INDUSTRY PERCEPTIONS OF ERC GRADUATES: CONSENSUS DEVELOPMENT, INSTRUMENT/PROCEDURE DEVELOPMENT AND PILOTING

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Executive Summary

This project's original purpose was to design and pilot methods for assessing employers' perceptions of the educational outcomes of Engineering Research Centers (ERCs). The intent was to determine which of the available data sources and data collection methods seem to be most effective for assembling a data base that would be useful for assessing the degree to which the ERCs are meeting their educational goals. The major product would be recommendations to the National Science Foundation's Engineering Centers Division which could serve as guides for future ERC program evaluation efforts.

In the original proposal two types of employers were to be assessed. The first was to be employers of a sample of Engineering Research Center (ERC) graduates. The second group was to be a sample of employers of a comparison group of non-ERC graduates. Two modifications were made at the project's February 1991 Consensus Conference. First, conference attendees decided that it would not be practical to collect data from employers of non-ERC graduates, as a distinct group. As a result, plans were made to approach employers who had both ERC-trained and non ERC-trained graduates working under their direct supervision. Second, it was decided that, along with assessing employers' perceptions of ERC and non ERC graduates, methods and instruments for surveying ERC students and graduates should also be developed and piloted.

The resulting pilot project reported here is the first multi-center attempt to develop data sources and test methods systematically assessing programmatic impacts. The five ERC Directors who volunteered to participate in and completed all phases of this pilot project are to be commended for their cooperation and openness. They are:

The Systems Research Center at University of Maryland at College Park
The Engineering Design Research Center at Carnegie-Mellon University
The Center for Telecommunications Research at Columbia University
The Biotechnology Process Engineering Center at the Massachusetts Institute of Technology
The Engineering Research Center for Intelligent Manufacturing Systems at Purdue University

The quality of the results as evidenced by the cooperation and response rates demonstrate that ERC graduates are very willing to provide feedback to the NSF about their ERC experiences and to provide names of their immediate supervisors so that they can be approached about a telephone interview. It is also clear that employers of ERC graduates are eager to offer their opinions about ERCs, their impacts on students, and the degree to which ERCs are meeting the goals for which they were established.

Generally speaking, information at the ERCs about where graduates are and what they are doing is inadequate. Following-up ERC graduates and interviewing their employers, both very important tasks, will remain extremely labor intensive unless something is done to simplify them. This report recommends a tested low cost remedy.

Results, though preliminary, indicate that employers of ERC graduates have quite favorable views of ERC graduates [refer to Attachment B - page 21]. They also suggest that ERC graduates have generally positive opinions about their ERC experiences [see Attachment E - page 59]. Many ERC graduates report they need even more interactions with industry. Finally, it is common for ERC graduates and their employers to indicate that they are not particularly well informed about ERCs. Clearly, individuals served by ERCs feel a need to be, and can be better informed about why ERCs were established, what they are, and how their educational programs differ from those of non-ERC programs.

Summary of Methodological Recommendations

Steps should be taken to ensure that evaluative data on ERCs and their graduates be regularly and systematically gathered from employers of ERC graduates. To that end the following recommendations are offered:

1 Require each ERC to approach each student who is about to graduate with a BS, MS, or Ph.D. for the purpose of asking them to voluntarily complete a Graduate Location Information Form by May 1st of each academic year.

2. Do not require ERCs to collect program/ evaluation data from current students.

3. The forms developed and used in this pilot were adequate for graduates who are four or five years from graduation. We recommend, however, that form revision conferences be convened every three or four years.

Employers were asked to make comparative judgments about ERC-trained versus otherwise comparable employees who were not ERC-trained. About-to-graduate undergraduate and graduate ERC students were asked to reflect upon their ERC accomplishments and experiences. Baccalaureate, MS, and Ph.D. graduates of ERCs were asked for their retrospective assessments of their ERC experiences.

METHODS

The Site Visits and the Consensus Conference. Four of the ERCs, that were established prior to 1987, were site visited by a project staff member in November of 1990. A Consensus Development Conference was convened in Washington D.C. in February of 1991. The 20+ participants in the Consensus Conference met for the purpose of developing a consensus on definitions of educational success within the context of ERCs and on ERC educational outcome indicators. Conference participants represented six ERCs, four industrial sponsors of ERCs, and the NSF. Conference attendees decided that as many as six (rather than only two) of the oldest ERCs should be included in the project. Conference attendees included:

From industry:
Jeff Siirowa, Eastman Chemical Company
Ted Winterrowd, Director of Engineering, Cummins Engine Company
Richard Alben, GE Corporation Research and Development
Stuart L. Brodsky, Contel Technology Center

From ERCs:
Anthony Acompora, Center for Telecommunications Research
Columbia University
John S. Baras, Systems Research Center,University of Maryland
Georgette Demes, Engineering Design Research Center
Carnegie-Mellon University
John W. Fisher, Center for Adv Technology for Large Structural Systems
Lehigh University
George Harhalakis, Systems Research Center, University of Maryland
Chris Hendrickson, Engineering Design Research Center
Carnegie-Mellon University
Ralph P. Schlenker, Systems Research Center, University of Maryland
James Solberg, Engineering Research Center for Intelligent
Manufacturing Systems, Purdue University

The Survey Instruments. Following the Consensus Conference, five survey instruments were developed. The first two were:

Baccalaureate Pre-Graduation Form
Graduate Student Pre-Graduation Form [for current MS and Ph.D. students]

These were to be administered by ERC personnel just prior to commencement. The remaining three forms included:

Undergraduate Student Follow-up Form
Graduate Student Follow-up Form [for graduates employed in industry]
Graduate Student Follow-up Form [for graduates employed in academia]

These were to be administered by mail following location of the graduates by project staff. Attachments E through J contain aggregated preliminary results of the five forms. Attachments K through M contain masked preliminary results, by ERC, of the three ERC graduate surveys; these are generally available only to NSF/ECD and to personnel in the five participating ERCs.

Responsibility for Subject Recruitment and Data Collection. Because NSF/ECD staff do not envision requesting ERC faculty or staff to locate or recruit graduates for follow-up studies, they were not expected to do so in this pilot effort. The only requirement was that the ERCs supply as much information about their graduates as they could so that project staff could proceed with locating, contacting, and recruiting ERC graduates and their employers.

Subjects

Five of the 6 ERCs that participated in the Consensus Conference supplied project staff with names of their BS, MS, and Ph.D. graduates. The centers also supplied, if known, lists of employers of their graduates Each center provided as much information as they could about its graduates' supervisor and/or managers. The quality of the graduate and employer identification and locator information varied greatly from center to center. Regardless, project staff made every effort to locate as many ERC graduates and their employers as possible from each center, using a variety of approaches, from the information provided.

Current ERC Students

Response to Pre-Graduation Surveys. The two forms that were developed for gathering opinions from current students. These were designed to be administered by staff at each of the five participating ERCs. The forms were distributed to each center on May 14, 1991 via Federal Express. While this was a bit late for group administrations at several of the centers before the graduates departed, it is significant that only one set of each form was returned. This indicates that, contrary to the opinion of Consensus Conference attendees, relying on centers to administer this type of form, even in group administrations, is probably not realistic.

ERC Graduates

Graduate Inclusion/Exclusion Criteria. Graduates must have met the following inclusion/exclusion criteria in order to be included in the pilot:

1. They must have graduated from one of the five participating ERC institutions.

2 They must have been granted either a bachelors of science, a masters of science or a doctoral degree and have gone through commencement on or before August 31, 1989.

3. They must have been employed for at least six months.

Graduates who did not meet these three criteria were excluded from the pilot.

Identifying ERC Graduates. Names of and information to help locate and contact ERC-affiliated graduates were supplied to project staff by five of the six ERCs that participated in the Consensus Conference. Each of the ERCs was requested to supply, if available without an inordinate amount of effort, as much of the following information as possible:

1. Graduate's permanent home address (address of graduate's parents from their original application for admission);
2. Phone number of graduate's parents;
3. Name and phone number of graduate's academic advisor;
4. Graduate's last known address and phone number;
5. Graduate's employer's name and address (if known), and;
6. Graduate's employer's phone number (if known).

The quality of the information supplied by the centers varied considerably. One of the centers provided exceptionally complete and accurate information (items 5 and 6 were up-to-date for over 90% of the graduates). This enabled project staff to contact graduates with great efficiency. Two of the centers provided information that was 80% complete for item 5 and 60% complete for item 6. As a result, project staff were most often able to contact these centers' graduates within 3 to 5 telephone calls. Two of the centers submitted data sets which were only 50% complete for items 1 through 6. For these centers, therefore, project staff were often required to make 6 to 9 telephone calls in order to contact graduates. One of the centers provided virtually no information other than their graduates' names. A few employer names were provided, but no information on the employers' state or city was included. Project staff made several attempts to improve the quality of data from this center and to contact the graduates with the information provided. These efforts failed and the center was not included in the pilot. Since this was an entirely voluntary effort, however, and since more that enough interview and survey data were being gathered from the other five ERCs, dropping this ERC from the feasibility project was not a problem.

Location of ERC Graduates. Using the above-referenced information several combinations of approaches were tested by project staff for locating ERC graduates. When the information provided for a graduate was exhausted without success, staff attempted to get more information from the center. When this was necessary, the graduate's center typically had no more information than was initially provided. Contacts with student's advisors were usually not productive, either because they had no additional information or were non responsive to letters which requested more information.

Contact/Recruitment of ERC Graduates. Methods of contacting graduates included sending informational letters about the project which referred to pending phone calls, as well as phone contacts alone. Phone calls to graduates which were preceded by an informational letter were no more effective for recruiting ERC graduates than were phone calls alone. Located graduates were first informed about the purposes of the pilot project.

Each contacted graduate was first asked if they would be willing to complete a follow-up survey that would be mailed to them. They were then asked whether they would be willing to supply the name of their immediate supervisor or manager so that project staff could approach them to see if they would be willing to participate in the telephone interview. Each graduate was assured that his or her name would not be divulged to their supervisor or manager; and that the employer interview was designed to elicit their opinions about ERC trained employees in general, not about specific ERC trained employees. Once these points were covered by the interviewer, over 95% of ERC graduates agreed to complete a survey and to provide the name of the individual within their company or university to whom they reported. This was usually their supervisor, manager, or department chairperson. Once contacted by phone each graduate was asked if they would be willing to provide the name of the individual(s) in their employing company, or in the case of graduates who were employed in academia their employing university, who would be most knowledgeable about their abilities, strengths and weaknesses. The names the graduates supplied turned out to be either managers, supervisors, or department heads. Each located graduate was informed that we would contact, if they gave their permission, the individual(s) whose name(s) they gave us for the purpose of asking them to participate in a telephone interview. The graduates were assured that under no circumstances would we use their name.

Location, Participation, and Response Rates for Graduates.

No attempts were made to locate graduates that centers reported as being employed in locations foreign to the United States.

Location rates. Location rates (the percentage of graduate names submitted by the centers that were located and subsequently contacted by project staff) were as follows:

85% for center #1
74% for center #2
60% for center #3
66% for center #4
81% for center #5 [Center #5's response rate is based on the number of graduates employed in industrial settings that were located and contacted, divided by the number of names of graduates employed in industrial settings that were randomly selected from the list the center submitted.]

Participation rates for located graduates who then participated were as follows:

99% for center #1
100% for center #2
100% for center #3
99% for center #4
90% for center #5

Response rates for graduates who were located and contacted were as follows:

88% for center #1
84% for center #2
88% for center #3
71% for center #4
79% for center #5

A total of 283 ERC graduate follow-up survey forms were mailed. Of these, 230 survey forms were returned resulting in a response rate of 81%. Only 217 (94%) of these were usable because 13 (6%) were not complete [7 had no center identifiers and 6 were not completed because the graduates did not feel they had enough contact with the ERC]. The totals for the BS Graduate Follow-Up Survey, the MS/Ph.D. Industrially Employed Graduate Follow-Up Survey, and the MS/Ph.D. Academically Employed Graduate Follow-Up Survey, were 39, 111, and 67, respectively.

ERC Graduate Employer/Supervisors

Project staff identified and contacted employers of ERC graduates. Several methods were piloted. These are summarized in this section.

Identifying Employers of ERC Graduates. A combination of approaches for locating ERC graduate employers were tested. These included letters and phone calls, as well as phone contacts alone. The communications were with the personnel departments of employers whose names were supplied by the centers to project staff. None of these approaches were effective for getting names of supervisors or managers of ERC-trained employees. The individuals contacted were either unwilling or unable to provide the information. As a result, all attempts to identify and contact ERC graduate employers directly were abandoned because they were unproductive. The only feasible method of identifying employed ERC graduates' supervisors, managers, and department chairpersons was to ask the ERC-trained employees for the names. Over 95% of the contacted graduates provided the names of their immediate supervisor.

Contacting Employers of ERC Graduates. With the graduate's permission, then, each supervisor/manager name was given to one of five interviewers to be contacted by phone and asked whether they would be willing to participate in the telephone interview. Each employer was informed that their name had been supplied to us by one or more of their current employees.

Participation Rates. A total of 165 employers were contacted by project staff. Of these 163 (99%) agreed to be interviewed. Because ERC graduate names were not released to the interviewees and because some employers did not know who their ERC graduate(s) were, 62 interviews (38%) of the otherwise eligible employers of ERC graduates had to be terminated before they were completed. Employer/supervisors could not make comparative judgments unless they knew or were able to figure out which of their employee(s) were ERC graduates. Some employer/supervisors could only ascertain which of their employee(s) were ERC graduates after project staff information about ERCs in general and/or about the specific ERCs involved in this pilot project. Many could not figure it out even with this information. Therefore, only 101 (62%) of the 163 interviews were fully completed. Of the 101 completed interviews, 85 were of employers from industry and 16 were of employers from academia. The number of completed employer interviews from the five participating ERCs ranged from 14 to 40. The completion rates were roughly proportional to the numbers of graduates in the centers.

PRELIMINARY RESULTS

Description of the Attachments. All results from this project's data collection efforts must be considered preliminary. Attached to the main body of this report are a series of attachments which contain both aggregated and center-specific results from the employer interviews and the surveys of current ERC students and graduates. The Attachments are as follows:

Attachment	A	Employer Telephone Interview Script
Attachments	B - D	Aggregated Results of ERC Employer Interviews
Attachments	E - J	Aggregated Results of ERC Graduate and Student Follow-up Surveys
Attachments	K - M	Masked Results by ERC of the ERC Graduate Surveys

[NOTE: Attachments K-M are available only to participating ERCs and NSF/Engineering Centers Division Staff. The KEY to the ERC Identity Codes is not available. Center Directors have been informed as to which number represents their center's data. They are not informed as to which numbers have been assigned to data from other centers.]

The preliminary results in the attachments provide an informative glimpse at ERC graduate employers' and ERC graduates' views about ERC impacts on student development. Results from this 1991-92 development/pilot study clearly reflect initial progress towards the ultimate educational goals and outcomes of the ERCs. They should be useful as baselines against which future assessments may be compared.

Conclusions about Data Sources and Methods. Results lead to several conclusions about data sources and data collection methods. First, regarding data sources, graduates of ERCs are very willing to complete a mail survey about their ERC experiences and to provide names of their immediate supervisors so that they can be approached about a telephone interview. Employers also respond willingly to questions that ask them to compare their ERC-trained employees with otherwise comparable employees who did not have ERC training. Second, regarding methods, Information available at the ERCs about where graduates are and what they are doing is inadequate. Even if the locating information is improved, the process of locating ERC graduates and getting information about them from their employers is simply too labor intensive to expect the centers to conduct quality follow-up studies. It is very likely that if responsibility for such studies is assigned to the centers, there will be too many inconsistencies and holes in the data sets to make them comparable. A tested low cost remedy is described in the following section.

Conclusions about the ERC Program's Educational Impacts. What do the preliminary results of this pilot suggest about the ERC Program and the ERCs' impacts on students? First, the pilot data from ERC students, graduates, and their employers indicate that each category of individuals have quite favorable views of ERCs and of their associations with them. Attachments B and E demonstrate this most graphically. Generally, both students and graduates report that they need more direct experiences with industry than they're now getting. Responses of graduates and employers indicate that neither group is very well informed about the ERC Program or about the specific ERC with which they are/were associated. Students, especially those about to graduate, need to be better informed about: why ERCs were established; what ERCs are; the ways in which an ERC's educational program differs from other graduate programs in the same academic area; how ERC-trained graduates can be expected to differ from non-ERC trained graduates, and; how to market themselves when they interview for jobs. Employers also say they would like more information about, as well as involvement in ERCs.

METHODOLOGICAL AND STUDY RECOMMENDATIONS

Recommendations. Steps should be taken to ensure that evaluative data on ERCs and their graduates be regularly and systematically gathered from employers of ERC graduates. The primary reason is that employers of ERC graduates are viewed by ERCs various constituencies as being the most credible data source for assessing the impacts of ERCs on industry. This was evident at both the ERC Conference in Boulder, Colorado in October of 1991, and at the NSF Centers Evaluation Work Group Meeting in February of 1992. To that end the following recommendations are offered:

1a. Require each ERC to approach each student who is about to graduate with a BS, MS, or Ph.D. for the purpose of asking them to voluntarily complete a Graduate Locator Information Form by May 1st of each academic year.

[Neither industrial nor academic employers of ERC graduates are set up to or willing to identify for 'outsiders' which of their employees are ERC-trained. Individual center's personnel should not be relied on for setting up or maintaining any more detailed data bases than currently have.]

1b. All about to graduate students should be encouraged to complete a Graduate Locator Information Form. [If Federal Law allows it, completing the forms could be required.] Students who elect not to complete a form must be assured that there will not be any negative consequences for not to do so.

GRADUATE LOCATOR INFORMATION FORM

CONTACTS FOR POSSIBLE USE IN LOCATING GRADUATES WHO ARE AFFILIATED WITH NATIONAL SCIENCE FOUNDATION ENGINEERING RESEARCH CENTERS

It is likely that the National Science Foundation will want to contact you and other graduates of this Engineering Research Center sometime during the next five years to obtain retrospective opinions about the Center and its graduate training program.

We would appreciate it if you would list the names and phone numbers of people who are likely to know where you will be during the next five years whom we could contact, if necessary, in order to locate you for these follow-up studies.

These people would only be contacted if the NSF Survey Team cannot reach you using other available information.

YOUR NAME: _____
YOUR CURRENT PHONE NUMBERS: Home (___) _____; Office; (___) _____
EXPECTED DEGREE: _____
EXPECTED MONTH & YEAR OF COMPLETION: _____/_____
Month Year

PLEASE LIST BELOW

Individuals who are likely to know where you will be and how to locate YOU during the next five years:

NAME: _____ **PHONE:** (___) _____

NAME: _____ **PHONE:** (___) _____

NAME: _____ **PHONE:** (___) _____

Your Signature: _____

[Please return your completed form to the person from whom you received it]

[The Graduate Locator Information Form on page 13 should be distributed to students, possibly by mail, as early as possible during each student's last semester or quarter. It requests a signature from each student so that the form could be sent to any individual listed by the student who might want written confirmation that the then student had provided the name so that project staff could locate them for follow-up purposes.]

[A cover letter signed by the Center Director would increase the likelihood that the students would voluntarily return the form. The person to whom it is to be returned should check off the individual forms as they are received. A second form should be distributed to students who do not return the first form within a reasonably short period of time.]

2. Do not require ERCs to collect program/ evaluation data from current students.

[First, this approach did not work well in this pilot. Second, ERCs personnel should stay concentrated on education-related tasks. Finally, follow-up data from current students would be redundant with currently collected course evaluation data and with the follow-up data that will be collected from ERC graduates.]

3. The forms developed in this pilot appear to have been adequate for graduates during their first four or five years following graduation. We recommend, however, that consensus conferences similar to the one held for this pilot be convened every three or four years.

[During this pilot we were looking for outcomes that would be attributable to ERCs relatively early. As the centers and graduates mature other less frequently tracked graduate characteristics and accomplishments need to be considered. These could include such things as certifications and licenses obtained, appointed and elected positions held in professional societies, political appointments and/or offices, etc. In essence, professional accomplishments valued by industry and/or academia need to be more systematically tracked in the future. The purpose of future consensus conferences, then, would be to re-examine and modify, as necessary, the survey forms and telephone interview script so as to make them more sensitive to maturing graduates' characteristics.]

4. ERC graduates' (BS, MS, and Ph.D.) employer/supervisor names should be sought, by telephone, directly from the graduates.

[Other methods of obtaining names of immediate supervisors were not effective. In addition, other methods would not assure that individual graduate's permission for contacting their immediate supervisor would have been obtained.]

5. ERC graduates (BS, MS, and Ph.D.) should be recruited for the mail follow-up survey at the same time that they are approached for obtaining the name of their immediate supervisors. Recruitment should be by third party staff.

[Since ERC graduates must be located and contacted in order to identify their immediate supervisors, and since this major effort would already have been

completed, not to recruit them for follow-up purposes would result in the loss of a valuable data source.]

6. Graduates should have been employed for a minimum of one year before they are included in a follow-up effort and before their employer/supervisor is approached for a telephone interview.

   [Prior to a full year of employment, neither the graduate or the employer has the experience necessary for providing meaningful perspectives on questions of interest.]

7. Graduates who decline to provide project staff with the name of their immediate supervisor should be excluded from the employer interview portion of any future studies. Such graduates may be included mail follow-ups, if they provide verbal consent.

8. Follow-up surveys of ERC graduates should be conducted on a cohort, center-by center basis, by a third party which is unaffiliated with an ERC or the ECD Program. These studies should not be conducted more often than at two year intervals. New members (graduates) should be added to the cohort at each iteration.

   [ERC Directors and NSF program managers agreed at the October 1991 ERC Meeting in Boulder, Colorado that it would be much more difficult to assure respondents that their responses would remain confidential if the forms were sought by and/or sent to individuals at the ERCs. In addition, as graduates mature in their careers it would be extremely informative to track their accomplishments attained, position held, awards received, patients secured, etc.]

9. Conduct telephone interview studies of employers of each ERC's BS, MS, and Ph.D. graduates once every two years. Employer selection should be tied to the graduate cohorts, thus allowing tracking of graduates' career development. Include individual ERCs beginning in the Spring of their fourth year of existence.

   Option 1: Study half of the eligible ERCs each year.
   Option 2: Study all eligible ERCs every other year.

10. Interviews of employers of ERC graduates should be conducted by a single third party that is not affiliated with either an ERC or the ECD Program.

    [ERC Directors and NSF program managers who attended the October 1991 ERC Meeting in Boulder, Colorado where preliminary interview results were presented, agreed that respondents would not feel free to provide frank responses to interviewers that had center or program affiliations.]

This pilot effort may become the first round of a series of recurring longitudinal efforts. Future replications could include additional ERCs as they mature and additional employers, students, and graduates as their numbers increase.

Confidentiality.

All data resulting from this pilot will remain confidential. No ERC, ERC graduate or their employer will be identified or identifiable in any communication or report. Likewise, all contacts with ERC teaching and administrative faculty, and with ERC graduates or with their employers also will remain confidential.

Respondents to the mail survey were informed that they were free to decline to answer any question(s) with which they were uncomfortable. This freedom to decline to respond to particular questions applied also to telephone interviewees.

Access to study data that has center-specific or individual-specific identifiers will be restricted to study personnel.

Report Distribution.

Initial distribution of this final report is to the NSF/ECD and to participants in the Project's 1991 Consensus Conference.

