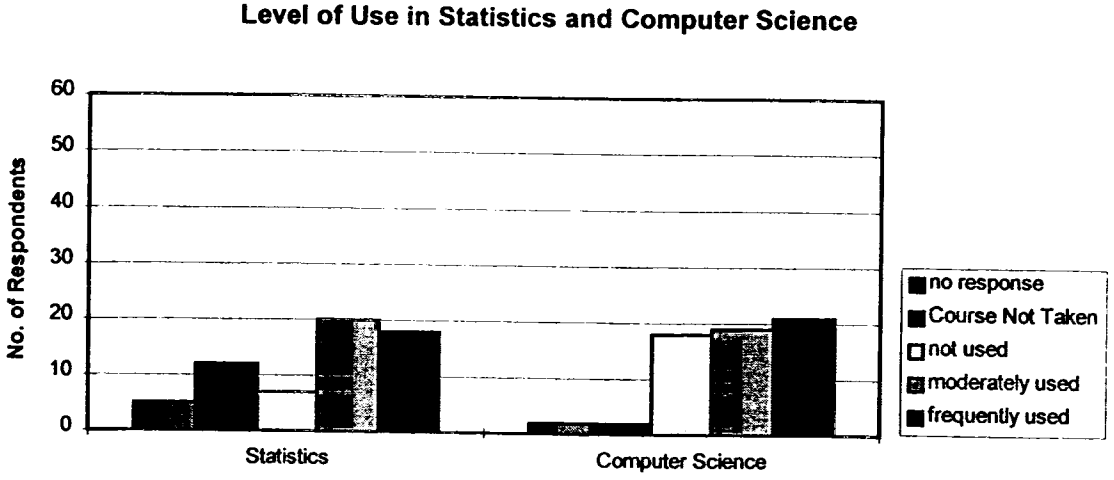




Most alumni stated that they are adequately prepared in physics, engineering mechanics, and ECE, yet one-third to two-thirds of them say that these courses are "not used." Therefore, if the department is looking for a course that could be dropped in favor of statistics, one of these three areas might be considered, depending upon a student's intended career path.