ATTACHMENT A / ERC Employer Telephone Interview Script

Interviewer Initials: _____ Respondent Code: _____
Date of Interview: _____ Company Code: _____
Date of Rescheduled Interview (If applicable): _____

Primary Interview of ERC Graduate Supervisor or Manager

1A. **Say something like:** *Hello, my name is* **[use first & last name].** *I'm calling in regard to a National Science Foundation Study that we're conducting that is designed to assess its Engineering Research Center Program.* **[pause?]** *The NSF wants to find out what employers think about the ERC Program and its graduates. We were informed that you may be the manager or supervisor of a unit that employes ERC Graduates. Is that the case?*

If Yes, go to 1B.
If 'Uncertain' or 'I don't think so' go to 4.
If No, go to 8.

1B. **Say:** *OK. We'd like you to participate in a brief interview. Your identity and the identity of your company would be kept completely confidential.*

Will you help us by participating in the interview? **Yes ___; No ___**

[If Yes, continue. If No, go to 8]

Is this a good time for you? **Yes ___; No ___**

[If they want a letter, go to 3]

[If Yes, say: *Good* **or** *Great!..***[go to 5]**
[If No, it's not a good time, Say: *Fine, When can we schedule an interview that would be more convenient for you?* **Date _____ ; Time _____**

Then say: *Good. I'll call you then. Thanks for your time. Good Bye.* **[go to 2]**

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2. **[NOTE: Begin @ #5 after reintroducing the interview]**

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3. **Say:** *Fine, I'll send you a letter and call you in a week or so. Thank you very much. Good Bye.*

---

4. **Say:** *OK. Since you may not [don't?] supervise or manage ERC trained graduates, I wonder if you know who in your company does?*

If Yes, go to 8.

If No, go to 10.

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5. **Say:** *First of all, there're a few preliminaries. As I mentioned, the NSF supports a number of Engineering Research Centers located throughout the country. They're funded by the NSF and Industry to achieve a number of specific goals.*

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6. **Say:** *Are you familiar with ERCs?*

Yes ___ [go to 7a]; No ___; Not Exactly ___

7a. **Say:** *Well, the NSF supports ERCs at 18 universities. We're primarily interested in graduates from the following six [only give the research area if you're asked]:*

MIT (Biotechnology Process Engineering)
Lehigh University (Large Structural Systems)
Purdue University (Intelligent Manufacturing Systems)
Carnegie-Mellon University (Engineering Design)
University of Maryland (Systems Research)
*& **Columbia Univ.***(Telecommunications) + 12 others **[go to 7b, unless...]**

[Only If they ask: 'Why these', or 'How many are there', or 'What other Universities have ERC's' say:

[There are 18 ERC's. We're interested in these six because they've been in existence long enough to have had a significant number of graduates.]

[Only If they want more information say: *Others formed prior to 1988 include [only give the research area if you're asked]:*

University of Illinois (Microelectronics)
University of Ohio (Net Shape Manufacturing)
University of Colorado/Colorado State (Optoelectronic Computing)
Brigham Young University (Advanced Combustion)
Duke Univ./Univ. of North Carolina (Cardiovascular Technologies)
*& **UCLA*** (Hazardous Substances)

7b. **Say:** *The National Science Foundation wants to know what employers think about ERC graduates in general, and about the overall center Program. Now, do you [still?] think that you supervise or manage any employees who graduated from one of these centers?*

Yes ___ [If Yes, go to 7c]; No ___ [If No, go to 8].

7c. *Do you supervise or manage them?* **Supervise ___; Manage ___; Both ___**

7d. *What's the approximate total # of employees that you supervise or manage?* ___

7e. *About what % of those would you say are ERC grads?* ___

7f. *Do most of your ERC graduates have Ph.D., masters or bachelor's degrees?*

Bachelor's Degrees ___: Master's Degrees ___
Ph.D. Degrees ___: An Even Mixture ___

7g. *Do you know whether, in general, your company has had to offer higher beginning salaries for ERC graduates than for non-ERC graduates?*

Yes ___ ; No ___; Don't Know

7h. *Are beginning ERC grads salaries generally higher, about the same, or lower than non-ERC grads?*

Higher ___; About The Same ___; Lower ___

[Go to 11]

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8. **Say:** *Who else in your company might have had enough experience with ERC graduates to participate in an interview such as this one?* **[If there's no one, go to 10]**

Name _____: Title _____: phone _____

If they give one name, say something like: *Are there others?*

Name _____: Title _____: phone _____

Name _____: Title _____: phone _____

[If the interviewee either supervises or manages ERC grads, go to 11]

[If the interviewee declined to do the interview OR neither supervises or manages ERC grads, go to 9]

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9. **Say:** *That's all I need to know. Thank you very much for your time.*

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10. **Say:** *In that case, I don't have any more questions. Thanks for your time.*

---

11. **Say:** *OK, now I've got a few questions that'll require you to make comparative judgments, if you can, between ERC trained employees and other employees from comparable schools but did not have a cross disciplinary research center experience. OK?*

11a. *Are you familiar with the reasons why ERCs were established?*

Yes ___ [go to 12]; No ___; Uncertain ___ [If No or Uncertain, say:

That's OK, I'll review some of the reasons for you in a few minutes. **[continue]**

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12. *Do you think that you have different expectations of ERC graduates than you do for non ERC graduates?*

Yes ___; No ___ [go to 13]

If Yes, say: *Can you elaborate?* _____

_____

_____

_____

_____

_____

---

13. **Say:** *Can you identify any **noteworthy strengths** that ERC trained employees tend to exhibit that you believe are attributable to their ERC training?* **If they hesitate, say:** *We're looking for any strengths that they may have that others do not usually exhibit.*

[check one] Yes ___ If Yes, say: *What are they?* **; No ___ [go to 14]**

_____ _____

_____ _____

_____ _____

---

14. **Say:** *Can you identify any **noteworthy weaknesses** that they tend to exhibit that you believe are attributable to their ERC training?* **If they hesitate, say:** *We're looking for any weaknesses that they may have that others do not usually exhibit.*

[check one] Yes ___ If Yes, say: *What are they?* **; No ___ [go to 15]**

_____ _____

_____ _____

_____ _____

---

15. **Say:** *Do they tend to demonstrate any more sense or vision of how their skills can contribute to company success than do non-ERC trained employees?* **[Check one]**

ERCers show More sense or vision ___ **Some More, Some Less ___**
ERCers show Less sense or vision ___ **No Difference ___**
Don't Know ___

---

16. **Say:** *For the next question, we're defining a systems orientation as beginning with an idea and carrying it through development and production to its final conclusion. With that in mind, how would you compare ERC trained and non-ERC trained employees with respect to showing a systems orientation?* **[Check one]**

Show More of a Systems Orientation ___ **Some More, Some Less ___**
Show Less of a Systems Orientation ___ **No Difference ___**
Don't Know ___

---

17. **Say:** *Do you think they show any more of a tendency to serve as change agents within your company than non-ERC trained employees?*

Yes ___; No ___; Uncertain ___

---

18. **Say:** *Do you think they exhibit any more of a tendency to use cross disciplinary approaches to problem solving than non-ERC trained employees?*

Yes ___; No ___; Uncertain ___

---

19. **Say:** *Do they generally require less initial training than non-ERC trained employees?*

Yes ___; No ___; Uncertain ___

20a. **Say:** *Do you believe that, in general, your ERC trained employees are any better than your non-ERC trained employees with respect to:*

20b. *Getting 'up to speed' so that they become useful to the company in less time?*

Yes ___; No ___; Uncertain ___

20c. *Scoping out problems?*

Yes ___; No ___; Uncertain ___

20d. *Evaluating potential solutions for practicality?*

Yes ___; No ___; Uncertain ___

20e. *Communicating with others ?*

Yes ___; No ___; Uncertain ___

20f. *Moving research concepts into usable processes, devices or outcomes?*

Yes ___; No ___; Uncertain ___

20g. *Breadth of technical understanding?*

Yes ___; No ___; Uncertain ___

20h. *Depth of technical understanding?*

Yes ___; No ___; Uncertain ___

20i. *Leadership - for example, making people they work with more effective?*

Yes ___; No ___; Uncertain ___

20j. *Overall understanding of your industry and how it works?*

Yes ___; No ___; Uncertain ___

---

21. *Based on your experiences with ERC-trained employees to date, are you any more or less likely to attempt to recruit them in the future?*

More Likely to Recruit ___: No More or Less Likely ___
Less Likely to Recruit ___: Uncertain ___

---

22. **Say:** *Prior to this interview, were you aware that ERCs were established by the National Science Foundation with the main goals being to increase the emphasis on cross disciplinary research with a teamwork and systems orientation and to increase involvement of U.S. industry in education?*

Yes ___ No ___; Uncertain ___

---

23. **Say:** *Based on your experiences with ERC trained employees, do you think the NSF is making reasonable progress towards these goals?*

Yes ___ No ___; Uncertain ___

---

24. **Say:** *Do you have any recommendations as to how the NSF could improve the ERC Program?*

A. _____

B. _____

C. _____

---

25. **Say something like:** *Thank You! That ends the interview....But before we hang up I have one more question.*

Say: *Do you know of anyone else in your company who might have had enough experience with ERC graduates to participate in an interview such as this one?*

[If there's no one, go to 26]

Name _____: Title _____: phone _____

If they give one name, say something like: *Are there others?*

Name _____: Title _____: phone _____
Name _____: Title _____: phone _____

---

26. **Say:** OK, *that completes the interview. Thank you VERY much for your time!*

USE THE SPACE BELOW TO MAKE ANY NOTES ONLY IF THERE WAS ANYTHING VERY UNUSUAL OR NOTEWORTHY ABOUT THIS INTERVIEW:

ATTACHMENT B / Results of 1991-92 Pilot Interviews of Employers ERC Graduates:
Figures 1 thru 18 Based on Aggregated Industrial and Academic Employers

Fig. 1: Do you have different expectations of ERC grads?
(Combined N = 101)

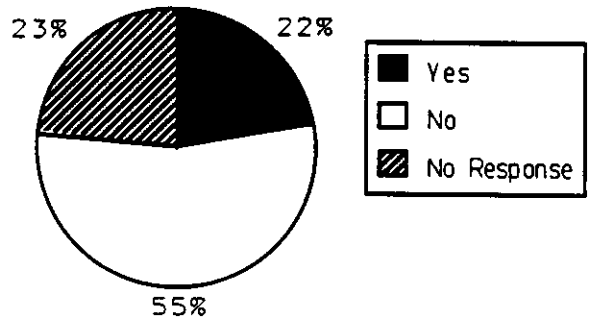


Fig. 2: Can you identify noteworthy weakness of ERC grads?
(Combined N = 101)

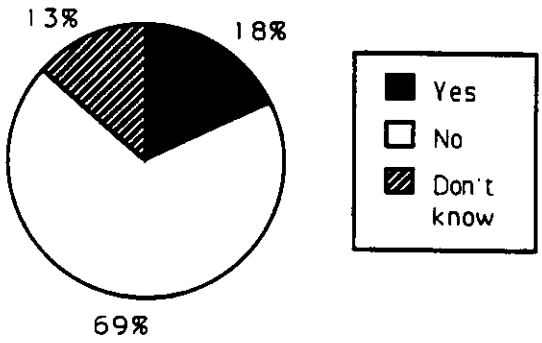


Fig. 3: Can you identify any noteworthy strengths of ERC grads?
(Combined N = 101)

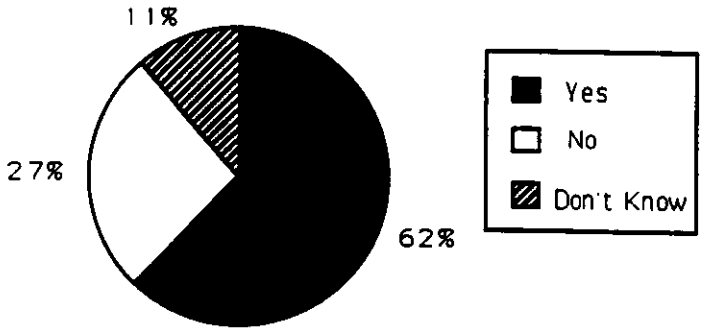


Fig. 4: Do ERC grads show more of a systems orientation?
(Combined N = 101)

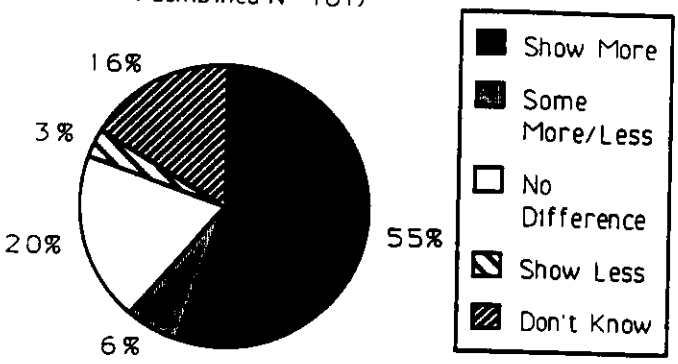


Fig. 5: Do ERC grads show more of a tendency to serve as change agents?
(Combined N = 101)

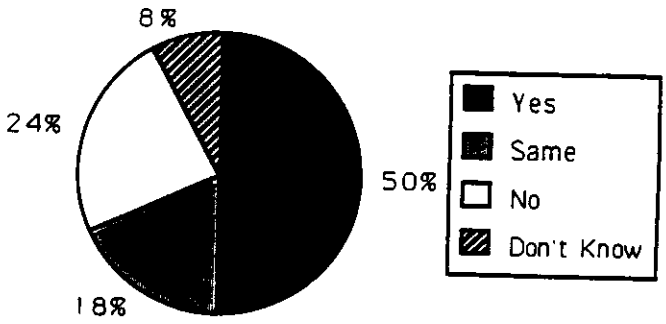


Fig. 6: Do ERC grads show more of a tendency to use cross-disciplinary approachs?
(Combined N = 101)

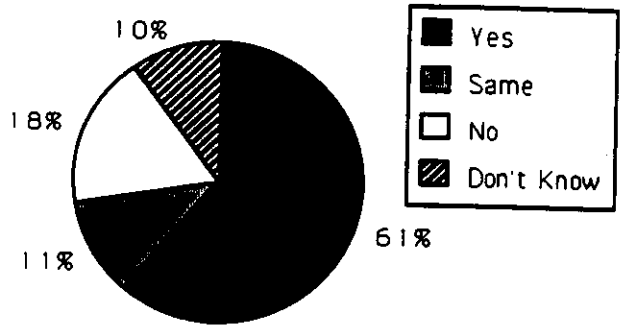


Fig. 7: Do ERC grads generally require less initial training?
(Combined N = 101)

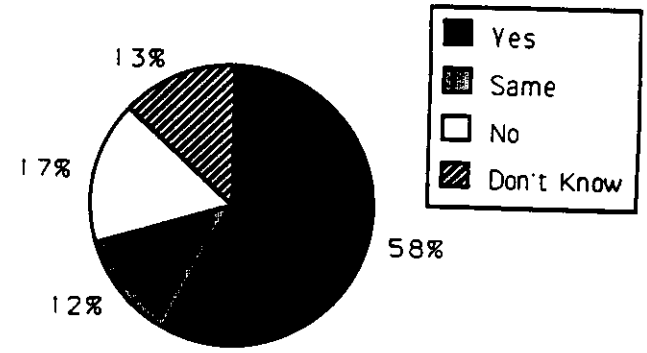


Fig. 8: Are ERC grads quicker at "getting up to speed"?
(Combined N = 101)

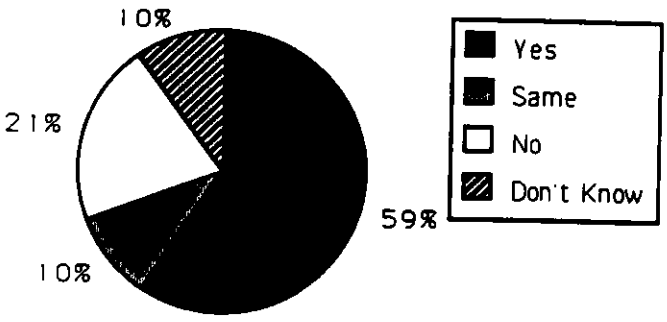


Fig. 9: Are ERC grads any better at scoping out problems?
(Combined N = 101)

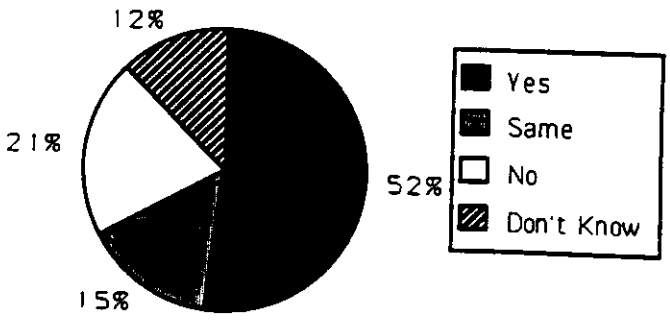


Fig. 10: Are ERC grads better at evaluating potential solution?
(Combined N = 101)

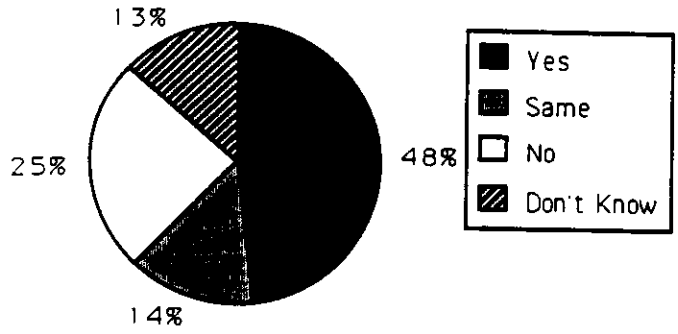


Fig. 11: Are ERC grads better at communicating with others?
(Combined N = 101)

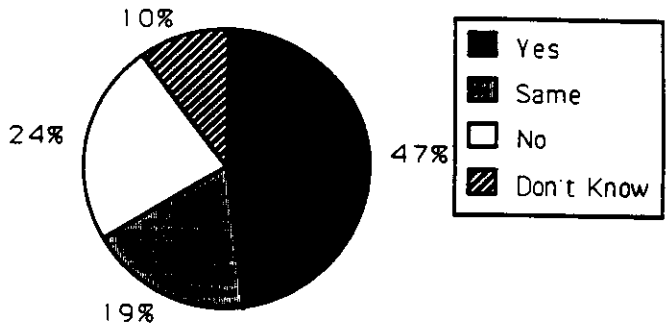


Fig. 12: Are ERC grads better at moving research concepts into usable products?
(Combined N = 101)

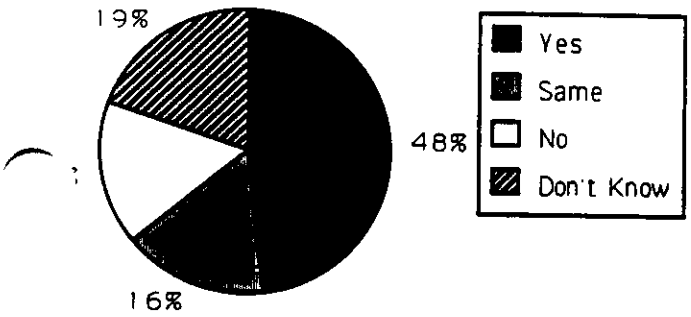


Fig. 13: Dr ERC grads have a greater breadth of technical understanding?
(Combined N = 101)

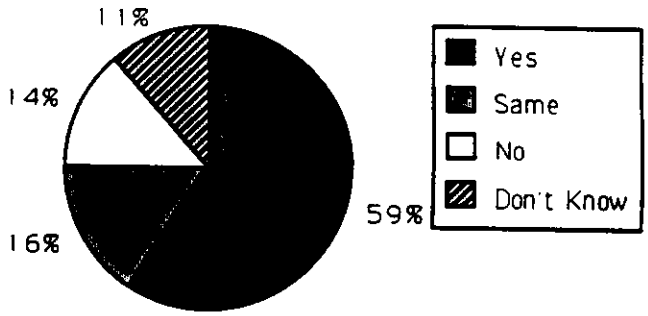


Fig. 14: Do ERC grads have a greater depth of technical understanding?
(Combined N = 101)

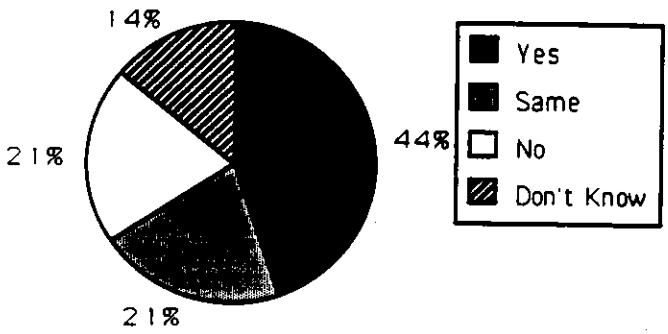


Fig. 15: Do ERC grads show more leadership?
(Combined N = 101)

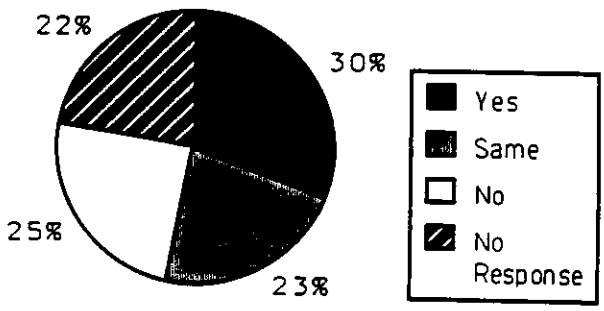


Fig. 16: Do ERC graduates tend to demonstrate any more sense/vision?
(Combined N = 101)

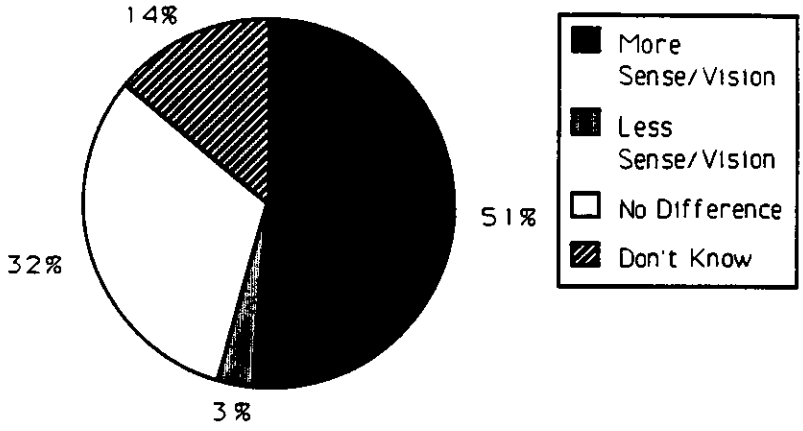


Fig. 17: Do ERC grads have an overall understanding of your industry?
(Combined N = 101)

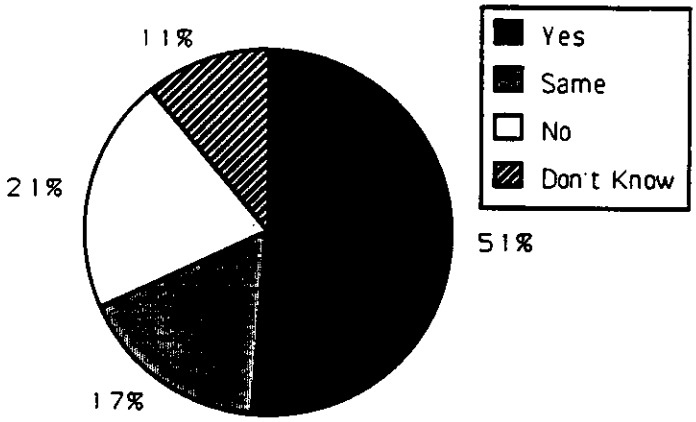
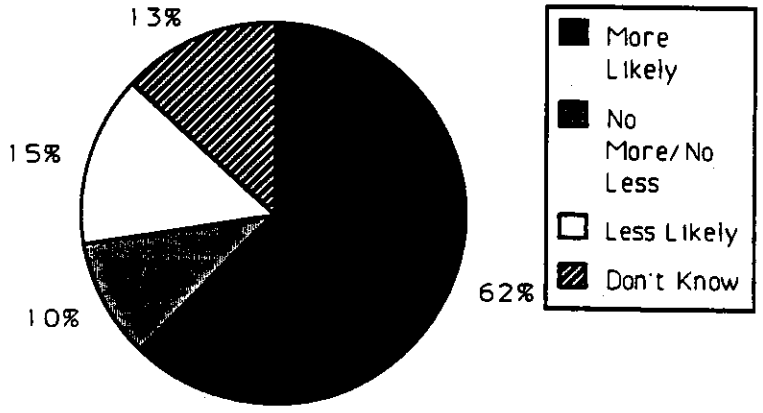


Fig. 18: Are you any more or less likely to recruit ERC grads?
(Combined N = 101)



Figures 19 thru 54 Present Paired Comparisons of Industrial versus Academic Employers' Ratings with Associated Chi Square and p-values

Fig. 19: Do you have different expectations of ERC grads?
(N = 83 industrial employers)

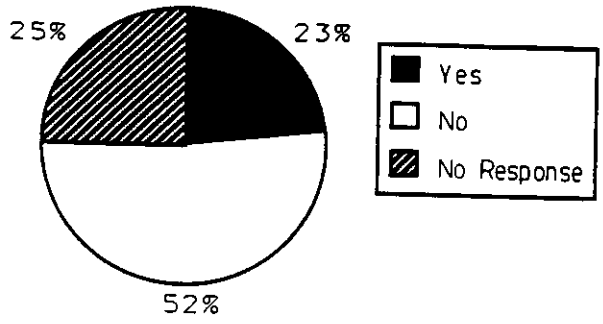
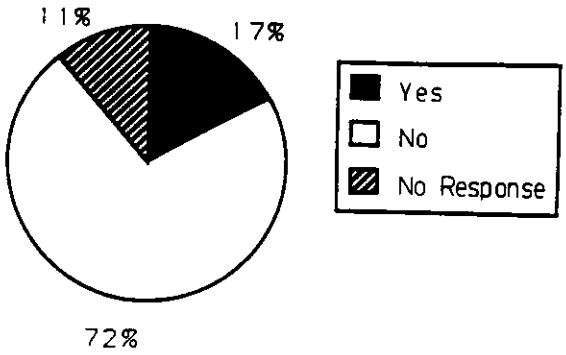


Fig. 20: Do you have different expectations of ERC grads?
(N = 18 academic employers)



X^2 = 2.683 d.f. = 2 p = 0.2615 Valid Cases = 101

Fig. 21: Can you identify noteworthy weakness of ERC grads?
(N = 83 industrial employers)

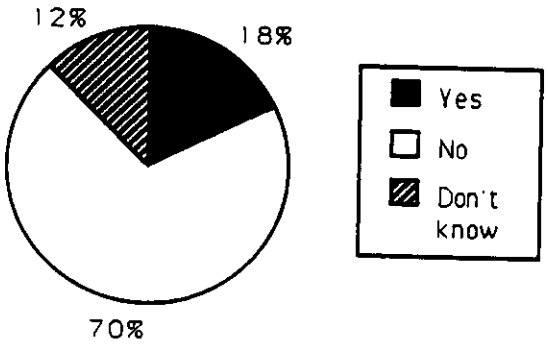
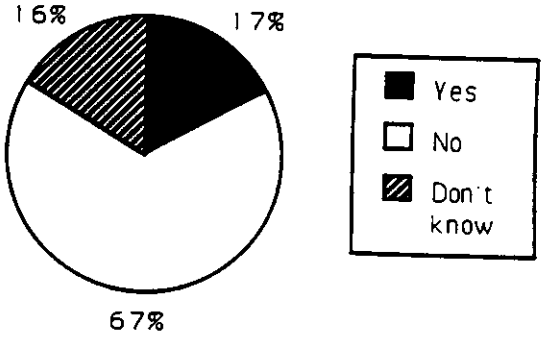


Fig. 22: Can you identify noteworthy weakness of ERC grads?
(N = 18 academic employers)



X^2 = 0.2836 d.f. = 2 p = 0.8678 Valid cases = 101

Fig. 23: Can you identify any noteworthy strengths of ERC grads?
N = 83 industrial employers)

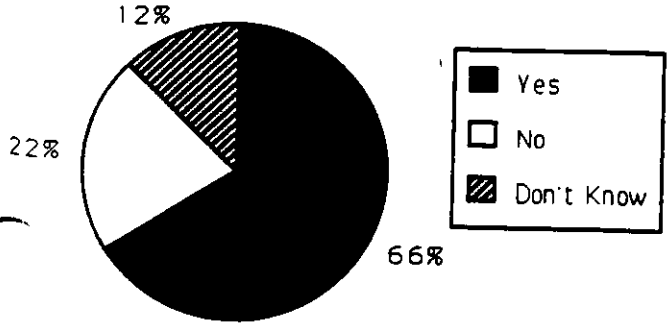
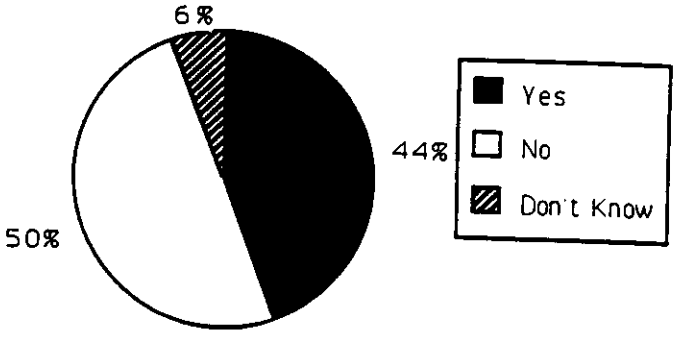
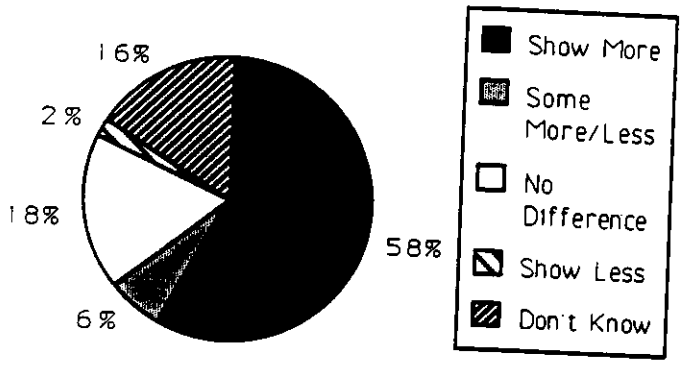


Fig. 24: Can you identify any noteworthy strengths of ERC grads?
(N = 18 academic employers)



X^2 = .6.1374 d.f. = 2 p = 0.0465 Valid cases = 101

Fig. 25: Do ERC grads show more of a systems orientation?
83 industrial employers)



$X^2 = 4.6767$ d.f.= 5 p = 0.4566 **Valid cases = 101**

Fig. 26: Do ERC grads show more of a systems orientation?
(N = 18 academic employers)

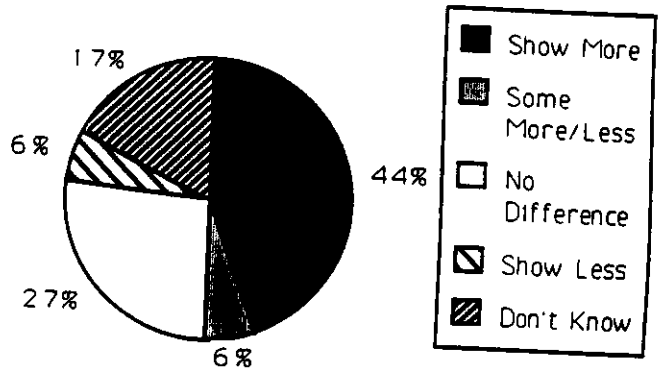


Fig. 27: Do ERC grads show more of a tendency to serve as change agents?
N = 83 industrial employers)

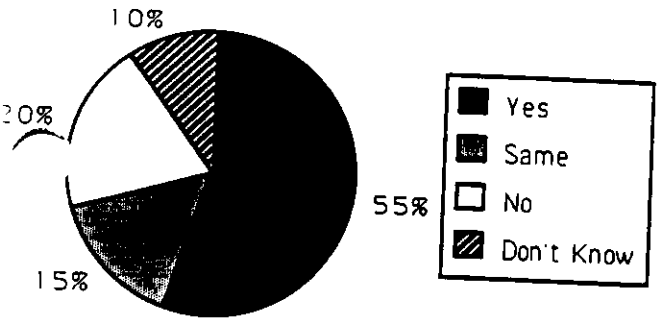
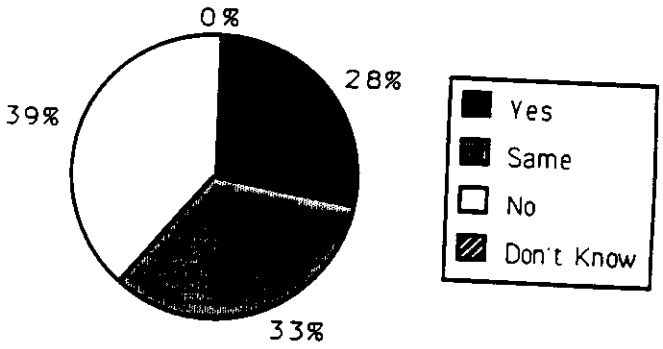


Fig. 28: Do ERC grads show more of a tendency to serve as change agents?
(N = 18 academic employers)



$X^2 = 9.0398$ d.f. = 4 p = 0.0601 **Valid cases = 101**

Fig. 29: Do ERC grads show more of a tendency to use cross-disciplinary approachs?
N = 83 industrial employers)

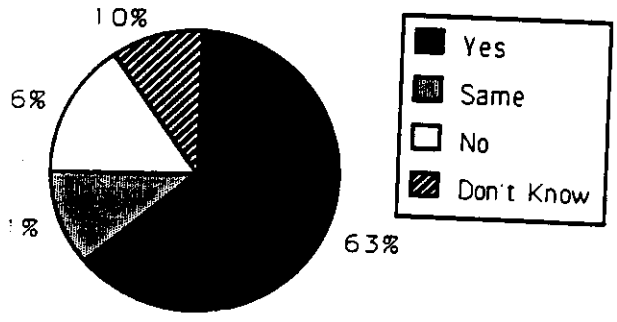
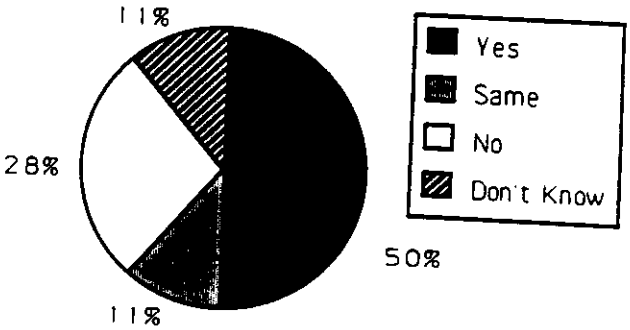


Fig. 30: Do ERC grads show more of a tendency to use cross-disciplinary approachs?
(N = 18 academic employers)



$X^2 = 5.811$ d.f. = 4 p = 0.2137 **Valid cases = 101**

Fig. 31: Do ERC grads generally require less initial training?
(N = 83 industrial employers)

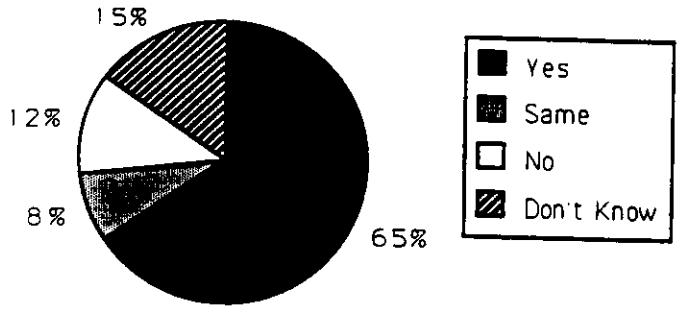
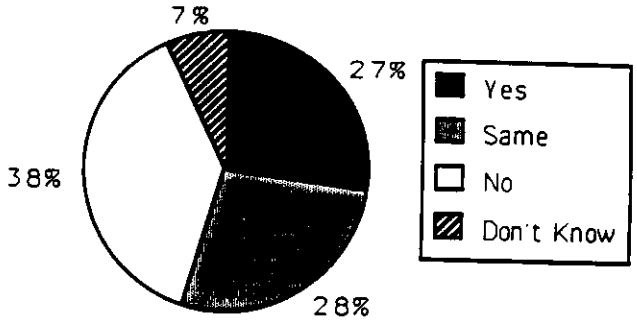


Fig. 32: Do ERC grads generally require less initial training?
(N = 18 academic employers)



X^2 = 16. 0332 d.ff. = 4 p = 0.003 Valid cases = 101

Fig. 33: Are ERC grads quicker at "getting up to speed"?
(N = 83 industrial employers)

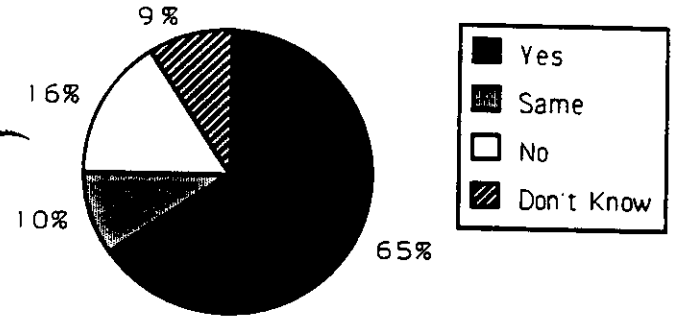
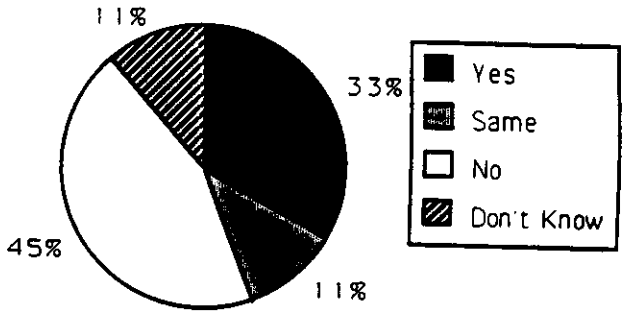


Fig. 34: Are ERC grads quicker at "getting up to speed"?
(N = 18 academic employers)



X^2 = 14.8374 d.f. = 4 p = 0.0051 Valid cases = 101

Fig. 35: Are ERC grads any better at scoping out problems?
(N = 83 industrial employers)

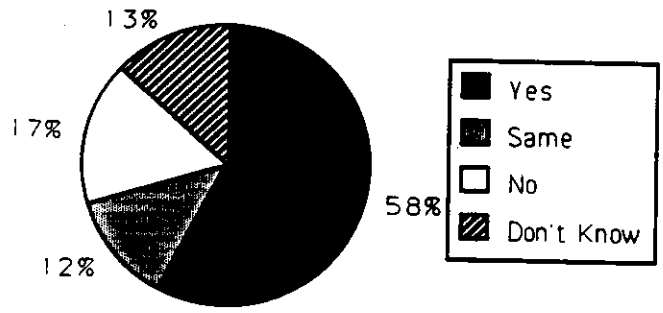
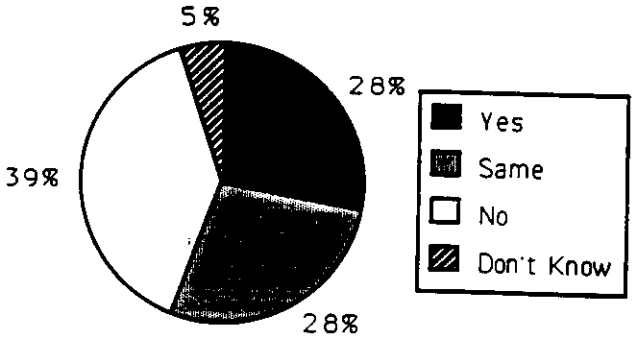


Fig. 36: Are ERC grads any better at scoping out problems?
(N = 18 academic employers)



X2 = 9.9946 d.f. = 4 p = 0.0405 Valid cases = 101

Fig. 37: Are ERC grads better at evaluating potential solutions?
(N = 83 industrial employers)

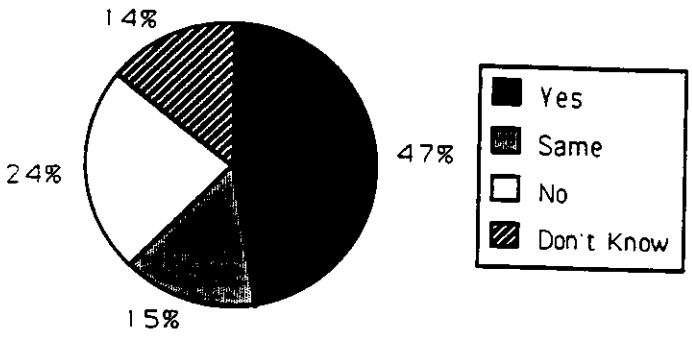
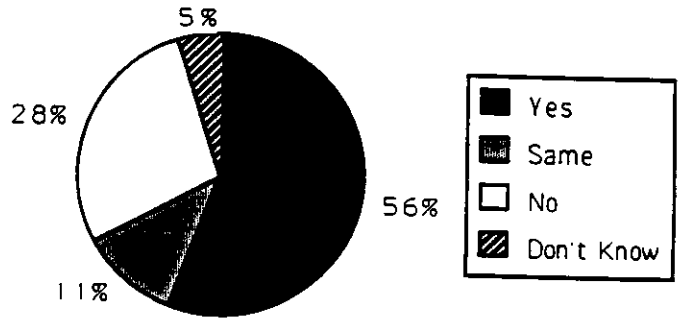


Fig. 38: Are ERC grads better at evaluating potential solutions?
(N = 18 academic employers)



X^2 = 1.9479 d.f. = 4 p = 0.7453 Valid cases = 101

Fig. 39: Are ERC grads better at communicating with others?
(N = 83 industrial employer)

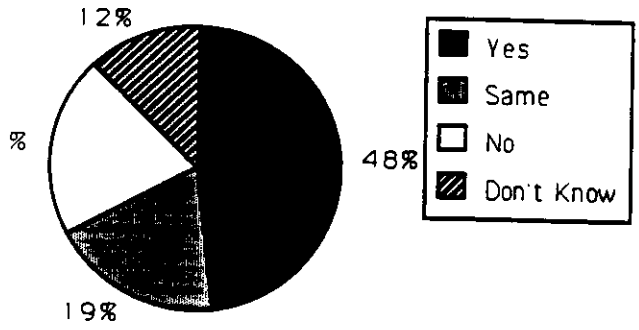
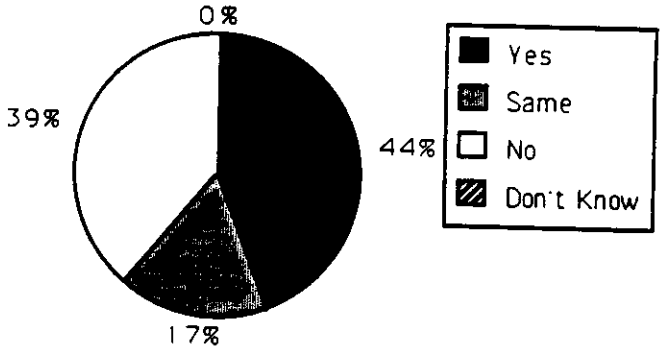


Fig. 40: Are ERC grads better at communicating with others?
(N = 18 academic employers)



X^2 = 4.3751 d.f. = 4 p = 0.3576 Valid cases = 101

Fig. 41: Are ERC grads better at moving research concepts into usable products?
(N = 83 industrial employers)

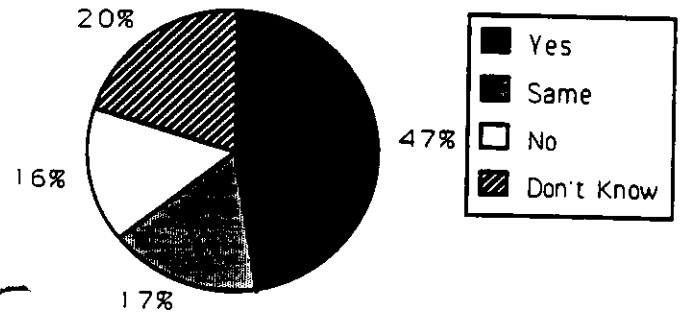
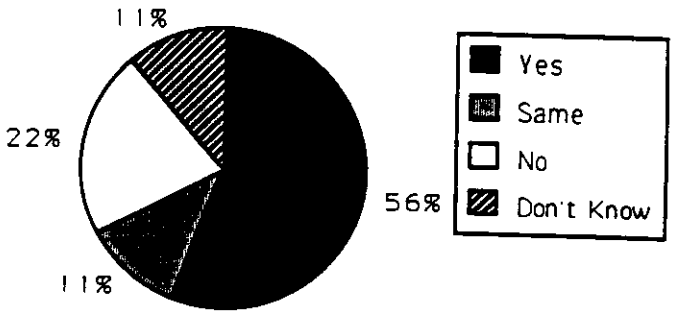


Fig. 42: Are ERC grads better at moving research concepts into usable products?
(N = 18 academic employers)



X^2 = 3.5784 d.f. = 4 p = 0.4661 Valid cases = 101

Fig. 43: Do ERC grads have a greater breadth of technical understanding?
(N = 83 industrial employers)

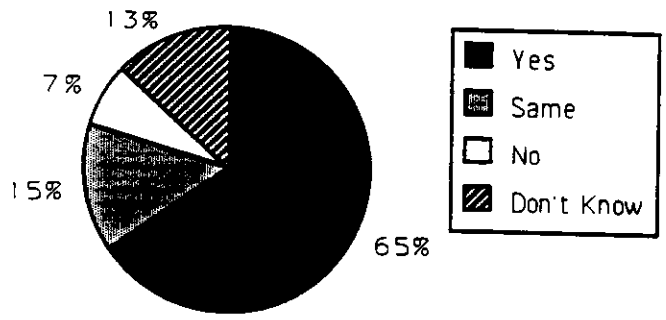
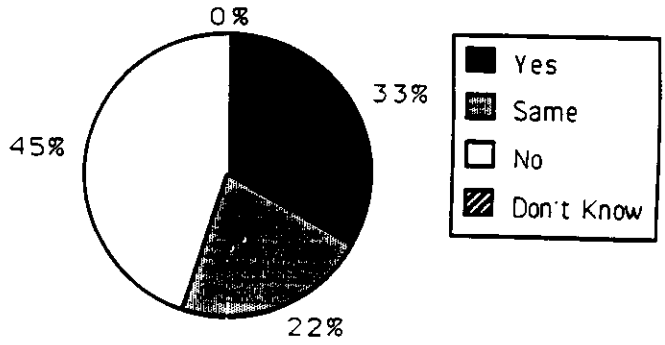