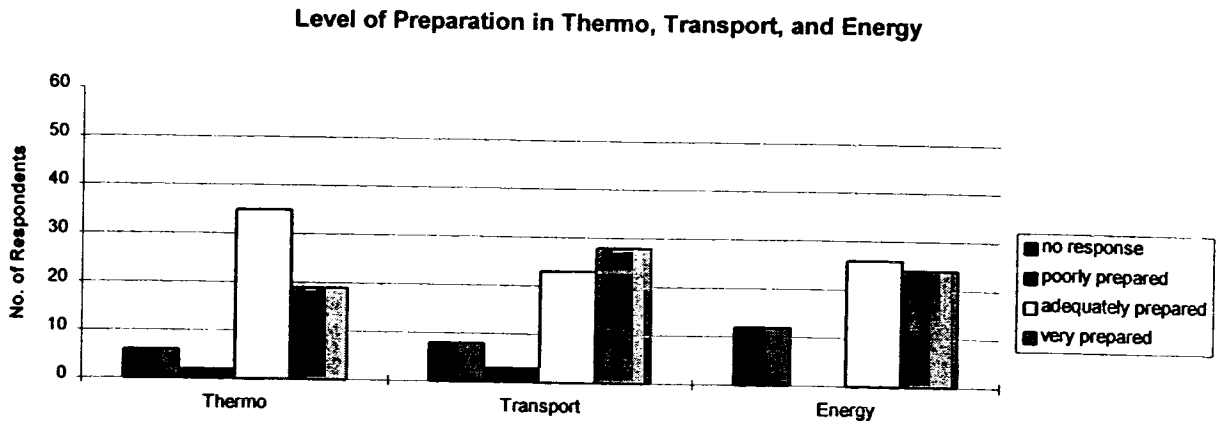
FIGURE 2

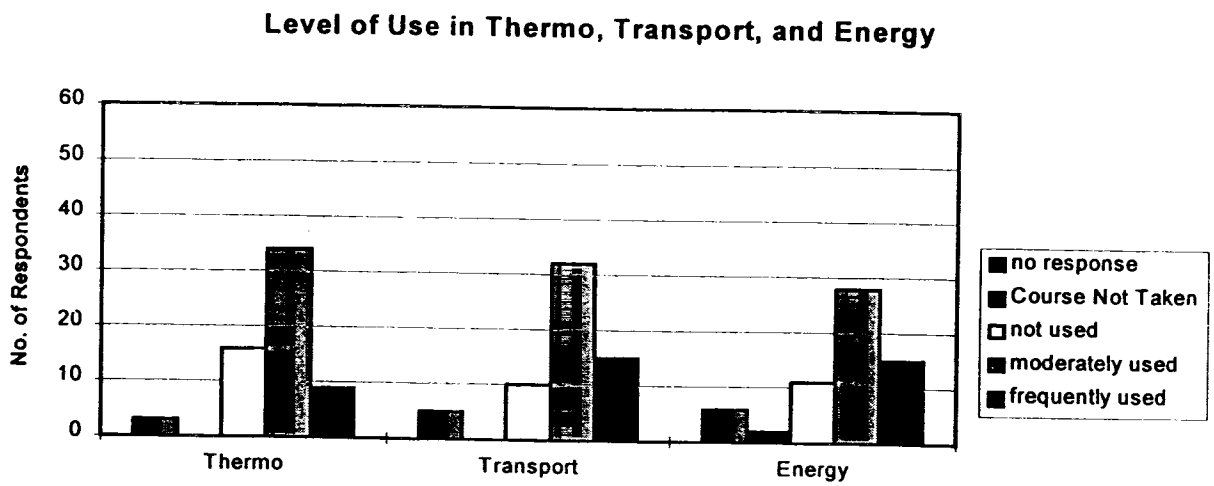




In statistics, few alumni said they were "very prepared", yet most said that statistics was "moderately" or "frequently used" for work. Computer skills were also "moderately" or "frequently used" by the majority of respondents, yet one-third of them felt that they were "poorly prepared" in computer science.

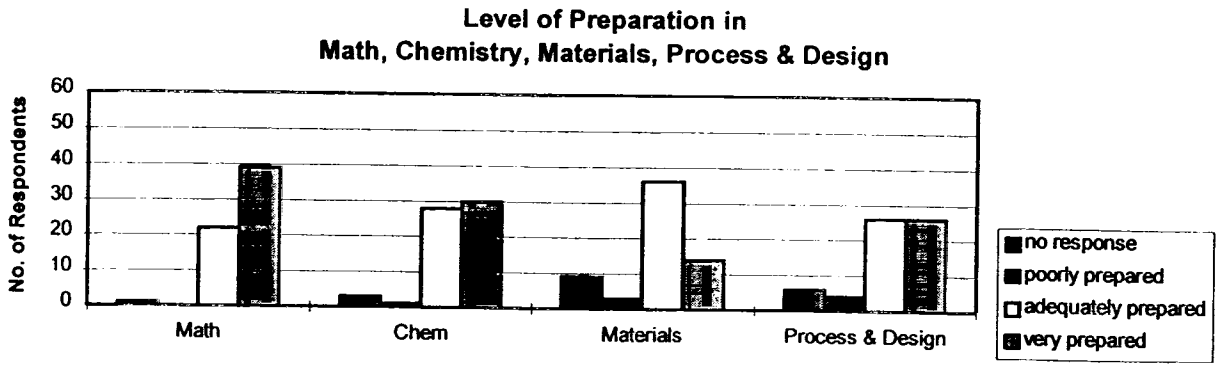
FIGURE 3

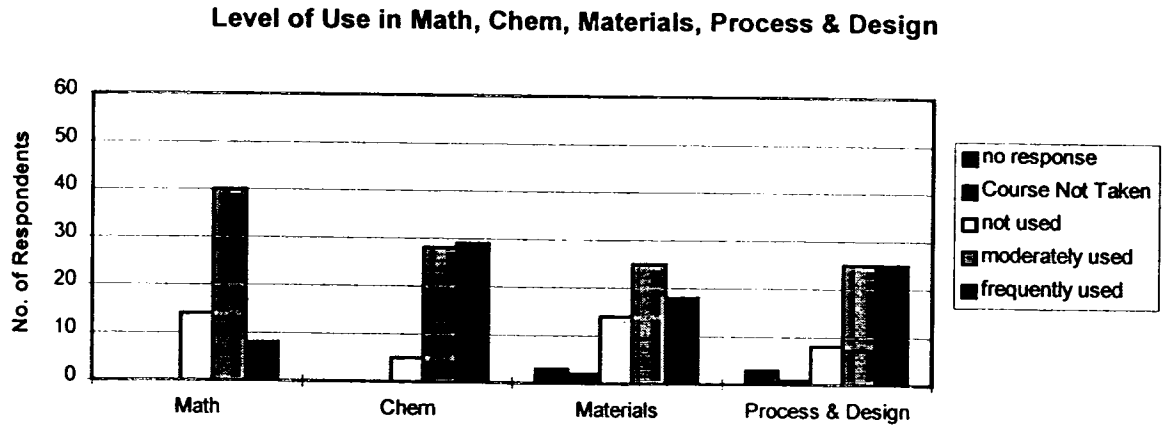




The above three courses (thermodynamics, transport, and energy) show a good match between how alumni are prepared and how often a course is used. Most alumni reported that they felt well prepared in these courses and most said that these courses were "moderately" or "frequently used."

FIGURE 4





The above four courses show a very good match between how alumni are prepared and how often a course is used. Virtually all alumni felt well prepared in these areas and use them often in their work.