Fig. 44: Dr ERC grads have a greater breadth of technical understanding?
(N = 18 academic employers)



X^2 = 20.2348 d.f. = 4 p = 0.0004 Valid cases = 101

Fig. 45: Do ERC grads have a greater depth of technical understanding?
(N = 83 industrial employers)

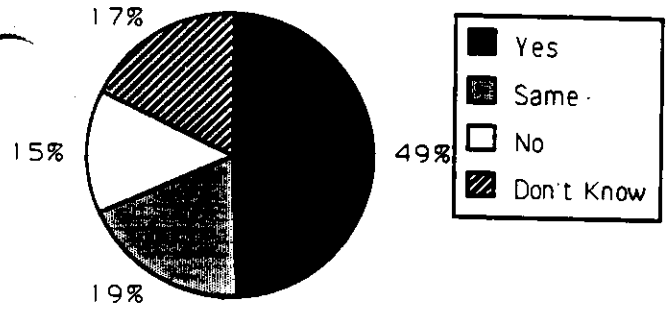
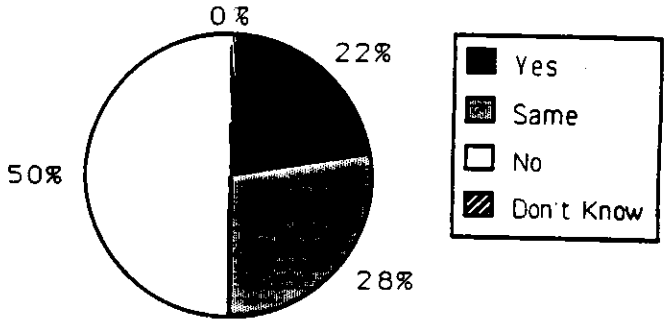


Fig. 46: Do ERC grads have a greater depth of technical understanding?
(N = 18 academic employers)



X^2 = 14.9891 d.f. = 4 p = 0.0047 Valid cases = 101

Fig. 47: Do ERC grads show more leadership?
(N = 83 industrial employers)

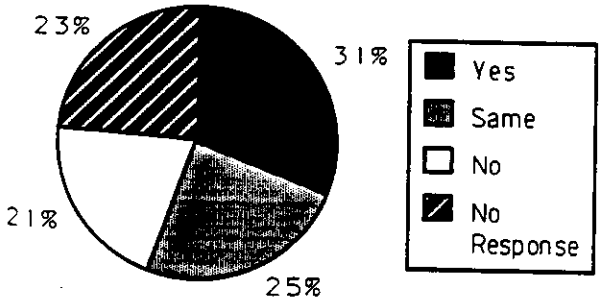
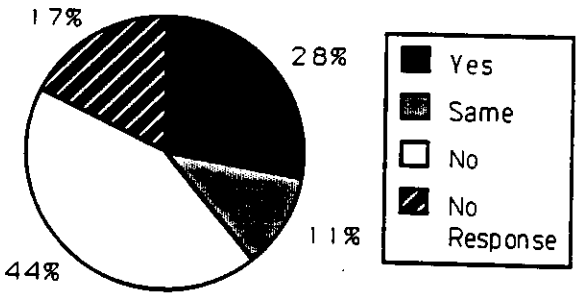


Fig. 48: Do ERC grads show more leadership?
(N = 18 academic employers)



X^2 = 7.3909 d.f. = 4 p = 0.1166 Valid cases = 101

Fig. 49: Do ERC graduates tend to demonstrate any more sense/vision? (N = 83 industrial employers)

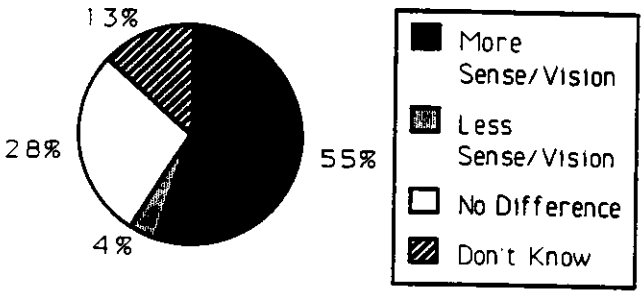
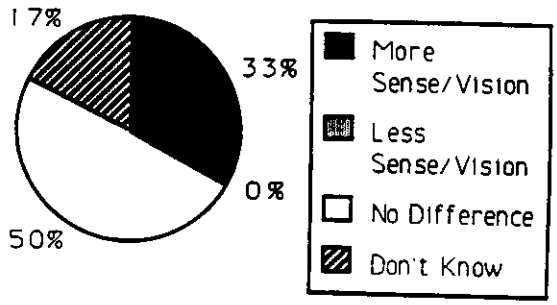


Fig. 50: Do ERC graduates tend to demonstrate any more sense/vision? (N = 18 academic employers)



X^2 = 4.6588 d.f. = 4 p = 0.3241 Valid cases = 101

Fig. 51: Do ERC grads have an overall understanding of your industry? (N = 83 industrial employers)

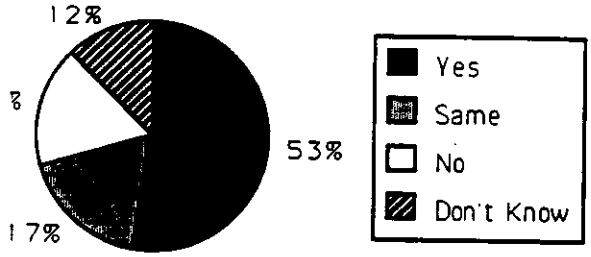
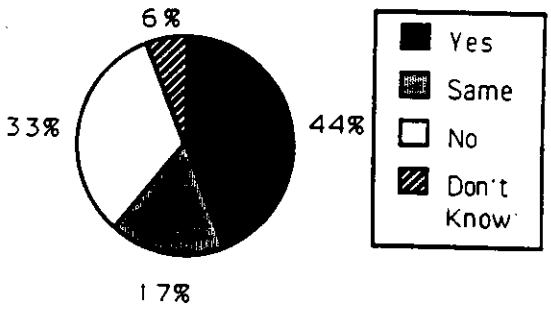


Fig. 52: Do ERC grads have an overall understanding of your industry? (N = 18 academic employers)



X^2 = 2.6735 d.f. = 4 p = 0.6139 Valid cases = 101

Fig. 53: Are you any more or less likely to recruit ERC grads? (N = 83 industrial employers)

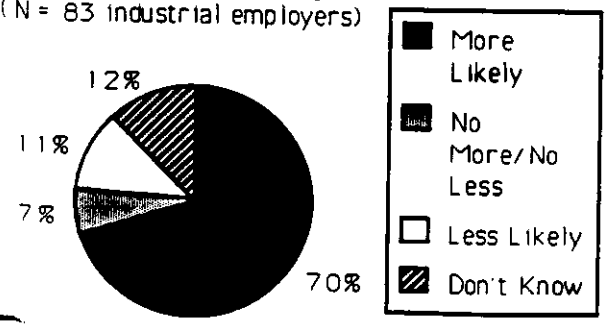
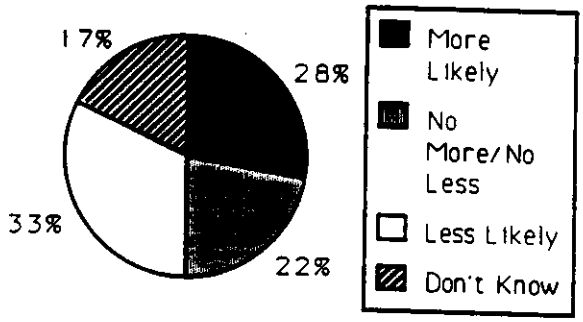


Fig. 54: Are you any more or less likely to recruit ERC grads? (N = 18 academic employers)



X^2 = 15.7045 d.f. = 4 p = 0.0034 Valid cases = 101

ATTACHMENT C / Employer Interview Results (1991-92 Pilot) by Center (Masked):
Employers' Comparisons of ERC Trained Employees
with Otherwise Comparable Employees From Non-ERC Institutions

1. Are you familiar with Engineering Research Centers (ERCs)?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	33.3	64.5	52.5	40.0	42.9	47.5
NOT EXACTLY	0.0	0.0	2.5	40.0	0.0	6.9
NO	61.1	28.6	27.5	20.0	42.9	34.7
UNCERTAIN	5.6	7.1	17.5	0.0	14.3	10.9

MISSING CASES = 0 X^2 = 39.6454 P = 0.0001

2. Do most of your firms ERC graduates have doctoral, masters or bachelors degrees?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
BS	11.1	14.3	0.0	6.7	14.3	6.9
MS	33.3	0.0	15.0	53.3	28.6	23.8
PHD	22.2	21.4	22.5	20.0	0.0	18.8
EVEN MIX.	11.1	64.3	47.5	20.0	14.3	34.7

MISSING CASES = 0 X^2 = 41.94 P = 0.0004

3. Does your firm offer higher beginning salaries for ERC graduates?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	5.6	7.1	10.0	0.0	0.0	5.9
NO	27.8	64.3	70.0	53.3	14.3	51.5
DONT KNOW	27.8	28.6	7.5	40.0	64.3	26.7
NO ANSWER	38.9	0.0	12.5	6.7	21.4	15.8

MISSING CASES = 0 X^2 = 35.2587 P = 0.0004

4. Are beginning ERC graduates salaries generally higher than non-ERC graduates?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
HIGHER	5.6	7.1	10.0	6.7	0.0	6.9
SAME	5.6	7.1	65.0	60.0	0.0	36.6
NO ANSWER	88.9	85.7	25.0	33.3	100.0	56.4

MISSING CASES = 0 X^2 = 44.4015 P = 0.0000

5. Do you know the reasons why ERCs were established?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	16.7	21.4	37.5	33.3	7.1	26.7
NO	33.3	21.4	25.0	66.7	35.7	33.7
NO ANSWER	50.0	57.1	37.5	0.0	57.1	42.7

MISSING CASES = 0 X^2 = 29.7329 P = 0.0031

6. Do you have different expectations of ERC graduates?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	16.7	21.4	22.5	33.3	14.3	21.8
NO	44.4	42.9	65.0	66.7	42.9	55.4
NO ANSWER	38.9	35.7	12.5	0.0	42.9	22.8

MISSING CASES = 0 X^2 = 14.5311 P = 0.0689

7. Can you identify noteworthy strengths of ERC graduates?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	77.8	92.9	52.5	60.0	42.9	62.4
NO	22.2	7.1	30.0	40.0	28.6	26.7
NO ANSWER	0.0	0.0	17.5	0.0	28.6	10.9

MISSING CASES = 0 X^2 = 18.3171 P = 0.0190

8. Can you identify noteworthy weaknesses of ERC graduates?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	33.3	0.0	20.0	26.7	0.0	17.8
NO	66.7	92.9	65.0	66.7	64.3	69.3
NO ANSWER	0.0	7.1	15.0	6.7	35.7	12.9

MISSING CASES = 0 X^2 = 18.4355 P = 0.0182

9. Do ERC graduates tend to demonstrate any more sense/vision?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
MORE	44.4	71.4	47.5	53.3	50.0	51.5
NO DIFFERENCE	44.4	14.3	40.0	33.3	7.1	31.7
LESS	0.0	7.1	0.0	0.0	14.3	3.0
DON'T KNOW	11.1	7.1	7.5	13.3	0.0	7.9
NO RESPONSE	0.0	0.0	5.0	0.0	28.6	5.9

MISSING CASES = 0 X^2 = 33.0639 P = 0.0072

10. Do ERC graduates show more of a systems orientation?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
MORE	61.1	71.4	50.0	60.0	42.9	55.4
MORE/LESS	11.1	0.0	5.0	6.7	7.1	5.9
LESS	0.0	7.1	5.0	0.0	0.0	3.0
NO DIFFERENCE	11.1	14.3	25.0	20.0	21.4	19.8
DON'T KNOW	16.7	7.1	7.5	13.3	0.0	8.9
NO ANSWER	0.0	0.0	7.5	0.0	28.6	6.9

MISSING CASES = 0 X^2 = 23.0725 P = 0.2852

11. Do ERC graduates show more of a tendency to serve as change agents?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	55.6	85.7	32.5	60.0	50.0	50.5
SAME	16.7	7.1	27.5	6.7	14.3	17.8
NO	22.2	7.1	35.0	26.7	7.1	23.8
UNCERTAIN	5.6	0.0	0.0	6.7	0.0	2.0
NO ANSWER	0.0	0.0	5.0	0.0	28.6	5.9

MISSING CASES = 0 X^2 = 35.0671 P = 0.0039

12. Do ERC graduates show more of a tendency to use cross-disciplinary approaches?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	55.6	78.6	57.5	60.0	64.3	61.4
SAME	11.1	7.1	12.5	13.3	7.1	10.9
NO	27.8	14.3	22.5	13.3	0.0	17.8
UNCERTAIN	5.6	0.0	0.0	13.3	0.0	4.0
NO ANSWER	0.0	0.0	5.0	0.0	28.6	5.9

MISSING CASES = 0 X^2 = 35.3787 P = 0.0634

13. Do ERC graduates generally require less initial training?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	66.7	78.6	52.5	46.7	57.1	58.4
SAME	11.1	7.1	17.5	6.7	7.1	11.9
NO	16.7	14.3	17.5	33.3	0.0	16.8
UNCERTAIN	0.0	0.0	7.5	13.3	7.1	5.9
NO ANSWER	5.6	0.0	5.0	0.0	28.6	6.9

MISSING CASES = 0 X^2 = 23.7866 P = 0.0943

14. Are ERC graduates quicker at "getting up to speed"?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	72.2	85.7	50.0	53.3	50.0	59.4
SAME	11.1	0.0	12.5	13.3	7.1	9.9
NO	11.1	14.3	30.0	26.7	7.1	20.8
UNCERTAIN	0.0	0.0	2.5	6.7	7.1	3.0
NO ANSWER	5.6	0.0	5.0	0.0	28.6	6.9

MISSING CASES = 0 X^2 = 23.4539 P = 0.1021

15. Are ERC graduates any better at scoping out problems?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	66.7	71.4	45.0	40.0	50.0	52.5
SAME	11.1	14.3	20.0	13.3	7.1	14.9
NO	16.7	14.3	27.5	26.7	7.1	20.8
UNCERTAIN	0.0	0.0	2.5	20.0	7.1	5.0
NO ANSWER	5.6	0.0	5.0	0.0	28.6	6.9

MISSING CASES = 0 $X^2 = 27.6099$ P = 0.0352

16. Are ERC graduates better at evaluating potential solutions?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	55.6	71.4	45.0	33.3	42.9	48.5
SAME	16.7	14.3	12.5	13.3	14.3	13.9
NO	22.2	14.3	32.5	33.3	7.1	24.8
UNCERTAIN	0.0	0.0	5.0	20.0	7.1	5.9
NO ANSWER	5.6	0.0	5.0	0.0	28.6	6.9

MISSING CASES = 0 $X^2 = 25.3244$ P = 0.0643

17. Are ERC graduates better at communicating with others?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	50.0	78.6	40.0	46.7	35.7	47.5
SAME	22.2	7.1	15.0	26.7	28.6	18.8
NO	22.2	14.3	37.5	20.0	0.0	23.8
UNCERTAIN	0.0	0.0	2.5	6.7	7.1	3.0
NO ANSWER	5.6	0.0	5.0	0.0	28.6	6.9

MISSING CASES = 0 $X^2 = 28.752$ P = 0.0338

18. Are ERC graduates better at moving research concepts into usable products?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	50.0	57.1	47.5	46.7	42.9	48.5
SAME	16.7	21.4	20.0	6.7	7.1	15.8
NO	16.7	14.3	22.5	13.3	7.1	16.8
UNCERTAIN	5.6	7.1	2.5	26.7	7.1	7.9
NO ANSWER	11.1	0.0	7.5	6.7	35.7	10.9

MISSING CASES = 0 $X^2 = 22.6299$ P = 0.124

19. Do ERC graduates have a greater breadth of technical understanding?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	66.7	78.6	65.0	46.7	28.6	59.4
SAME	11.1	14.3	10.0	20.0	35.7	15.8
NO	16.7	7.1	17.5	20.0	0.0	13.9
UNCERTAIN	0.0	0.0	2.5	13.3	7.1	4.0
NO ANSWER	5.6	0.0	7.5	0.0	28.6	6.9

MISSING CASES = 0 X^2 = 28.8686 P = 0.0248

20. Do ERC graduates have a greater depth of technical understanding?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	61.1	42.9	45.0	26.7	42.9	44.6
SAME	11.1	35.7	17.5	26.7	21.4	20.8
NO	22.2	14.3	30.0	20.0	0.0	20.8
UNCERTAIN	0.0	7.1	2.5	26.7	7.1	6.9
NO ANSWER	5.6	0.0	5.0	0.0	28.6	6.9

MISSING CASES = 0 X^2 = 32.3714 P = 0.0089

21. Do ERC graduates show more leadership?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	33.3	71.4	22.5	13.3	28.6	30.7
SAME	22.2	21.4	15.0	46.7	21.4	22.8
NO	27.8	7.1	42.5	6.7	7.1	24.8
UNCERTAIN	5.6	0.0	10.0	33.3	14.3	11.9
NO ANSWER	11.1	0.0	10.0	0.0	28.6	9.9

MISSING CASES = 0 X^2 = 41.5651 P = 0.0005

22. Are you any more or less likely to recruit ERC graduates?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
MORE LIKELY	72.2	85.7	55.0	60.0	50.0	62.4
NO MORE/LESS	0.0	0.0	15.0	26.7	0.0	9.9
LESS LIKELY	5.6	14.3	20.0	13.3	14.3	14.9
UNCERTAIN	11.1	0.0	5.0	0.0	0.0	4.0
NO ANSWER	11.1	0.0	5.0	0.0	35.7	8.9

MISSING CASES = 0 X^2 = 32.6544 P = 0.0082

23. Prior to this interview, were you aware of ERC's sponsor and goals?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	11.1	71.4	50.0	40.0	35.7	42.6
SAME	0.0	0.0	2.5	0.0	0.0	1.0
NO	77.8	28.6	37.5	60.0	35.7	46.5
NO ANSWER	11.1	0.0	10.0	0.0	28.6	9.9

MISSING CASES = 0 $X^2 = 23.3565$ P = 0.0248

24. Based on your experiences with ERC trained employees, do you think the NSF is making reasonable progress towards these goals?

Center Number	1 (N=18)	2 (N=14)	3 (N=40)	4 (N=15)	5 (N=14)	OVERALL (N=101)
YES	50.0	78.6	52.5	46.7	57.1	55.4
SAME	16.7	7.1	12.5	6.7	0.0	9.9
NO	5.6	0.0	12.5	13.3	7.1	8.9
UNCERTAIN	11.1	14.3	7.5	33.3	7.1	12.9
NO ANSWER	16.7	0.0	15.0	0.0	28.6	12.9

MISSING CASES = 0 $X^2 = 19.8679$ P = 0.2262

ATTACHMENT D / Verbal Comments (recorded by interviewers) From 1991-92 Pilot Interviews of 101 ERC Graduate Employers (Supervisors/Managers)

[NOTE: The numbers in parentheses identify the ERC from which their employee(s) came. As there were five ERCs in this pilot project, the numbers range from 1 to 5. The numbers have been included in this attachment in order to enable individuals within each participating ERC to identify comments made by employers of their center's graduates. The only individuals who have access to the key for the center codes are the individuals in the participating centers. These individuals only know their particular center's code. In order to maintain the integrity of the coding system, any information in these comments that might have enabled a reader of this report to decipher the code and thereby identify centers has been modified or deleted.]

[NOTE: The number of comments varies across centers primarily because the number of interviews varies.]

7g. Do you know whether, in general, your company has had to offer higher beginning salaries for ERC graduates than for non-ERC graduates?

(03) No, in our industry we tend to pay higher salaries to people in [specific academic area] and related disciplines due to the higher demand for people in these fields.

(04) Salary is influenced by the field of study and the caliber of the school attended.

7h. Are beginning ERC grads salaries generally higher, about the same or lower than non-ERC graduates?

(02) We are very selective, so ERC graduates are worth more to us.

(03) Our ERC graduate was hired on strength of his publications, the reputation of adviser and because he met our goals and expectations. There was no reflection upon the Center!

(03) About the same, the determining factor is where they graduated from.

(04) It's hard to say because it depends mostly on the candidate.

(04) Salaries tend to be about the same for either; our recruiting program is designed to locate the best available Ph.D. graduates.

11a. Are you familiar with the reason why ERCs were established?

(03) Yes, participated in a recent review at [name of specific university].

(04) Bring industry and education together.

12. Do you think that you have different expectations of ERC graduates than you do for non ERC graduates?

(01) We expect ERC graduates to have a better idea of the "real world."

(02) ERC graduates are very quickly able to be effective.

(02) We expect ERC graduates to be of high quality.

(02) We expect ERC graduates to have a stronger sense of "real world."

(03) Yes. Interdisciplinary focus; gives broader exposure; more involvement.

(03) Our company works closely with [name of specific ERC] in its internship programs. I was not aware that the our ERC graduate was actually from ERC until today when I figured it out at the beginning of this interview.

(03) We expect ERC graduates to come with strong practical experiences and the ability to transfer technology.

(03) Expect them to arrive with the level of education and experience reflecting the University from which they graduates.

(03) ERC graduates tend to be more aware of non-academic life; work on whole variety of things; know more.

(03) ERC graduates tend to be more conversant with technological issues.

(03) ERC graduates tend to be more knowledgeable about their area of expertise.

(03) ERC graduates tend to be far more qualified to walk right in to the industrial setting.

(03) I expect ERC grads to be more focused; but that isn't, necessarily, what we are looking for.

(03) At [name of specific ERC] there is strong tendency to take a theoretical approach (applied [name of academic area). Graduates from the ERC tend to be more focused on problems of direct concern to industry.

(04) ERC graduates are expected to be better problem solvers, more adaptable and flexible.

(04) Yes. Graduates who really get involved in industry projects should be more valuable employees.

(04) Depends a lot upon who their advisor is.

(04) We expect more research orientation from ERC graduates.

(05) We expect ERC graduates to have better knowledge of industry and industrial processes.

(05) Most new hires from the ERC come with a different "tool kit."

(05) No knowledge of ERCs.

13. Can you identify any noteworthy strengths that ERC trained employees tend to exhibit that you believe are attributable to their ERC training?

(01) ERC graduates have high degree of competence.

(01) Quality of education; better suited to our industry; ERC graduates tend to be higher quality individuals.

(01) [name of specific academic discipline].

(01) ERC graduates have better idea of end products; rather than academic excellence.

(01) ERC graduates have noteworthy strengths in specific areas.

(01) Process experience.

(01) ERC graduates have a better sense of the 'real world' versus the isolation of academics.

(01) Creativity, problem-solving skills, foresight.

(01) ERC graduates are very motivated and eager to learn.

(01) ERC graduate keeps on top of technology; good analytical skills, keeps in touch with colleagues from the ERC program.

(01) Our ERC graduate has expertise in hardware and languages.

(01) ERC graduates are enthusiastic, thorough, and detail oriented.

(01) Our ERC graduate is highly motivated, follows through.

(01) ERC graduates are problems solvers, get things done, lots of initiative.

(02) ERC graduates have more in-depth training.

(02) ERC graduates have broader exposure to the field; high caliber of education; good knowledge of industry; personal sense of national technology community.

(02) ERC graduates have broader palette of experience.

(02) ERC graduates have interdisciplinary knowledge of both worlds, both industry and academia.

(02) ERC graduates have strong capabilities through multi-disciplinary approach. More abstract.

(02) ERC graduates are more technically competent and ready to go.

(02) ERC graduates are great entrepreneurs.

(02) ERC graduates are very capable with very sophisticated equipment.

(02) ERC graduates have significant interdisciplinary training. They have had practical 'hands-on' involvement within the corporate world.

(02) ERC graduates have strong theoretical background in engineering principles.

(02) ERC graduates have technical understanding and willingness to apply same.

(02) Closely related to needs of industry. Could have an even closer alliance with industry.

(02) Team work. Strong interdisciplinary approach.

(03) ERC graduates have better communication skills.

(03) ERC graduates are quick to understand.

(03) ERC graduates are familiar with a broader range of topics.

(03) ERC graduates have a more theoretical orientation, need more applied research.

(03) Their degree of expertise.

(03) ERC graduates have good practical knowledge; strongly focused on disciplinary research;

(03) ERC graduates have a broader knowledge base; more capable working across disciplines.

(03) Geared toward research with economic impact; near term future.

(03) ERC graduates are lots more capable of working on interdisciplinary projects, less specialization, more understanding of how the world works.

(03) ERC graduates tend to have more a system experience

(03) Fairly strong theoretically; research oriented.

(03) ERC graduates usually become associated with very best researchers. They arrive with very interesting pieces of work.

(03) Expect a stronger systems background.

(03) ERC graduates know the field and the profession.

(03) I can not attribute anything to ERC, because I don't know anything about the ERCs.

(03) ERC graduates have more expertise. I expect more from ERC graduates. As a comparative base; I judge their graduates against the best of all other universities. Not just against other graduates.

(03) ERC graduates are familiar with the latest technologies.

(03) Might be able to work on larger engineering efforts with more understanding. Not truly unique to the ERC students.

(03) No difference between this graduate and other graduates. (Incomplete Interview)

(03) ERC graduates have more breadth of knowledge and a better understanding of what industry is looking for.

(03) Our ERC graduate is really strong.

(03) This ERC is very involved, crossing many disciplines.

(03) Our graduate is very strong technically; digs into problems in a different fashion; uses library and other research papers.

(03) Never really though about it - whether their skills are a result of the ERC program - I look at personality - more what they actually did.

(03) As long as the University is conducting, the ERC is nice. If the ERC did not exist, then industry would have to train them later.

(04) ERC training at the [name of specific industrial site] was clearly an asset of several employees (Disclaimer: The respondent was not sure whether the project to which he was referring was an ERC project)

(04) ERC graduates are very well technically trained.

(04) ERC graduates are more interdisciplinary.

(04) Exposure to the computing sciences was required as part of the ERC experience.

(04) ERC graduates are more aggressive/assertive.

(04) ERC graduates have a better feel for the business environment and what is important. ERC grads with hands-on within industry were especially valuable.

(04) ERCs provide stronger practical experiences.

(04) ERCs are more thorough, good analytic versus intuitive.

(04) There is a large network of contacts at the university.

(05) ERC graduates are best in group.

(05) Well rounded, both intellectually and practically.

(05) While our ERC graduates lack very strong quantitative skills in process results and machine design, they make up for it with a willingness to work on the production floor. Their attitudes are different than other MS/Ph.D. graduates.

(05) We are always happy with these people.

(05) ERC graduates are highly motivated.

14. Can you identify any noteworthy weaknesses that ERC graduates tend to exhibit that you believe are attributable to their ERC training?

(01) ERC graduates are less practical

(01) ERC graduates are sometimes too technically oriented; not fully rounded.

(01) ERC graduates are too "mission oriented" and amidst the constraints of institutional freedom.

(01) ERC graduates are not too practical; should be more analytical.

(01) Verbal/written skills.

(02) ERC graduates lack 'hands-on' in actual situations.

(03) ERC graduates tend to pursue what they thought was important to NSF rather than what should be done. Lack courage.

(03) ERC graduates need hard engineering problems - long term core research. Less emphasis on near term solutions/research.

(03) ERC graduates focus more on research than on teaching.. (academic graduates)

(03) Lack practical applications due to their association with excellent professors. Lack experience.

(03) Our ERC graduate initially had difficulty making the transition from academics to the "real world."

(03) A university is a seamless thing; This ERC is an excellent center with faculty and students - a hybrid system.

(03) I hope that ERC graduates' foundation in science is broad enough. Anything that tends to be practical could be outdated in a few years time.

(03) A little bit industry oriented - similar to people in industry. Less deep academically (too much like Bell and IBM labs)

(03) ERC graduates are too narrowly focused.

(03) ERC graduates are variable in quality, nothing systematic, however. The staff are often very busy and must relate to all of the agencies - less time to supervise students.

(04) No strong 'hands-on' labs.

(04) Too much theoretical.

(04) Our ERC-trained graduates have somewhat detached views of reality; they excel at theory, but are weak in practical on the job analytic vs intuitive, research vs real world.

(04) ERC-trained graduates have difficulty applying advanced techniques to practical [name of specific academic area] problems.

(04) ERC graduates' depth may suffer.

(05) Pessimistic attitudes.

15. Do they tend to demonstrate any more sense or vision of how their skills can contribute to company success than do non-ERC trained employees?

(03) Vision is a major strength of ERC graduates.

(04) ERC graduates have a better perspective on industry.

16. For the next question, we are defining a systems orientation as beginning with an idea and carrying it through development and production to its final conclusion. With that in mind, how would you compare ERC trained and non-ERC trained employees with respect to showing a systems orientation?

(03) Superior

17. Do you think ERC graduates show any more of a tendency to serve as change agents within your company than non-ERC trained employees?

(03) No - good researcher will do it anyway

(03) Yes, conceptually - they ought to be better, broader.

18. Do you think ERC graduates exhibit any more of a tendency to use cross disciplinary approaches to problem solving than non-ERC trained employees?

(03) No more than anyone else.

(04) Current graduates are still schooled in traditional styles. New generation of graduates will show this more because of new trends in teaching and advising.

(05) ERC graduates have a higher "comfort level" with cross-disciplinary research.

19. Do ERC graduates generally require less initial training than non-ERC trained employees?

(03) Our ERC graduate was hired because he knew his research area. It is difficult to judge when you only have one ERC graduate.

(03) A gross generalization: ERC broader; non-ERC narrower. This is a complex question. ERC graduates seem to take longer to adapt to environments but are able to draw upon more sources.

20b. Are ERC graduates generally better at getting 'up to speed' so that they become useful to the company in less time?

(03) Non-ERC graduates tend to be narrow and therefore useful very quickly; ERC graduates tend to be broader and more useful across time. As a result, they tend to require fine-tuning.

20e. Are ERC graduates generally better at communicating with others?

(01) Our ERC graduate communicates well with others at his level; there is a problem communicating with less experienced employees.

(03) Clearly

20f. Moving research concepts into usable processes, devices or outcomes.

(01) Outstanding

21. Based on your experiences with ERC-trained employees to date, are you any more or less likely to attempt to recruit them in the future?

(03) No. this is not a strong motivating factor - ERCs and other institutes are comparable in that regard.

22. Prior to this interview, were you aware that ERCs were established by the NSF with the man goal being to increase the emphasis on cross disciplinary research with a teamwork and systems orientation and to increase the involvement of US Industry in education?

(03) Absolutely

23. Based on your experiences with ERC trained employees, do you think the NSF is making reasonable progress towards these goals?

(03) Mixed feelings on ERCs. If done selectively that I would support them. If making large awards then negative.

24. Do you have any recommendations as to how the NSF could improve the ERC Program?

(01) More balance toward the practical side of an idea.

(01) Problems are not with NSF, but with industry.

(01) Wider spectrum of courses; out of immediate focus.

(01) Each subject should not be confined to one school; foster more cooperation between universities. Model the program after the Canadian "Centers of Excellence."

(01) More team leadership.

(01) Increase the visibility of the ERC Programs.

(02) Keep up the good work.

(02) Increase the emphasis on [specific academic area].

(02) Insist on multi-disciplinary approach. Need to identify strong leaders at EACH institution.

(02) Provide more funding.

(02) Expand the program; target some 'second tier' schools.

(02) Significant chunk of time is spent defending decisions; counter-productive. Trained to evaluate quarterly; in the corporate world we evaluate annually.

(02) Heighten the emphasis on cross-disciplinary efforts. Would be helpful for students to interrupt their studies for a year long internship within industry and then return to their academic studies.

(03) NSF should provide more information to industry regarding these ERC programs.

(03) Needs to encourage more industrial involvement.

(03) ERC is doing a fine job.

(03) Centers need more autonomy and guaranteed funding levels. The Board of Directors at [name of specific ERC] was always making sure that NSF was happy with what they saw. Always looking for grant dollars. If a grant is lost, it affects many people. Too much looking over the shoulder to please the NSF and not always doing meaningful research.

(03) Model at [name of specific ERC] is as good as it can become. The NSF's desire to have cross disciplinary institutes is not happening because the faculty are not interested in doing cross-disciplinary training. Need to encourage more 'networking' among the ERCs. Little evidence that much of the technology/research has been directly transferred to industry.

(03) The University environment is extremely segmented - lacks cross-disciplinary work. Mostly you just see fluffy packaging that appears cross-disciplinary. Bring industry in even further. Encourage students to participate more fully in joint university/industrial projects.

(03) Need to increase the number of people in the summer internship programs. These practical experiences turn-out to be invaluable.

(03) Help build strengths within existing departments. Researchers don't change much, just disguise research to fit the ERC program. Cost per student is far too high ($350K/student). Far too much overhead in terms of maintaining an image. More time at other universities to work with other students.

(03) More aggressive information sharing with industry (companies that hire graduates). [respondent wasn't aware that the ERC programs even existed.]

(03) Hold yearly sympósia; interface with employers/business; more awareness to industry; advertise!

(03) Need more information; limited knowledge of either the NSF or ERC programs.

(03) Spend more money on the computing initiatives. We need more leadership in the leading edge technologies: high performance computing, software engineering. ERCs were nice when there were lots of dollars to go around. Now they have become a luxury we cannot afford. The economy simply isn't as strong as it was when the ERCs were established. Now we need to come in and support the focal causes; the periphery may lag.

(03) Wrong idea to select a few schools. Same dollars should have been distributed to many schools. There should be many centers in the same subject areas to promote competition and different degrees of specialization.

(03) Make a long term commitment to ERCs. Stress the long term research goals. The money will decrease and the focus needs to be retained on long term goals.

(03) There needs to be more information disseminated throughout the industry. Someone is not doing their jobs of selling the ERC concept. The general idea of cross-disciplinary research is good. Be careful not to focus people too much or too early. Careers last a long time and new developments can open new pathways. The narrow focus only helps in attaining the first job. After that a broad based background can be more adaptive to the swinging tides of technology.

(03) The funding levels should be increased so the ERCs can function effectively. Currently they have created fiefdoms and warlords. Teamwork doesn't exist between professors and students.

Change away from a means of distributing money to become an effective producer of engineering knowledge. The internal cooperation is pretty poor - pool of funding is not equitably distributed.

Too many surveys result in paper and don't result in a change. The information ends up someone's computer and then it just sits there!

(03) Scrutinize the sites before awarding an ERC - don't do it because someone has an idea. The support should fit the reality of research.

Would like to see a middle ground (3-5 investigator situation) - incubator ERCs! There is a place to make ERC programs fuller.

Most dollars go toward larger programs with many PIs and projects or studies with specific goals. How many universities have this kind of synergy? Smaller universities don't have large numbers of PIs but could be effective with 3-4 person projects and NSF support.

(03) Put one at [name of specific non-ERC university]!

(03) There needs to be increased industry awareness of ERCs- advertising is needed - There should be presentations at industry functions and during recruiting. Let other people in company know about ERCs and their benefits. Schools should promote the fact that they have an ERC.

(03) We need to hear more about the programs at the ERCs. NSF must do a better job of informing companies, especially small companies in specific research fields, about the ERC program.

(03) I had many expectations for ERCs that this ERC did not live up to. Universities are important to industry. It's a delicate balance - many universities cannot live up to expectations. [Name of specific university] ERC director worked in industry prior to the university - he understands timelines and restrictions. I expect a pruning to take place in the 'next round.' I want universities to get more involved in the applied areas. Those ERCs that are struggling should be closed. Keep the ERCs small. [Name of specific university] does produce good graduates and has tried hard to meet the goals of the ERCs. Their program is very good.

(03) I am aware of the ERCs programs, I was on the faculty at [name of specific university]. The ERC was viewed as a way to get more dollars for the school. It was frustrating and is worth trying to change.

(03) I don't want to give input based on an N of 1. I believe that ERCs are potentially worthwhile programs. Let the employers know more about ERCs; do a better job of advertising them.

(03) Better public relations are needed- let employers know the ERCs are out there. More practical "real world" experiences are needed.

(03) What would be interesting is if they convinced students to put their ERC training on their resumes. Many of them don't even mention it during their interviews.

(03) We choose candidates based upon individual strengths, not based upon an ERC experience. There is a link, but nothing specific.

(03) These are large amount of dollars; the NSF needs to be more careful. Forces professors to focus. Past research centers did not have enough industry input for impact and significance and for correcting the rather random nature of research.

Quality of faculty and student determines everything. Re-package what they do. Professors tend to align themselves better for funding.

(03) Don't get out after 5 years - it would be OK to phase out in some areas and emphasize others. But don't abandon the concept. Level of funding should remain more constant and stimulate the ERC, not leave it behind.

(03) NSF tends to have a binary approach (either you are or aren't). There is a tendency to set ERCs apart from technical community of which they are a part. No encouragement by NSF for non-ERC universities. The NSF should encourage collaboration between ERC and non-ERC universities/sites.

(04) How can an industry get involved? I want more information on ERCs from the NSF.

(04) Actively encourage work/study programs. Industry needs engineers with real world experiences. (Throughout the interview this respondent cautioned that in some instances s/he did not know if stronger on the job performance was attributable to the ERC program or that the individuals in the ERC program were above average performers. The respondent felt that 50% of his ERC employees were better than non-ERC and 50% were the same.

(04) Increase the number of internships. Encourage entrepreneurial behaviors.

(04) That is a loaded question! The panel and task force were formed last year to determine if NSF should keep funding centers or not. [the respondent would not comment for fear that some Centers may lose their funding.]

(04) Hire research faculty.

(04) My observation is that the ERC graduate in my unit had less "hands-on" - direct knowledge than others coming to my department.

(04) Continue co-op experiences.

(04) Difficult to say, Nothing in particular, Program is working.

(04) Encourage greater use of internships; working on-site in industry should occur as often as possible.

(05) Keep up the good work.

(05) Continue to fund strong programs; do not just fund the start-up phase and then drop the funding.

(05) Need to make industry more aware of the ERC program.

(05) Continue the programs, create more industry awareness of ERCs.

(05) Excellent program, top notch individuals - but, should concentrate on those ERCs already established, not add more.

Unsolicited Comments from the 101 Completed Interviews

(01) No difference between our ERC graduate and other 'peers.'

(01) It is "systems development" in industry; cannot differentiate between the recently hired individuals. Individuals who may be from an ERC program are at the entry level and it is too early to evaluate them.

(02) Our company may try to recruit others in order to maintain balance. Graduates from the [name of specific ERC] group, in general, is better with higher motivation to succeed.

(02) This respondent wanted to make it clear that he could not differentiate ERC grads who had been part of the ERC program. And, that anyone who had been admitted to [name of specific university], was already "way ahead of the pack."

(02) This company is involved with the ERC program and this individual is a graduate; also serves on the ERC advisory committee.

(03) Respondent had been unaware of ERC program. His one employee is "top of the line" but cannot say this is due to ERC; most likely these qualities led to his being accepted into the ERC program.

(03) The respondent believes the program was established to promote Japanese methods; s/he finds it ironic that many graduates are Japanese!

(03) It is really difficult to sort out exactly what is attributable to the ERC experience.

(03) This respondent has very strong opinion and ideas regarding the ERCs and the future of technology in the US. Sees the US losing ground in software development, strategic and high performance computing. Would be happy to talk with anyone concerning these issues and serve on any committee that might guide the NSF into the future.

(03) Our ERC graduate did not mention the fact that he had been involved with an ERC - it was not on his resume or his application nor was it mentioned during the interview.

(04) Graduates with practical industrial experience are more beneficial than those with only schooling.

(04) Need to place more emphasis on applied research.

(05) Very new industry - no background for comparison.

Unsolicited Comments from Incomplete Interviews [NOT included in the 101 complete interviews]

[NOTE: Most potential interviewees were known by project staff to manage or supervise ERC graduates. Incomplete interviews resulted either because the interviewee was not aware of ERCs and/or of the fact that they had at least one ERC graduate working for them. Since we would not give out graduate(s) name(s) some interviews were terminated.]

01) A new faculty member from [name of specific ERC] is starting today. I was unable to participate in evaluating program (search), but the ERC graduate was chosen from 237 applicants so that must give some credit to ERCs. [Therefore, because it was too early, this ERC graduate employer's interview was terminated.]

(01) Not familiar with ERC; employee is fairly new, really not able to evaluate program. Individuals admitted with [name of specific ERC] would be good going in, should be good coming out. [Therefore, this ERC graduate employer's interview was terminated.]

(01) Did not want to continue the interview, stating that his one ERC employee is extremely sharp, bright, innovative, impressive, but believes this would be true wherever/whatever program. [Therefore, this ERC graduate employer's interview was terminated.]

(02) Only one person from the ERC program. Highest ranked, most educated, not able to compare. [Therefore, this ERC graduate employer's interview was terminated.]

(03) Does not know the backgrounds of his employees. [Since we would not give out graduate(s) name(s) the interview was terminated]

(03) ERCs are not placed in schools that you are trying to improve. All of these schools already have good strong programs.

(03) Does not know that he has anyone who graduated from an ERC working for him. [Since we would not give out graduate(s) name(s) the interview was terminated]

(04) Does not know what an ERC is, or what it does. [The interviewee didn't think he knew what an ERC is and he hung up too fast for the interviewer to explain that he had at least one working for him.]

(04) Respondent not aware that he has hired any ERC graduates, totally unfamiliar with ERCs. [Since we would not give our graduate(s) name(s) the interview was terminated] (x 2)

(04) We don't employ any ERC graduates. [The interviewee didn't think he knew what an ERC is and he hung up too fast for the interviewer to explain that he had at least one working for him.]

(04) Graduate told her that we would be calling but indicated that he really had not been active in the ERC.

(04) ERC is not a factor in their hiring - unfamiliar with ERC. No one within the company would know anything about ERCs. [Therefore, this ERC graduate employer's interview was terminated.]

(04) Never heard of ERCs. (x 2) [Therefore, these ERC graduate employer interview s were terminated.]

(04) They have never hired ERC graduates - it is a furniture company. [an ERC graduate was working there!]

(04) Has graduates of [name of specific ERC] but doesn't think they were involved with the ERC.

(04) Is headed out of the country and declined the opportunity to be interviewed.

(04) Respondent didn't know anything about ERCs or who were ERC grads. [This employer actually declined to be interviewed.]

(04) Not sure if he has ERC graduates working for him.[He did, but didn't know it! Therefore, this ERC graduate employer's interview was terminated.]

ERC is not a factor in his hiring. Employees have never made their ERC experience known to him. [Therefore, this ERC graduate employer's interview was terminated.]

(04) Does have [name of specific ERC] graduates but no one has ever mentioned that they had an affiliation with an ERC. Would not be able to answer the interview questions. [Therefore, this ERC graduate employer's interview was terminated.]

(04) They employ graduates of [name of specific ERC] but whether they are ERC or not is not known. He did not recognize the term ERC. [Therefore, this ERC graduate employer's interview was terminated.]

(05) Really not able to compare ERC and non-ERC graduates- told to expect a call, but has no knowledge of the ERC program. [Therefore, this ERC graduate employer's interview was terminated.]

ATTACHMENT E / Results of 1991-92 Pilot Follow-Up Surveys of ERC Graduates: Figures 55 thru 57 based on Aggregated BS and Graduate Degree (MS & PHD) Recipients' Retrospective Perceptions of Their ERC Experiences

Figure 55: ERC Graduates' Opinions About the Relative Value of Their Training for General Professional preparation

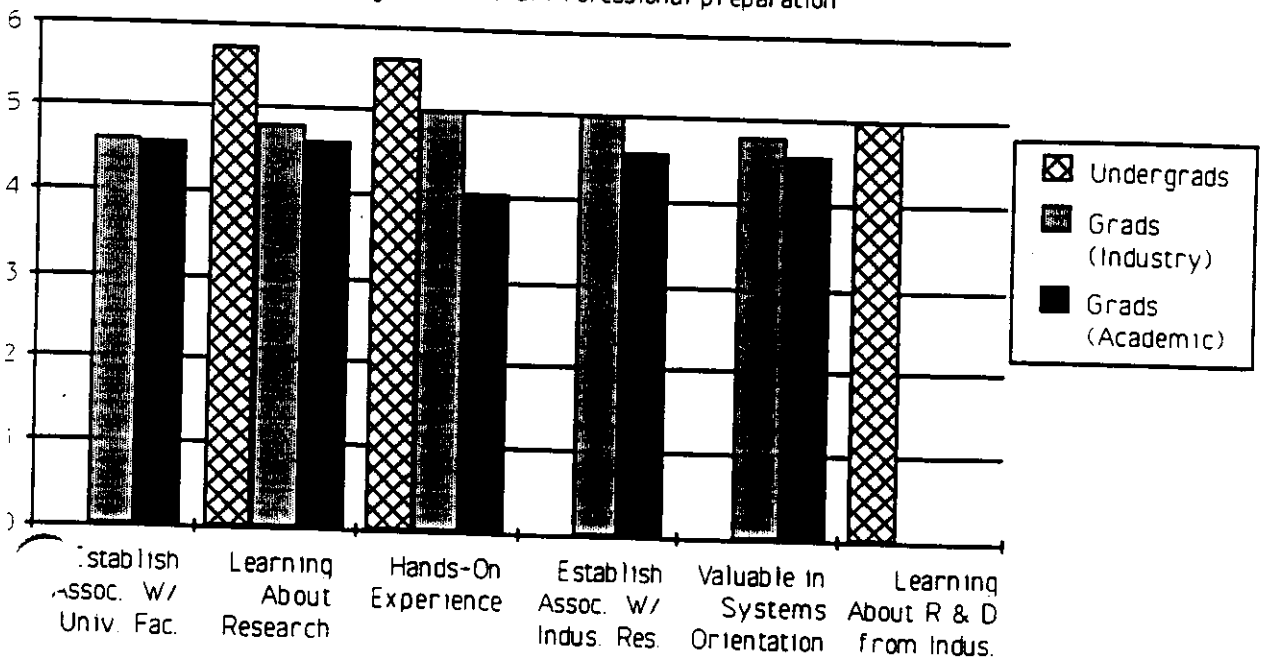


Figure 56: ERC Graduates' Opinions About Their Training For Professional Skill Development

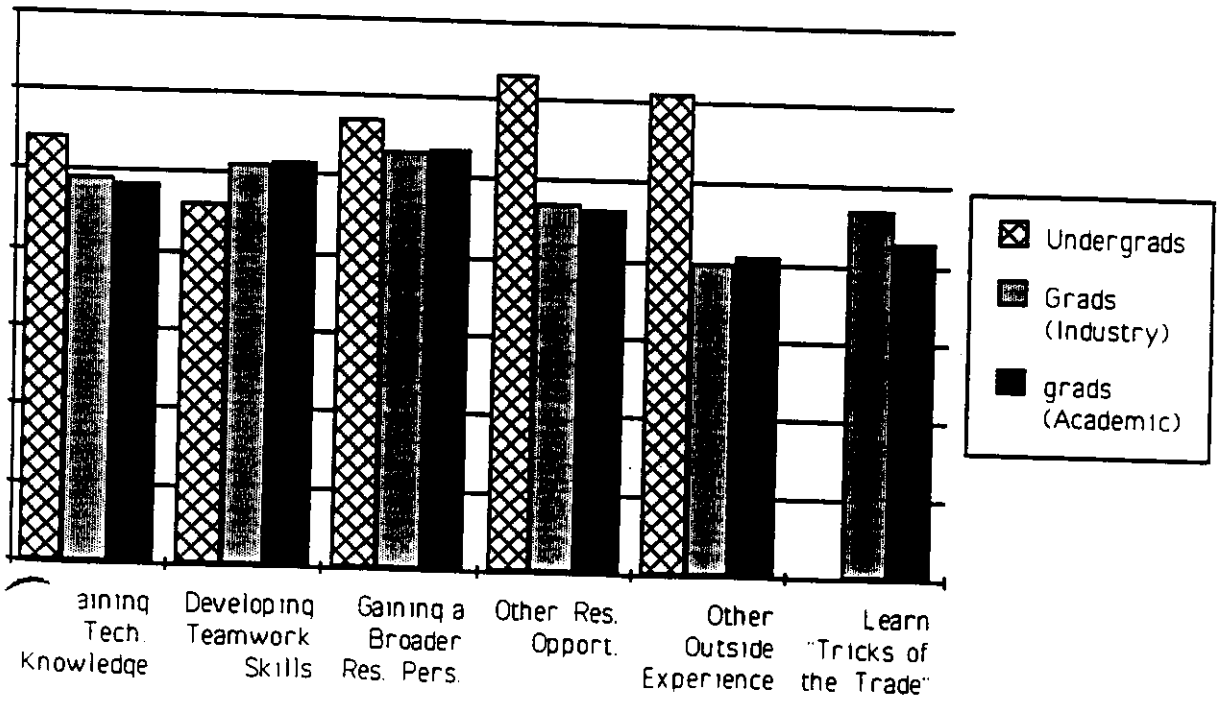
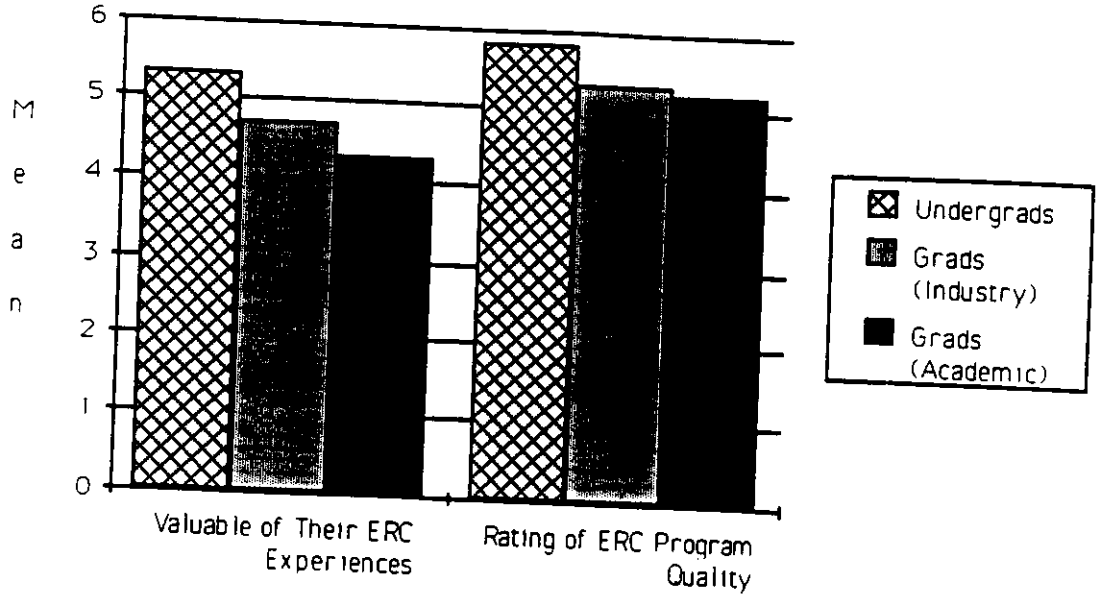


Figure 57: ERC Graduates' Opinions About Overall Value of Their ERC Experiences



ATTACHMENT F / Aggregated Results From Five ERCs of the Pilot Follow-up Survey of ERC Bachelor of Science Degree Graduates Who Were Employed in Industry in 1991

Aggregate Results (N = 39: Includes 6 Surveys with No Center Identifiers)

PROFESSIONAL PREPARATION

Respondents' ratings of how valuable was their association with the Engineering Research Center (ERC) in terms of providing them with opportunities for:

a. learning about research:

1	2	3	4	5	6	7	
0.0%	0.0%	2.6%	7.7%	17.9%	51.3%	12.8%	Mean = 5.7

Regular undergraduate activities more valuable — **ERC activities more valuable**

b. participating in hands-on experimental engineering:

1	2	3	4	5	6	7	
0.0%	2.6%	2.6%	12.8%	17.9%	33.3%	25.6%	Mean = 5.6

Regular undergraduate activities more valuable — **ERC activities more valuable**

c. learning about R & D in industrial setting(s):

1	2	3	4	5	6	7	
0.0%	2.6%	5.1%	20.5%	23.1%	20.5%	10.3%	Mean = 5.0

Regular undergraduate activities more valuable — **ERC activities more valuable**

PROFESSIONAL SKILLS

Respondents' ratings of the extent to which they felt their ERC met (or did not meet) their expectations in helping them develop the following skills and knowledge:

a. gaining technical knowledge:

1	2	3	4	5	6	7	
0.0%	2.6%	2.6%	20.5%	20.5%	28.2%	20.5%	Mean = 5.4

ERC not very helpful — **ERC very helpful**

b. developing cross-disciplinary teamwork skills:

1	2	3	4	5	6	7	
0.0%	7.7%	15.4%	20.5%	17.9%	28.2%	5.1%	Mean = 4.6

ERC not very helpful — **ERC very helpful**

c. gaining a broader perspective of research:

1	2	3	4	5	6	7	
0.0%	0.0%	0.0%	10.3%	30.8%	35.9%	17.9%	Mean = 5.7

ERC not very helpful — **ERC very helpful**

III COMPARATIVE VALUE OF RESPONDENTS' ERC EXPERIENCES

1. Respondents' ratings of how their participation in the ERC's program compared to the rest of the educational activities available to them:

a. Non-ERC research opportunities:

1	2	3	4	5	6	7	Not Applicable	
0.0%	0.0%	2.6%	17.9%	20.5%	17.9%	10.3%	25.6%	Mean = 6.3

other research opportunities more valuable — **ERC activities more valuable**

b. other outside work/internship experience:

1	2	3	4	5	6	7	Not Applicable	
0.0%	0.0%	17.9%	10.3%	10.3%	17.9%	5.1%	30.8%	Mean = 6.1

other research opportunities more valuable — **ERC activities more valuable**

2. Percent of respondents who indicated that their ERC experiences gave them a competitive edge over other students seeking similar jobs following graduation.

1	2	3	4	5	6	7	
2.6%	2.6%	5.1%	10.3%	23.1%	25.6%	20.5%	Mean = 5.3

not very — **extremely**

3. Respondents' overall ratings of the quality of the time they spent at their ERC.

1	2	3	4	5	6	7	
0.0%	0.0%	0.0%	5.1%	38.5%	25.6%	25.6%	Mean = 5.8

poor — **excellent**

EDUCATIONAL/RESEARCH ACTIVITIES

.n what year did you receive your baccalaureate degree? 19___ [for use in later surveys]

Percent of respondents who indicated that they expected that their first full-time post-baccalaureate job will be with a current ERC industrial affiliate.

Yes 2.6%: No 61.5%

How long respondents participated in their University's ERC.

Three months 30.8%: Six months 7.7%: One year 10.3%: More than one year 41.0%

While at their ERC, respondents participated in the following activities.

Respondents checked ALL that apply:

84.6%	Participated in the ERC's research program.	
17.9%	Had an ERC fellowship;	If checked, average number checked: 1.3
17.9%	Participated in an ERC seminar series;	If checked, average number checked: 1.8
20.5%	Attended ERC meeting with industry;	If checked, average number checked: 1.1
7.7%	Conducted ERC formal poster session;	If checked, average number checked: 2.3

While at their ERC, respondents participated in the following activities. (cont'd)

5.1%	Attended professional society meeting;	If checked, average number checked: 1.0
28.2%	Made presentation to university group;	If checked, average number checked: 1.7
15.4%	Made presentation to industrial group;	If checked, average number checked: 1.7
0.0%	Made presentation at prof. society meeting;	If checked, average number checked: 0.0
12.8%	Visited industrial site;	If checked, average number checked: 1.3
25.6%	Worked on an industrial project;	If checked, average number checked: 1.0

Percent of respondents who indicated that their involvement in the ERC increased the likelihood that they will pursue another advanced degree.

Yes 53.8%: No 15.4%: Uncertain 23.1%

Percent of respondents who indicated that their involvement in the ERC increased the likelihood that they will pursue a engineering career.

Yes 43.6%: No 28.2%: Uncertain 20.5%

Respondents' recommendations as to how the NSF could improve the ERC experience for undergraduate students.

[NOTE: The numbers in parentheses identify the ERC from which the grad that made the comment came. As there were five ERCs in this pilot project, the numbers range from 1 to 5. The numbers have been included in this attachment in order to enable individuals within each participating ERC to identify comments made by graduates of their center. The only individuals who have access to the key for the center codes are the individuals in the participating centers. These individuals only know their particular center's code. In order to maintain the integrity of the coding system, any information in these comments that might have enabled a reader of this report to decipher the code and thereby identify centers has been modified or deleted.]

(01) Excellent program. The only recommendation I have is that the seminars they had should have been more cohesive.

More selection; in terms of engineering research fields. More realistic work - give undergraduates experiences of what they will actually do after earning their degree. More team work experience is an absolute must in real life.

(01) Increase length of REU program during the summers.

(01) Work more with the Organization (the University in this case) such that the undergraduate participants get wid varieties of research, rather than one project.

(01) The length of participation in the program should be at least a year so that the mentor can make some practical use of the undergraduate student.

(02) I think that apart from the research experience students should actively get involved in grant proposal writing and the research presenting process, so it would be great if NSF had seminars related to such processes, or even workshops which would help us to learn such important skills.

(03) Encourage more undergraduates to join the ERC by not forcing the issue of immediate results - it takes a while to get started.

(03) Have group meetings for just undergraduates. By discussing our projects, we might have been able to get new ideas for future projects.

(03) Not enough opportunities for undergraduates. More money should be spent on hiring people. Since when I asked them, they said "no money for hiring, but if you want to volunteer....." So, I volunteered!

(03) Allow more people to experience the ERC. Currently only one or two undergraduates get to do this. Allow people in more fields to get the experience. I think that only [name of center's academic area] students do this, even though the this is primarily an [name of department's academic area] department.

(04) I must say the experience I had at the ERC at [name of specific university] was excellent because of the professor I worked with: I did not really know or notice any controls or regulations related to the NSF or the REU on my work. I'm glad the program made the experience possible - but the excellence came from my advisor.

(04) The program at [name of specific university] needed more organization. More enthusiastic technical staff should be used to prevent discouraging delays in progression of projects.

(04) Provide more opportunities to meet other undergraduates.

(04) ERCs are a proven concept. The NSF should continue funding such efforts. It would be nice if NSF coul stimulate further industrial involvement. My participation in the ERC at [name of specific university] has proved to be very valuable for future efforts.

V EMPLOYMENT RELATED INFORMATION

1. Average number of job interviews respondents had following your ERC experience. **4.4**
2. Percent of respondents that had a reduced number of interviews because they accepted an early offer.

   Yes **25.6%**: No **25.6%**.

   If Yes, was the offer from an ERC affiliate.

   Yes **0.0%**: No **20.5%**
3. Average number of job interviews respondents received from ERC-affiliated companies. **0.2**
4. Average number of offers respondents received following their ERC experiences. **2.1**
5. Average number of offers respondents received from ERC-affiliated companies. **1.0**
6. Respondents' first full-time job following their ERC experience with their current employers.

   Yes **23.1%**: No **17.9%**

VI DEMOGRAPHIC/DESCRIPTIVE INFORMATION

1. Time respondents had been at their ERC's university.

   Years **3**: Months **2**:

Departments in which respondents did their ERC-related worked.

APPLIED BIOLOGICAL SCIENCE	5.2%
BIOMEDICAL ENGINEERING	2.6%
CHEMICAL ENGINEERING	15.4%
CIVIL ENGINEERING	5.1%
COMPUTER SCIENCE	2.6%
CTR	2.6%
ELECTRICAL ENGINEERING	35.9%
LIGHTWAVE RESEARCH LAB.	2.6%
MATHEMATICS	2.6%
MECHANICAL ENGINEERING	7.7%
RADIOLOGY	2.6%

Percent of respondents who participated in any REU (Research Experience for Undergraduates) Program.

Yes 64.1%: No 28.2%: Uncertain 5.1%

Percent of respondents who participated in a summer cooperative educational program in industry.

Yes 12.8%: No 84.6%: Uncertain 0.0%

Ethnic group of respondents:

0.0%	Native American, Alaskan Indian
30.8%	Asian or Pacific Islander
5.1%	Black
0.0%	Hispanic
61.5%	White, not Hispanic

Percent of respondents who were U.S. citizens.

Yes 79.5%: No 17.9%

cent of respondents who were U.S. residents.

Yes 10.3%: No 10.3%

Negative respondents' intentions:

7.7%	respondents planning on becoming U.S. Citizens.
0.0%	respondents planning on staying in the U.S. but do not plan on becoming U.S. Citizens.
5.1%	respondents planning on returning to their home country.

Respondents' final degree objectives.

BA 2.6% DDS 2.6% MBA 2.6% MD 15.4% MSME 2.6% PHD 38.5%

Percent of respondents who plan on working in industry before obtaining their final degree objective.

Yes 30.8%: No 51.3%

Respondents' sex. Male 66.7%: Female 30.8%

Average age of respondents. 23.7

ATTACHMENT G / Aggregated Results From Five ERCs of the Pilot Follow-up Survey of Doctoral and Master of Science Degree Graduates Who Were Employed in Industry in 1991

Aggregate Results (N = 111: Includes 2 Surveys with No Center Identifiers)

I PROFESSIONAL PREPARATION

Respondents ratings of how valuable their association with the Engineering Research Center (ERC) in terms of providing them with opportunities for:

a. establishing useful associations with a variety of university faculty:

1	2	3	4	5	6	7
6.4%	5.5%	10.1%	24.8%	17.4%	27.5%	8.3%

Regular graduate level activities more valuable — **ERC activities more valuable**

Mean = 4.6
Missing = 2

---

b. learning about research:

1	2	3	4	5	6	7
5.5%	5.5%	9.2%	22.0%	16.5%	27.5%	13.8%

Regular graduate level activities more valuable — **ERC activities more valuable**

Mean = 4.8
Missing = 2

---

c. participating in hands-on experimental engineering:

1	2	3	4	5	6	7
3.9%	3.9%	7.8%	24.3%	15.5%	26.2%	18.4%

Regular graduate level activities more valuable — **ERC activities more valuable**

Mean = 5.0
Missing = 8

---

d. establishing useful associations with industrial researchers:

1	2	3	4	5	6	7
2.0%	5.9%	6.9%	23.5%	19.6%	23.5%	18.6%

Regular graduate level activities more valuable — **ERC activities more valuable**

Mean = 5.0
Missing = 9

---

e. **A systems orientation can be defined as the process of beginning with an idea and carrying it through all of its development and production to its final manifestation.** With this in mind, respondents were asked how valuable were their association with the Engineering Research Center (ERC) in terms of providing them with opportunities for participating in systems oriented research:

1	2	3	4	5	6	7
2.8%	5.6%	4.7%	29.9%	19.6%	23.4%	14.0%

Regular graduate level activities more valuable — **ERC activities more valuable**

Mean = 4.8
Missing = 4

PROFESSIONAL SKILLS [INDUSTRIALLY EMPLOYED GRADUATES]

Respondents ratings of the extent to which they felt their ERC met (or did not meet) their expectations in helping them develop the following skills and knowledge:

a. gaining technical knowledge that is useful in industry:

1	2	3	4	5	6	7	
3.6%	3.6%	6.3%	18.0%	26.1%	12.5%	13.5%	Mean = 4.9 Missing = 7

ERC not very helpful — **ERC very helpful**

b. learning the practical "tricks of the trade" useful for conducting research:

1	2	3	4	5	6	7	
1.8%	7.2%	8.1%	20.7%	26.1%	23.4%	6.3%	Mean = 4.7 Missing = 7

ERC not very helpful — **ERC very helpful**

c. developing cross-disciplinary teamwork skills that are useful in industry:

1	2	3	4	5	6	7	
1.8%	4.5%	9.0%	16.2%	19.8%	26.1%	17.1	Mean = 5.1 Missing = 7

ERC not very helpful — **ERC very helpful**

d. gaining a broader perspective of research that is useful in industry:

1	2	3	4	5	6	7	
1.8%	1.8%	8.1%	15.3%	16.2%	32.4%	18.9%	Mean = 5.3 Missing = 4

ERC not very helpful — **ERC very helpful**

COMPARATIVE VALUE OF RESPONDENTS ERC EXPERIENCE [INDUSTRIALLY EMPLOYED GRADUATES]

Respondents ratings of how their participation in their ERCs' program compared to the rest of their educational activities:

a. other research opportunities:

1	2	3	4	5	6	7	
1.8%	6.3%	8.1%	27.0%	21.6%	18.0%	10.8%	Mean = 4.7 Missing = 7

other research opportunities more valuable — **ERC activities more valuable**

b. other outside work/internship experience:

1	2	3	4	5	6	7	
6.3%	14.4%	9.9%	15.3%	20.7%	14.4%	3.6%	Mean = 4.0 Missing =17

other work/internship experience more valuable — **ERC activities more valuable**

2. Respondents indication of whether their ERC experiences gave them competitive edges over other students seeking jobs in industry following graduation.

1	2	3	4	5	6	7	
6.3%	7.2%	6.3%	13.5%	22.5%	23.4%	12.6%	Mean = 4.7 Missing = 9

not very — **extremely**

---

3. Respondents' overall rating of the quality of the time that they spent at their ERC.

1	2	3	4	5	6	7	
1.8%	2.7%	5.4%	12.6%	18.9%	34.2%	17.1%	Mean = 5.3 Missing = 8

poor — **excellent**

IV EDUCATIONAL/RESEARCH ACTIVITIES [INDUSTRIALLY EMPLOYED GRADUATES]

1. In what year did you receive your baccalaureate degree? 19___ [for use in future surveys]
2. After receiving your baccalaureate respondents (checked all that applied): **Missing = 0**

- **4.5%** Obtained part-time employment.
- **27.0%** Obtained full-time employment.
- **64.0%** Proceeded directly to graduate school.
- **6.3%** Other

3. When did you receive your last post-graduate degree? Month ___ Year 19___ [for use in future surveys]
4. Field of respondents last post-graduate degrees? **Missing = 2**

AERO & ASTRO ENGINEERING	2.7%
APPLIED MATHEMATICS	0.9%
BIOCHEMICAL ENGINEERING	5.4%
CHEMICAL ENGINEERING	15.3%
CIVIL ENGINEERING	1.8%
COMPUTER ENGINEERING	0.9%
COMPUTER SCIENCE	6.3%
DESIGN AUTOMATION-AR	0.9%
ELECTRICAL & COMPUTER ENGINEERING	2.7%
ELECTRICAL ENGINEERING	36.0%
ENGINEERING	0.9%
HIGH SPEED OPTOELECT	0.9%
INDUSTRIAL ENGINEERING	2.7%
MECHANICAL ENGINEERING	9.9%
NUCLEAR ENGINEERING	0.9%
OPERATIONS RESEARCH	4.5%
SOLID STATE SCIENCE	0.9%
SYSTEMS ENGINEERING	0.9%

5. Respondents' degree. M.S. 38.7%; Ph.D. 52.3%; Other (please specify) 4.5% **Missing = 5**

Time respondents were associated with their ERC. **Missing = 7**

One year or less **15.3%**: Two years **27.0%**:

Three years **19.8%**: More than three years **31.5%**

Respondents indicating that while associated with their ERC, they had what they consider to be a close personal collaboration with a mentor in industry.

Yes **14.4%** No **74.8%** Uncertain **6.3%** **Missing = 5**

Respondents indicating that while involved in their ERC, they participated in the following activities. **Missing = 0**

Please check ALL that apply:

73.9%	Participated in the ERC's research program.	
23.4%	Had an ERC fellowship;	If checked, average number checked: **1.2**
44.1%	Participated in an ERC seminar series;	If checked, average number checked: **4.2**
36.0%	Attended ERC meeting with industry;	If checked, average number checked: **2.9**
41.4%	Conducted ERC formal poster session;	If checked, average number checked: **2.0**
31.5%	Attended professional society meeting;	If checked, average number checked: **3.3**
40.5%	Made presentation to university group;	If checked, average number checked: **3.4**
36.0%	Made presentation to industrial group;	If checked, average number checked: **3.0**
40.5%	Made presentation at professional meeting;	If checked, average number checked: **2.9**
22.5%	Visited industrial site;	If checked, average number checked: **3.1**
17.1%	Worked on an industrial project;	If checked, average number checked: **1.8**

Percent of respondents indicating that their involvement in the ERC increased the likelihood that they would pursue another advanced degree.

Yes **21.6%**: No **56.8%**: Uncertain **10.8%** **Missing = 12**

Percent of respondents indicating that their involvement in the ERC increased the likelihood that they would pursue an engineering career.

Yes **34.2%**: No **47.7%**: Uncertain **5.4%** **Missing =14**

Percent of respondents that participated in an REU (Research Experiences for Undergraduates) Program.

Yes **14.4%**: No **79.3%**: Uncertain **2.7%** **Missing = 4**

Percent of respondents that participated in a summer cooperative educational program in industry.

Yes **12.6%**: No **78.4%**: Uncertain **2.7%** **Missing = 7**

Industrially employed MS or Ph.D. graduate's Number One recommendation for how the NSF could improve the ERC experience for graduate students heading for positions in industry.

[NOTE: The numbers in parentheses identify the ERC from which the grad that made the comment came. As there were five ERCs in this pilot project, the numbers range from 1 to 5. The numbers have been included in this attachment in order to enable individuals within each participating ERC to identify comments made by graduates of their center. The only individuals who have access to the key for the center codes are the individuals in the participating centers. These individuals only know their particular center's code. In order to maintain the integrity of the coding system, any information in these comments that might have enabled a reader of this report to decipher the code and thereby identify centers has been modified or deleted.]

( ) Stress more team interaction on projects and coordination of efforts - ongoing projects often lacked continuity due to students leaving.

(01) Encourage more joint projects with industry to allow students to have industrial research experience.

(01) Educate potential students about what the ERC has to offer before they enter graduate school.

(01) More interaction with industry and better understanding of problems in industry (long term) are needed.

(01) Break down the formidable departmental barriers that continue to work against interdepartmental collaboration.

(01) Increase industrial involvement. Increase research contribution of graduate students so that the research momentum is maintained while in industry.

(01) Establish closer relationship between graduate students and industry.

(01) There should be six week industry liaisons to work with industrial groups.

(01) There should be more hardware experience. Also, hire professors with industrial experience.

(01) It seems that many faculty receive ERC funding, but do not bother to be truly involved with ERC research and activities except during industrial or NSF reviews. Students involved in the ERC should be required to work on some sort of inter-group or inter-disciplinary activity at some point.

(01) Provide students/researchers with a comprehensive report regarding what is being done in each of the nation's ERCs; who is doing it, with what industrial sponsors; also include a list of available positions and catalog of ERC publications.

(02) Providing some basic knowledge of patent ability of an invention would be very useful since academic standards of invention are far higher than those of industry.

(02) Increase possibilities for graduate student industrial internships of at least 3 months duration.

(02) The ERC needs more industrial speakers to talk on research problems/approaches.

(02) Provide more funding.

(02) There should be more emphasis on short internships at industrial sites. (x 4)

(02) Participating companies could be more open and descriptive of the types of research they would like to see conducted (and would be willing to sponsor).

(02) Ensure that there is adequate moneys for graduate students to attend/make presentation at many professional meetings. This greatly enhances industrial contact.

(02) Develop a more predefined focus to the center that is maintained throughout its existence. Our center's focus varied year to year and thus little continuity/community was achieved. Of course, the predefined objective must be carefully selected.

(03) Encourage connections between industrial professionals and graduate students. Introduce more opportunities for cooperative/summer employment in industry for students who are going to look for jobs in industry.

(03) Make research at universities more cooperative.

(03) There should be more internships, summer work, joint projects. These are critical to education!

(03) Support students' work on applied research projects most closely associated with industry.

(03) Ensure fair admission (based on merit) for students.

(03) Instill a sense of mission to all participants of the ERCs.

(03) Increase NSF funded summer internships at leading industrial R&D organizations.

(03) There should be more summer internships before graduation in an industry related to their work.

(03) There should be more opportunities to exchange experience of the "cultural change" between academic study and industrial jobs.

(03) Encourage stronger participation in the ERC by industry. In particular, graduate students need to know what high risk/high payoff problems that will face industry over the next 3 to 10 years. This information is not readily available in a university environment.

(03) Encourage the colleges to give students a genuine research experience and not look to students as a way of getting some dirty work done that the professors does not want to do themselves.

(03) Create more contacts between university and industry to facilitate the interview and job search process.

(03) There should be more collaboration with industry. There should be an industrial advisor for each student.

(03) Ensure substantial contact with personnel in a position or field equivalent to that which the student is planning to enter, especially toward the end of the student's degree program.

(03) Every ERC fellowship graduate student should get a mentor in industry.

(03) It is necessary to get real cooperation among the different departments. That is very hard to do under current funding practices. In addition, it is impossible for young professors to cooperate and get tenure at the same time.

(03) Fund more research that has immediate industrial applications in fields where there are jobs waiting for graduates. Don't fund research where there are no jobs.

(03) I participated in at least 3 NSF reviews of our center. Some of the NSF reviewers were poorly informed and inexperienced with the research that they were reviewing. A recommendation to the ERC for how it may improve its program: From 1984 to 1989 there was far too little experience with and concentration on software and computer networking in the [name of specific department]. There was too much on analytical studies of computer networks.

(04) More summer employment for graduate students should be available through the auspices of the ERC.

(04) In my case, the research I did was under the tight control of my advisors. In my opinion the graduate student should be given some freedom to experiment with his ideas and use his creativity in doing his research.

(04) There should be more "hands-on" experimental engineering.

(04) Sponsor some sort of technical writing and/or speaking short courses. The importance of these skills is vastly underestimated by most students and educators.

) Emphasize interdisciplinary team work.

(04) More cooperation with industry.

(04) Industry cooperative program should be mandatory.

(04) Get graduate students more involved in industry and maybe have a 2 month position doing research there.

(04) There should be more active involvement in research organizations of Fortune 500 companies to bring research and development activities to market in the shape of a product.

(04) There should be more industrial projects with involvement of industrial mentors.

(04) Create opportunities for more graduate student exposure to the industry.

(04) Instead of letting just the faculty in on the active research areas, let the students also participate so that they don't just choose what they can get paid for.

(04) There should be more contact with different companies involved (I had contact with only one).

(04) Increase the number of summer co-op opportunities with industry.

(05) Impose schedules and project management; like in the real world.

(05) Need to establish more summer intern programs for the ERC graduate and undergraduate students in INDUSTRY!

(05) Recruit more graduate students who had industrial experience (at least 2 years) after they received their bachelors degree.

Have an industrial member serve on each thesis/dissertation advisory committee.

(05) Encourage more exposure to the industrial partners - both via greater numbers of industrial site visits and via more student interaction when industrial partners visit. (The emphasis was always on showcasing the center to the visiting partners, rather than showcasing the partner; e.g.. opportunities, challenges, perspectives, etc. to the student.)

(05) Help faculty to maintain better organization in pursuing research goals. Better communication is key (there was a bit too much tendency for individuals to get tunnel vision, and those who did were not discouraged from that approa

(05) There should be more organized research objectives throughout the ERC (i.e.. more consistency between projects). More cooperation between professors and students.

(05) Allow graduate students to perform some research "on-site" in industry where it is directly applicable to a real world problem/solution.

V EMPLOYMENT RELATED INFORMATION [INDUSTRIALLY EMPLOYED GRADUATES]

1. Average number of job interviews respondents had following their ERC experience.

   5.9 **Missing = 13**

2. Percent of respondents that had reduced numbers of interviews because they accepted an early offer.

   Yes 40.5% No 49.5%. **Missing = 11**

   If Yes, was the offer from an ERC affiliate? Yes 12.6%: No 27.9%

3. Average number of job interviews respondents had with companies affiliated with their ERC.

   1.5 **Missing = 24**

4. Average number of offers were with companies affiliated with the ERC.

   1.1 **Missing = 23**

5. Average number of offers of employment respondents received following their ERC experience.

   2.6 **Missing = 17**

6. Respondents first full-time post-graduate job with their current employer.

   Yes 75.7: No 18.9 **Missing = 6**

7. Average number of the following authored or co-authored.

   Respondents checked all that applied: **Missing = 0**

Average			
3.5 Internal technical report;	Presented?	Yes 47.7%;	No 14.4%
1.8 Technical report published by industry;	Presented?	Yes 14.6%;	No 10.8%
3.1 Technical report published in prof. journals;	Presented?	Yes 43.2%;	No 16.2%

VI DESCRIPTIVE INFORMATION [INDUSTRIALLY EMPLOYED GRADUATES]

1. Time respondents associated with the ERC university. Years 5: Months 2 **Missing = 4**
2. Time respondents associated with their ERC. Years 2: Months 11 **Missing = 10**

Departments in which industrially employed MS or Ph.D. graduates ERC-related worked.

Missing = 4

AERO AND ASTRO	**2.7%**
APPLIED BIOLOGICAL SCIENCES	**1.8%**
ARCHITECTURE	**0.9%**
BIOTECHNOLOGY	**0.9%**
CHEMICAL ENGINEERING	**18.0%**
CIVIL ENGINEERING	**1.8%**
COMPUTER ENGINEERING	**0.9%**
COMPUTER SCIENCE	**5.4%**
CIR	**0.9%**
ELECTRICAL & COMPUTER ENGINEERING	**3.6%**
ELECTRICAL ENGINEERING	**35.1%**
INDUSTRIAL ENGINEERING	**5.4%**
MATH AND ELECTRICAL ENGINEERING	**0.9%**
MECHANICAL ENGINEERING	**11.7%**
NUCLEAR ENGINEERING	**0.9%**
OPERATIONS RESEARCH	**0.9%**
SYSTEMS ENGINEERING	**0.9%**
SYSTEMS RESEARCH CENTER	**0.9%**
SYSTEM RESEARCH LAB	**0.9%**

Percent of respondents that had an office: **Missing =20**

38.7% in the Center.
43.2% in other university or department space not associated with the ERC.

Percent of respondents that had laboratory space in: **Missing =29**

45.0% in the Center.
28.8% in other university or department space not associated with the ERC.

Respondents ethnic groups: **Missing = 4**

0.9% Native American, Alaskan Indian
36.9% Asian or Pacific Islander
0.0% Black
2.7% Hispanic
55.9% White, not Hispanic

Percent of respondents U.S. Citizen. Yes **64.9%**: No **30.6%** **Missing = 5**

Percent of respondents permanent U.S. resident. Yes **12.6%**: No **19.8%**

If No to either #9 or #10, respondents intentions:

8.1% respondents planning on becoming U.S. Citizens.
7.2% respondents planning on staying in the U.S. but not planing on becoming U.S. Citizens.
3.6% respondents planning on returning to their home country.

10. Department from which industrially employed respondents' received their last post-graduate degrees?

Missing = 8

AERO AND ASTRO	**2.7%**
APPLIED BIOLOGICAL SCIENCE	**1.8%**
ARCHITECTURE	**0.9%**
CHEMICAL ENGINEERING	**17.1%**
CIVIL ENGINEERING	**1.8%**
COMPUTER ENGINEERING	**0.9%**
COMPUTER SCIENCE	**5.4%**
ELECTRICAL & COMPUTER ENGINEERING	**3.6%**
ELECTRICAL ENGINEERING	**36.9%**
INDUSTRIAL ENGINEERING	**6.3%**
MATHEMATICS	**0.9%**
MECHANICAL ENGINEERING	**11.7%**
NUCLEAR ENGINEERING	**0.9%**
OPERATIONS RESEARCH	**0.9%**
SYSTEMS ENGINEERING	**0.9%**

11. Respondents' sex: Male **90.1%**; Female **8.1%** **Missing = 2**

Respondents' average age: **29.9** **Missing = 2**

ATTACHMENT H / Aggregated Results From Five ERCs of the Pilot Follow-up Survey of Doctoral and Master of Science Degree Graduates Who Were Employed in Academia in 1991

Aggregate Results (N = 67: Includes 1 Survey with No Center Identifier)

PROFESSIONAL PREPARATION [ACADEMICALLY EMPLOYED RESPONDENTS]

Respondents' ratings of the relative value of their association with their Engineering Research Center (ERC) in terms of providing them with opportunities for:

a. establishing useful associations with a variety of university faculty:

1	2	3	4	5	6	7	Mean = 4.6
6.1%	12.1%	6.1%	18.2%	22.7%	24.2%	10.6%	Missing = 1

Regular graduate level activities more valuable — **ERC activities more valuable**

---

b. learning about research:

1	2	3	4	5	6	7	Mean = 4.6
3.0%	6.1%	12.1%	24.2%	27.3%	15.2%	12.1%	Missing = 1

Regular graduate level activities more valuable — **ERC activities more valuable**

---

c. participating in hands-on experimental engineering:

1	2	3	4	5	6	7	Mean = 4.0
9.4%	9.4%	15.6%	31.3%	10.9%	17.2%	6.3%	Missing = 3

Regular graduate level activities more valuable — **ERC activities more valuable**

---

d. establishing useful associations with industrial researchers:

1	2	3	4	5	6	7	Mean = 4.6
9.1%	4.5%	12.1%	24.2%	15.2%	13.6%	21.2%	Missing = 1

Regular graduate level activities more valuable — **ERC activities more valuable**

---

e. **A systems orientation can be defined as the process of beginning with an idea and carrying it through all of its development and production to its final manifestation.** With this in mind respondents were asked how valuable was their association with the Engineering Research Center (ERC) in terms of providing them with opportunities for participating in systems oriented research:

1	2	3	4	5	6	7	Mean = 4.7
10.9%	1.6%	7.8%	20.3%	17.2%	29.7%	12.5%	Missing = 3

Regular graduate level activities more valuable — **ERC activities more valuable**

II PROFESSIONAL SKILLS [ACADEMICALLY EMPLOYED RESPONDENTS]

Respondents ratings of the extent to which they felt the ERC met (or did not meet) their expectations helping them to develop the following skills and knowledge:

a. gaining technical knowledge that is useful in academia:

Mean = 4.8
Missing = 0

1	2	3	4	5	6	7
6.0%	4.5%	13.4%	14.9%	19.4%	17.9%	22.4%

ERC not very helpful — **ERC very helpful**

---

b. learning the practical "tricks of the trade" useful for conducting research:

Mean = 4.3
Missing = 0

1	2	3	4	5	6	7
11.9%	9.0%	9.0%	16.4%	25.4%	13.4%	13.4%

ERC not very helpful — **ERC very helpful**

---

c. developing cross-disciplinary teamwork skills that are useful in academia:

Mean = 5.1
Missing = 0

1	2	3	4	5	6	7
4.5%	3.0%	4.5%	17.9%	23.9%	23.9%	20.9%

ERC not very helpful — **ERC very helpful**

---

d. gaining a broader perspective of research that is useful in academia:

Mean = 5.5
Missing = 1

1	2	3	4	5	6	7
3.0%	1.5%	7.5%	7.5%	23.9%	25.4%	29.9%

ERC not very helpful — **ERC very helpful**

III COMPARATIVE VALUE OF ACADEMICALLY EMPLOYED RESPONDENTS' ERC EXPERIENCES

1. Respondent's ratings of how their participation in their ERCs' program compared to the rest of their educational activities:

a. other research opportunities:

Mean = 4.3
Missing = 0

1	2	3	4	5	6	7
6.0%	7.5%	7.5%	32.8%	22.4%	16.4%	6.0%

other research opportunities more valuable — **ERC activities more valuable**

b. other outside work/internship experience:

1	2	3	4	5	6	7
4.5%	13.4%	14.9%	17.9%	19.5%	9.0%	4.5%

Mean = 4.0
Missing = 0

other work/internship experience more valuable — **ERC activities more valuable**

Ratings of academically employed ERC respondents regarding the degree to which experiences gave them competitive edges over other students seeking jobs in academia following graduation.

1	2	3	4	5	6	7
11.9%	11.9%	9.0%	9.0%	23.9%	17.9%	13.4%

Mean = 4.3
Missing = 0

not very — **extremely**

Respondents' overall ratings the quality of the time that they spent at their ERC.

1	2	3	4	5	6	7
0	0	10.4%	16.4%	28.4%	29.9%	13.4%

Mean = 5.2
Missing = 0

poor — **excellent**

EDUCATIONAL/RESEARCH ACTIVITIES [ACADEMICALLY EMPLOYED RESPONDENTS]

In what year did you receive your baccalaureate degree? 19___ [for use in future surveys]

After receiving your baccalaureate degree respondents (respondents checked all that applied):

Missing = 0

9.0%	Obtained part-time employment.
28.4%	Obtained full-time employment.
65.7%	Proceeded directly to graduate school.
4.5%	Other

When did you receive your last post-graduate degree? Month ___ Year 19___ [for use in future surveys]

Respondents' last post-graduate degrees:

Missing = 0

ARCHITECTURE	0.0%
CHEMICAL ENGINEERING	3.0%
CIVIL ENGINEERING	13.4%
COMPUTER ASSISTED DESIGNING	1.5%
COMPUTER ENGINEERING	3.0%
COMPUTER SCIENCE	11.9%
ELECTRICAL & COMPUTER ENGINEERING	4.5%
ELECTRICAL ENGINEERING	34.3%
ENGINEERING	1.5%
MECHANICAL ENGINEERING	16.4%
MOLECULAR BIOLOGY	1.5%
OPERATIONS RESEARCH	3.0%

espondents' last degree: M.S. 23.9%; Ph.D. 70.1%; Other 6.0%

Missing = 0

6. How long respondents were associated with their ERC? **Missing = 0**

One year or less 9.0%: Two years 31.3%:

Three years 25.4%: More than three years 32.8%

7. While associated with the ERC, the percent of respondents that indicated that they had what they considered to be a close personal collaboration with a mentor in industry.

Yes 17.9%: No 71.6% Uncertain 7.5% **Missing = 0**

8. While involved at the ERC, activities in which respondents' participated. **Missing = 0**

Respondents checked ALL that applied:

76.1% Participated in the ERC's research program.	
35.8% Had an ERC fellowship;	If checked, average number checked: 1.0
76.1% Participated in an ERC seminar series;	If checked, average number checked: 3.9
32.8% Attended ERC meeting with industry;	If checked, average number checked: 3.2
52.2% Conducted ERC formal poster session;	If checked, average number checked: 2.8
43.3% Attended professional society meeting;	If checked, average number checked: 2.4
52.2% Made presentation to university group;	If checked, average number checked: 3.6
38.8% Made presentation to industrial group;	If checked, average number checked: 2.1
52.2% Made presentation at professional meeting;	If checked, average number checked: 3.0
41.8% Visited industrial site;	If checked, average number checked: 3.3
22.4% Worked on an industrial project;	If checked, average number checked: 2.5

9. Percent of respondents indicating that their involvement in the ERC increased the likelihood that they would pursue another advanced degree.

Yes 11.9%: No 56.7%: Uncertain 16.4% **Missing = 0**

10. Percent of respondents indicating that their involvement in the ERC increased the likelihood that they would pursue an engineering career.

Yes 29.9%: No 55.2%: Uncertain 9.0% **Missing = 0**

11. Percent of respondents that participated in an REU (Research Experiences for Undergraduates) Program.

Yes 9.0%: No 85.1%: Uncertain 3.0% **Missing = 0**

12. Percent of respondents that participated in a summer cooperative educational program in industry.

Yes 17.9%: No 79.1%: Uncertain 1.5% **Missing = 0**

13. Academically employed MS or Ph.D. Graduates' Number One recommendation for how the NSF could improve the ERC experience for graduate students who are heading for positions in academia.

[NOTE: The numbers in parentheses identify the ERC from which the grad that made the comment came. As there were five ERCs in this pilot project, the numbers range from 1 to 5. The numbers have been included in this attachment in order to enable individuals within each participating ERC to identify comments made by graduates of their center. The only individuals who have access to the key for the center codes are the individuals in the participating centers. These individuals only know their particular center's code. In order to maintain the integrity of the coding system, any information in these comments that might have enabled a reader of this report to decipher the code and thereby identify centers has been modified or deleted.]

(01) Provide more incentives for collaborative research.

(01) No need to improve - it is an excellent program as it stands.

(01) Offer seminar series explaining funding in academia, tenure, etc. Careers in academia are very different. Explanations of career progress, funding, etc. would be very helpful.

(01) Encourage more exposure to research and researchers at other universities. We seemed to concentrate only on activities at our ERC.

(01) Encourage even more industrial cooperation in an attempt to break the academic mindset against practical results.

(01) Have industry help to define research issues and problems to an even greater degree. Make sure that the entire engineering and design process are taken into account in research agendas including human and organizational factors.

(01) Place more stress on publications and less on annual review presentations and posters.

(01) Provide opportunities for students to meet with other ERC members. Initiate visiting faculty programs among the ERCs etc.

(01) Provide more hands on involvement with NSF at the National level.

(01) Require teaching experience.

(01) Encourage more ERC interactions with other academic institutions (outside the home university).

(01) Provide better designed courses.

(01) Insistence on disciplinary courses in student's fields as well as interdisciplinary research

(01) Provide more funding stability.

(01) Set up a series of seminars that compares academic and industrial careers. Also explain to students what is important in both job choices. Set up an alternate course on presentation skills.

(01) Include more teaching experiences. Have poster sessions with other ERCs.

(01) Encourage projects that industrial affiliates are interested in and would be willing to participate in and sponsor. This would give graduate students a better feel for research needs and opportunities.

(03) The ERC's goals are good, even though these goals were only marginally realized. Stronger interactions with industry is strongly recommended. The interdisciplinary systems approach while highly recommended was not achieved while I was in school.

EMPLOYMENT INFORMATION FOR ACADEMICALLY EMPLOYED RESPONDENTS

Average number of job interviews respondents had following your ERC experience.

3.5 **Missing = 0**

Average number of respondents that had a reduced number of interviews because they accepted an early offer.

Yes **28.4%**: No **50.7%** **Missing = 0**

If Yes, was the offer from an ERC affiliate? Yes **6.0%**: No **25.4%** **Missing = 0**

Average number of job interviews respondents had with companies affiliated with their ERC.

0.6 **Missing = 0**

Average number of offers respondents received from companies affiliated with their ERC.

0.4 **Missing = 0**

Average number of employment offers respondents received following their ERC experience.

2.3 **Missing = 0**

Percent of respondents whose first full-time post-graduate job was with their current employer.

Yes **58.2%**: No **16.4%** **Missing = 0**

7. Average number respondents authored or co-authored. Respondents checked all that applied:

Average — **Missing = 0**

4.1 Internal technical report;	Presented?	Yes 44.8%;	No 17.9%
3.0 Technical report published by industry;	Presented?	Yes 19.4%;	No 3.0%
3.8 Technical report published in prof. journals;	Presented?	Yes 62.7%;	No 13.4%

VI DEMOGRAPHIC/DESCRIPTIVE INFORMATION

1. Time respondents were associated with the ERCs' university.

Years 5: Months 1: — **Missing = 0**

2. Time respondents were associated with the ERC.

Years 2: Months 10: — **Missing = 0**

3. Departments in which respondents did ERC-related work. — **Missing = 0**

ARCHITECTURE	**4.5%**
CHEMICAL ENGINEERING	**13.4%**
CIVIL ENGINEERING	**4.5%**
COMPUTER SCIENCE	**10.4%**
DESIGN	**1.5%**
ELECTRICAL AND COMPUTER ENGINEERING	**12.0%**
ENGINEERING	**1.5%**
INDUSTRIAL ENGINEERING	**1.5%**
MECHANICAL ENGINEERING	**13.4%**
OPERATIONS RESEARCH	**1.5%**

4. Percent of respondents that had an office: — **Missing = 0**

44.8% in the Center.
49.3% in other university or department space not associated with the ERC.

5. Percent of respondents that had laboratory space in: — **Missing = 0**

41.8% in the Center.
31.3% in other university or department space not associated with the ERC.

6. Respondents' ethnic groups: — **Missing = 0**

0.0% Native American, Alaskan Indian
4.3% Asian or Pacific Islander
.0% Black
.0% Hispanic
5.2% White, not Hispanic

7. Percent of respondents U.S. Citizens.

Yes 49.3%: No 49.3% — **Missing = 0**

8. Percent of respondents permanent U.S. residents. — **Missing = 0**

Yes 13.4%: No 34.3%

9. If No to either #9 or #10, respondents' intentions: — **Missing = 0**

9.0% respondents planning on becoming a U.S. Citizens.
7.5% respondents planning on staying in the U.S. but not planing on becoming U.S. Citizens.
7.5% respondents planning on returning to their home country.

10. Departments from which respondents received their last post-graduate degree. **Missing = 0**

ARCHITECTURE	**4.5%**
BIOLOGY	**1.5%**
CHEMICAL ENGINEERING	**11.9%**
CIVIL ENGINEERING	**4.5%**
COMPUTER SCIENCE	**11.9%**
ELECTRICAL & COMPUTER ENGINEERING	**10.5%**
ELECTRICAL ENGINEERING	**34.3%**
ENGINEERING	**1.5%**
MECHANICAL ENGINEERING	**14.9%**
OPERATIONS RESEARCH	**3.0%**

11. Respondents' sex: Male **86.6%**; Female **10.4%** **Missing = 0**

Respondents' average age: **31.2**

ATTACHMENT I / Results of 1991-92 Pilot of ERC Undergraduate Student Pre-Graduation Survey
(N = 28: Missing Cases = 0)

I PROFESSIONAL PREPARATION

Respondents' ratings of how valuable their association with the Engineering Research Center (ERC) was in terms of providing them with opportunities for:

a. learning about research:

1	2	3	4	5	6	7	
0%	0%	0%	0%	14.3%	57.1%	28.6%	Mean = 6.1

Regular undergraduate activities more valuable — **ERC activities more valuable**

c. participating in hands-on experimental engineering:

1	2	3	4	5	6	7	
0%	0%	0%	7.1%	28.6%	35.7%	28.6%	Mean = 5.9

Regular undergraduate activities more valuable — **ERC activities more valuable**

b. learning about R & D from an industrial perspective:

1	2	3	4	5	6	7	
0%	0%	0%	14.3%	25.0%	39.3%	21.4%	Mean = 5.7

Regular undergraduate activities more valuable — **ERC activities more valuable**

II PROFESSIONAL SKILLS

Respondents' rating of the extent to which they felt the ERC met (or did not meet) their expectations in helping them develop the following skills and knowledge:

a. gaining technical knowledge:

1	2	3	4	5	6	7	
0%	0%	0%	0%	42.9%	35.7%	21.4%	Mean = 5.9

ERC not very helpful — **ERC very helpful**

b. developing cross-disciplinary teamwork skills:

1	2	3	4	5	6	7	
0%	0%	10.7%	17.9%	28.6%	32.1%	10.7%	Mean = 5.4

ERC not very helpful — **ERC very helpful**

c. gaining a broader perspective of research:

1	2	3	4	5	6	7	
0%	0%	0%	0%	17.9%	50.0%	32.1%	Mean = 6.1

ERC not very helpful — **ERC very helpful**

III COMPARATIVE VALUE OF YOUR ERC EXPERIENCE

1. Respondents'ratings of how their participation in the ERCs' program compare to the rest of their educational activities:

a. Non-ERC research opportunities:

1	2	3	4	5	6	7	Not Applicable	
0%	0%	0%	0%	14.3%	32.1%	17.9%	21.4%	Mean = 6.1

other research opportunities more valuable — **ERC activities more valuable**

---

b. other outside work/internship experience:

1	2	3	4	5	6	7	Not Applicable	
0%	0%	7.1%	3.6%	17.9%	32.1%	17.9%	21.4%	Mean = 5.4

other research opportunities more valuable — **ERC activities more valuable**

2. Respondents' opinions as to the extent to which their ERC experiences gave them a competitive edge over other students seeking similar jobs or education following graduation?

1	2	3	4	5	6	7	
0%	0%	0%	14.3%	28.6%	32.1%	25.0%	Mean = 5.3

not very — **extremely**

---

3. Respondents' overall ratings of the quality of the time that they spent at their ERC?

1	2	3	4	5	6	7	
0%	0%	0%	0%	21.4%	46.4%	32.1%	Mean = 6.1
poor						excellent	

IV EDUCATIONAL/RESEARCH ACTIVITIES

1. In what year will you receive your baccalaureate degree? 19___ [for use in later surveys]

2. Percent of respondents expecting that their first full-time post-baccalaureate job would be with a current ERC industrial affiliate.

   Yes 7%: No 7.1%: Uncertain 82.1%

3. Length of time respondents participated in their University's ERC.

   Three months 71.4%: Six months 21.4%: One year 0%: More than one year 7.1%

4. While involved in the ERC, activities in which respondents participated.

   Respondents were asked to check ALL that apply:

92.9%	Participated in the ERC's research program.	
25%	Had an ERC fellowship;	If checked, how many? 1
0%	Participated in an ERC seminar series;	If checked, how many?
0%	Attended ERC meeting with industry	If checked, how many?
0%	Conducted ERC formal poster session;	If checked, how many?
0%	Attended professional society meeting;	If checked, how many?
0%	Made presentation to university group;	If checked, how many?
0%	Made presentation to industrial group;	If checked, how many?
0%	Made presentation at prof. society meeting;	If checked, how many?
7.1%	Visited industrial site;	If checked, how many? 1
17.9%	Worked on an industrial project;	If checked, how many? 1

5. Has your involvement in the ERC increased the likelihood that you will pursue another advanced degree.

   Yes 85.7%: No 0% Uncertain 14.3%

6. Has your involvement in the ERC increased the likelihood that you will pursue an engineering career.

   Yes 82.1%: No 3.6% Uncertain 14.3

   If Yes, please check one of the following:

   In industry 39.3%: In academia 21.4%: Uncertain 21.4%

7. Respondents' recommendations as to how the NSF could improve the ERC experience for undergraduate students?

V EMPLOYMENT RELATED INFORMATION

1. Percent of respondents planning to accept an offer of employment from a company affiliated with the ERC.

Yes 10.7%: No 14.3%: Uncertain 75%

VI DEMOGRAPHIC/DESCRIPTIVE INFORMATION

1. Time respondents had been at the ERCs' university. Years 2: Months 2

2. Departments in which respondents did their ERC-related work.

AERONAUTICAL ENGINEERING	7.4%
ELECTRICAL ENGINEERING	33.3%
INDUSTRIAL ENGINEERING & COM.	3.7%
INDUSTRIAL ENGINEERING	22.2%
MANAGEMENT	7.4%
MATERIALS SCI. ENGINEERING	7.4%
MECHANICAL ENGINEERING	18.5%

3. Percent of respondents that participated in any REU (Research Experience for Undergraduates) Program.

Yes 14.3%: No 75% Uncertain 10.7%

4. Percent of respondents reporting participation in a summer cooperative educational program in industry.

Yes 3.6%: No 92.9%: Uncertain 3.6%

5. Respondents' ethnic group:

0%	Native American, Alaskan Indian
32.1%	Asian or Pacific Islander
0%	Black
7.1%	Hispanic
60.7%	White, not Hispanic

6. Percent of respondents who were U.S. Citizens. Yes 71.4% [go to 9]: No 28.6% [go to 7]

7. Percent of respondents who were permanent U.S. residents. Yes 7.1% [go to 9]: No 21.4% [go to 8]

8. If No to either #9 or #10, percent of these respondents with various intentions:

14.3%	Percent of respondents planning on becoming a U.S. Citizen.
7.1%	Percent of respondents planning on staying in the U.S. but not planning on becoming Citizens.
3.6%	Percent of respondents planning on returning to their home country.

9. Respondents' final degree objective. MS 64.3% PHD 32.1%

10. Percent of respondents who plan on working in industry before obtaining their final degree objective.

Yes 17.9%: No 32.1%: Uncertain 50%

Respondents' sex. Male 71.4%: Female 28.6%

12. Respondents' average age? 21.1

ATTACHMENT J / Results of 1991-92 Pilot of Graduate Student Pre-Graduation Survey
(N = 22: Missing Cases = 0)

I PROFESSIONAL PREPARATION

Respondents' ratings of how valuable their association with the Engineering Research Center (ERC) was in terms of providing them with opportunities for:

a. learning about research:

1	2	3	4	5	6	7	Mean = 5.3
0%	9.1%	9.1%	4.5%	27.3%	22.7%	27.3%	

Regular graduate level activities more valuable — **ERC activities more valuable**

b. participating in hands-on experimental engineering:

1	2	3	4	5	6	7	Mean = 5.4
0%	4.5%	4.5%	18.2%	13.6%	40.9%	18.2%	

Regular graduate level activities more valuable — **ERC activities more valuable**

c. learning about R & D from an industrial perspective:

1	2	3	4	5	6	7	Mean = 5.8
0%	4.5%	4.5%	4.5%	9.1%	45.5%	31.8%	

Regular graduate level activities more valuable — **ERC activities more valuable**

d. establishing useful associations with industrial researchers:

1	2	3	4	5	6	7	Mean = 5.5
4.5%	4.5%	9.1%	9.1%	9.1%	22.7%	40.9%	

Regular graduate level activities more valuable — **ERC activities more valuable**

e. establishing useful associations with a variety of university faculty:

1	2	3	4	5	6	7	Mean = 4.8
0%	9.1%	13.6%	13.6%	22.7%	36.4%	4.5%	

Regular graduate level activities more valuable — **ERC activities more valuable**

f. How valuable was your association with the Engineering Research Center (ERC) in terms of providing you with opportunities to have experiences with an engineering system? **[An engineering system is composed of integrated components and subsystems which are designed to optimally implement a function]:**

1	2	3	4	5	6	7	Mean = 5.6
0%	4.5%	9.1%	4.5%	22.7%	22.7%	36.4%	

Regular graduate level activities more valuable — **ERC activities more valuable**

PROFESSIONAL SKILLS

Respondents' ratings of the extent to which they felt the ERC met (or did not meet) their expectations in helping you develop the following skills and knowledge:

a. gaining technical knowledge:

1	2	3	4	5	6	7	Mean = 5.3
0%	4.5%	4.5%	9.1%	31.8%	36.4%	13.6%	

ERC not very helpful — **ERC very helpful**

---

b. developing cross-disciplinary teamwork skills:

1	2	3	4	5	6	7	Mean = 5.7
0%	9.1%	4.5%	4.5%	4.5%	45.5%	31.8%	

ERC not very helpful — **ERC very helpful**

---

c. gaining a broader perspective of research:

1	2	3	4	5	6	7	Mean = 6.1
0%	0%	0%	9.1%	22.7%	22.7%	45.5%	

ERC not very helpful — **ERC very helpful**

---

d. learning the practical "tricks of the trade" useful for conducting research:

1	2	3	4	5	6	7	Mean = 5.1
4.5%	4.5%	4.5%	18.2%	36.4%	18.2%	18.2%	

ERC not very helpful — **ERC very helpful**

III COMPARATIVE VALUE OF YOUR ERC EXPERIENCE

1. Percent of respondents reporting the extent to which their participation in their ERC's program compared to the rest of their educational activities:

   a. other research opportunities:

1	2	3	4	5	6	7	Mean = 5.3
0%	4.5%	4.5%	13.6%	27.3%	22.7%	22.7%	

other research opportunities more valuable — **ERC activities more valuable**

---

   b. other outside work/internship experience:

1	2	3	4	5	6	7	Mean = 4.7
0%	4.5%	4.5%	27.3%	18.2%	22.7%	0%	

other work/internship experience more valuable — **ERC activities more valuable**

2. Do you think that your ERC experiences have given you a competitive edge over other students seeking similar jobs or education following graduation?

1	2	3	4	5	6	7	Mean = 4.7
13.6%	9.1%	4.5%	9.1%	18.2%	22.7%	22.7%	

not very — **extremely**

3. Overall, how would you rate the quality of the time that you've spent at the ERC?

1	2	3	4	5	6	7	Mean = 5.9
4.5%	0%	0%	9.1%	13.6%	31.8%	40.9%	

poor — **excellent**

IV EDUCATIONAL/RESEARCH ACTIVITIES

1. In what year did you receive your baccalaureate degree? 19___ [for use in later surveys]
2. Respondents' plans after receiving their baccalaureate degree (please check all that apply):

9.1%	Obtain part-time employment.
36.4%	Obtain full-time employment.
59.1%	Proceed directly to graduate school.
0%	Other (please specify) _____

3. When did you receive your last post-graduate degree? Month ___ Year 19___ [for use in later surveys]
4. Respondents' last post-graduate degree field.

CIVIL ENGINEERING	4.5%
COMPUTER SCIENCE	13.6%
ELECTRICAL ENGINEERING	59.1%
MECHANICAL ENGINEERING	4.5%
NETWORK MANAGEMENT	4.5%
OPERATIONS RESEARCH	9.1%

5. Respondents' that degree. MS. 54.5%; PHD 40.9%; Other (please specify) 4.5%

Length of time respondents were associated with their ERC.

One year or less 18.2%: Two years 13.6%:

Three years 22.7%: More than three years 40.9%

While associated with their ERC, percent of respondents who reported they had a close personal collaboration with a mentor in industry.

Yes 27.3%: No 59.1%: Uncertain 9.1%

While involved in their ERC, percent of respondents who reported participation in the following activities.

Respondents were asked to check all that applied:

81.8%	Participated in the ERC's research program.	
59.1%	Had an ERC fellowship;	If checked, how many? 1.1
54.5%	Participated in an ERC seminar series;	If checked, how many? 5.9
27.3%	Attended ERC meeting with industry;	If checked, how many? 4.3
50.0%	Conducted ERC formal poster session;	If checked, how many? 2.3
54.5%	Attended professional society meeting;	If checked, how many? 4.3
50.0%	Made presentation to university group;	If checked, how many? 4.7
31.8%	Made presentation to industrial group;	If checked, how many? 4.0
40.9%	Made presentation at professional meeting;	If checked, how many? 2.9
31.8%	Visited industrial site;	If checked, how many? 2.6
9.1%	Worked on an industrial project;	If checked, how many? 1.0

Average number of the following which respondents reported having authored or co-authored.

Respondents were asked to check all that applied:

Number		
0.68	Internal technical report;	Presented? Yes 27.3%; No 18.2%
0.14	Technical report published by industry;	Presented? Yes 4.5%; No 9.1%
0.68	Technical report published in prof. journals;	Presented? Yes 59.1%; No 0%

Percent of respondents reporting that their involvement in the ERC increased the likelihood that they would pursue another advanced degree.

Yes 36.4%: No 27.3%: Uncertain 13.6%

Percent of respondents reporting that their involvement in the ERC increased the likelihood that they would pursue an engineering career.

Yes 40.9%: No 4.5%: Uncertain 27.3%: Not Applicable 22.7%

Percent of respondents that reported they participated in a summer cooperative educational program in industry.

Yes 31.8%: No 50.0%: Uncertain 13.6%: Not Applicable 0%

Respondents recommendations as to how the NSF could improve the ERC experience for graduate students.

V EMPLOYMENT RELATED INFORMATION

1. Percent of respondents planning to accept an offer of employment from a company affiliated with their ERC.

   Yes **36.4%**: No **27.3%**: Uncertain **27.3%**

VI DEMOGRAPHIC/DESCRIPTIVE INFORMATION

1. Time respondents reported being at the ERC's university. Years **4**; Months **2**

2. Percent of respondents that reported they had an office:

   40.9% in the Center.
   54.5% in other university or department space not associated with the ERC.

3. Percent of respondents that reported they had laboratory space in:

   45.5% in the Center.
   31.8% in other university or department space not associated with the ERC.

4. Respondents' ethnic group:

0%	Native American, Alaskan Indian
50%	Asian or Pacific Islander
0%	Black
0%	Hispanic
50%	White, not Hispanic

5. Percent of respondents that were U.S. Citizens.

   Yes **22.7%** **[go to 8]**: No **77.3%** **[go to 6]**

6. Percent of respondents that were permanent U.S. residents.

   Yes **4.5%** **[go to 8]**: No **72.7%** **[go to 7]**

7. If No, intentions of remaining respondents:

   18.2% Respondents planning on becoming U.S. Citizens.
   31.8% Respondents planning on staying in the U.S. but not planning on becoming U.S. Citizens.
   13.6% Respondents planning on returning to their home country.

8. Respondents' final degree objectives. MS **4.5%** PHD **68.2%**

9. Respondents' sex. Male **81.8%**: Female **18.2%**

10. Respondents' average age: **29.1**

ATTACHMENT K / Item Key for Center Results of Pilot 1991-92 Surveys of ERC BS Degree Graduates (Center Identities Masked)

I PROFESSIONAL PREPARATION

How valuable was your association with the Engineering Research Center (ERC) in terms of providing you with opportunities for:

a. learning about research.
b. participating in hands-on experimental engineering.
c. learning about R & D in industrial setting(s).

II PROFESSIONAL SKILLS

Rate the extent to which you feel the ERC met (or did not meet) your expectations in helping you develop the following skills and knowledge:

a. gaining technical knowledge.
b. developing cross-disciplinary teamwork skills.
c. gaining a broader perspective of research.

III COMPARATIVE VALUE OF YOUR ERC EXPERIENCE

1. How did your participation in the ERC's program compare to the rest of your educational activities:

   a. non-ERC research opportunities:
   b. other outside work/internship experience.

2. Do you think that your ERC experiences have given you a competitive edge over other students seeking similar jobs following graduation?

3. Overall, how would you rate the quality of the time that you spent at the ERC?

V EMPLOYMENT RELATED INFORMATION

1. How many job interviews did you have following your ERC experience?
3. How many of your job interviews were with companies affiliated with the ERC?
4. How many offers of employment did you have following your ERC experience?
5. How many of your offers were with companies affiliated with the ERC?

VI DEMOGRAPHIC/DESCRIPTIVE INFORMATION

1. How long have you been at the ERC's university?
2. What is your age?

ATTACHMENT K / Center Means and Standard Deviations From Pilot 1991-92 Surveys of ERC Bachelor Graduates (Center Identities Masked)

Center Number		1	2	3	4	5*	OVERALL
		(N=14)	(N=10)	(N=3)	(N=6)	(N=0)*	(N=33)
I.1.a.		5.55	5.63	5.75	6.40		5.69
	[s.d.]	[1.13]	[0.92]	[0.50]	[0.55]		[0.92]
I.1.b.		5.07	5.88	6.00	6.60		5.62
	[s.d.]	[1.54]	[0.99]	[0.82]	[0.55]		[0.26]
I.1.c.		4.92	5.40	5.00	4.60		5.03
	[s.d.]	[1.38]	[1.52]	[1.73]	[1.14]		[1.26]
II.a.		5.00	5.25	6.25	5.80		5.38
	[s.d.]	[1.36]	[1.04]	[0.50]	[1.30]		[1.28]
II.b.		4.43	4.88	6.00	4.40		4.62
	[s.d.]	[1.40]	[1.46]	[0.82]	[1.52]		[1.42]
II.c.		5.58	5.63	6.25	5.40		5.65
	[s.d.]	[0.94]	[0.74]	[0.96]	[1.14]		[0.92]
III.1.a.		6.36	5.75	6.75	6.80		6.24
	[s.d.]	[2.21]	[1.83]	[2.63]	[1.30]		[1.95]
III.1.b.		5.79	5.00	6.25	7.80		6.14
	[s.d.]	[2.64]	[2.38]	[2.06]	[1.64]		[2.34]
III.2		5.23	5.00	5.67	5.40		5.31
	[s.d.]	[1.09]	[2.27]	[0.58]	[1.52]		[1.49]
III.3		5.43	5.50	6.25	6.20		5.76
	[s.d.]	[0.76]	[0.93]	[0.96]	[1.10]		[0.93]
V.1.		7.30	4.00	1.33	0.50		4.42
	[s.d.]	[5.21]	[4.00]	[2.31]	[0.58]		[4.71]
V.3.		0.25	0.33		0.00		0.23
	[s.d.]	[0.71]	[0.58]		[0.00]		[0.60]
V.4.		1.58	3.67	1.00	0.67		1.79
	[s.d.]	[0.98]	[1.16]	[0.00]	[0.58]		[1.37]
V.5		0.83	2.00	1.00	0.00		1.00
	[s.d.]	[2.04]	[2.65]	[0.00]	[0.00]		[1.83]
VI.1.		25.75	48.00	34.00	46.50		38.16
	[s.d.]	[27.15]	[6.93]	[9.17]	[3.00]		[20.23]
VI.2.		24.79	23.22	24.50	26.60		24.21
	[s.d.]	[4.09]	[0.97]	[1.29]	[2.30]		[2.94]

* Data collection at this center, by decision of the PI, was limited to graduates employed by industry.

ATTACHMENT L / Item Key for Center Results of Pilot 1991-92 Surveys of ERC Graduates Working in Industry Settings (Center Identies Masked)

I PROFESSIONAL PREPARATION

How valuable was your association with the Engineering Research Center (ERC) in terms of providing you with opportunities for:

a. establishing useful associations with a variety of university faculty.
b. learning about research.
c. participating in hands-on experimental engineering.
d. establishing useful associations with industrial researchers.
e. How valuable was your association with the Engineering Research Center (ERC) in terms of providing you with opportunities for participating in systems oriented research.

II PROFESSIONAL SKILLS

Rate the extent to which you feel the ERC met (or did not meet) your expectations in helping you develop the following skills and knowledge:

a. gaining technical knowledge that is useful in industry.
b. learning the practical "tricks of the trade" useful for conducting research.
c. developing cross-disciplinary teamwork skills that are useful in industry.
d. gaining a broader perspective of research that is useful in industry.

III COMPARATIVE VALUE OF YOUR ERC EXPERIENCE

1. How did your participation in the ERCs' program compare to the rest of your educational activities:

   a. other research opportunities.

   b. other outside work/internship experience.

2. Do you think that your ERC experiences have given you a competitive edge over other students seeking jobs in industry following graduation?

3. Overall, how would you rate the quality of the time that you've spent at the ERC?

ATTACHMENT L / Center Means and Standard Deviations For Pilot 1991-92 Surveys of Master's & Ph.D.'s Graduates Working in Industrial Settings (Center Identities Masked)

Center Number	1 (N=16)	2 (N=17)	3 (N=34)	4 (N=27)	5* (N=15)	OVERALL (N=109)
I. Professional Preparations						
I.1.a.	**4.3**	**5.1**	**4.6**	**4.0**	**5.1**	**4.6**
[S.D.]	[1.8]	[1.1]	[1.7]	[1.4]	[1.7]	[1.6]
I.1.b.	**4.3**	**5.5**	**5.0**	**4.0**	**5.3**	**4.8**
[S.D.]	[1.5]	[1.5]	[1.4]	[1.8]	[1.7]	[1.7]
I.1.c.	**4.2**	**5.6**	**5.2**	**4.3**	**5.4**	**5.0**
[S.D.]	[1.6]	[1.1]	[1.6]	[1.7]	[1.5]	[1.6]
I.1.d.	**4.5**	**5.5**	**5.2**	**4.7**	**4.7**	**5.0**
[S.D.]	[1.8]	[1.3]	[1.6]	[1.4]	[1.5]	[1.5]
I.1.e.	**4.6**	**4.9**	**5.0**	**4.4**	**5.4**	**4.8**
[S.D.]	[1.6]	[1.4]	[1.7]	[1.4]	[1.1]	[1.5]
II. Professional Skills						
II.1.a.	**4.5**	**5.5**	**5.1**	**4.4**	**5.1**	**4.9**
[S.D.]	[1.5]	[1.1]	[1.6]	[1.4]	[1.5]	[1.5]
II.1.b.	**4.6**	**4.9**	**4.7**	**4.3**	**4.9**	**4.7**
[S.D.]	[1.5]	[1.3]	[1.5]	[1.4]	[1.5]	[1.4]
II.1.c.	**4.9**	**5.8**	**4.9**	**4.6**	**5.4**	**5.1**
[S.D.]	[1.9]	[1.3]	[1.6]	[1.3]	[1.4]	[1.5]
II.1.d.	**5.3**	**5.6**	**5.3**	**4.7**	**5.7**	**5.3**
[S.D.]	1.1]	[1.2]	[1.7]	[1.3]	[1.3]	[1.4]
III. Comparative Value of Center/Department						
III. 1.a.	**4.3**	**4.5**	**4.8**	**4.5**	**5.2**	**4.7**
[S.D.]	[1.3]	[1.3]	[1.5]	[1.6]	[1.3]	[1.7]
III.1.b.	**4.0**	**4.4**	**3.8**	**4.0**	**4.2**	**4.0**
[S.D.]	[2.1]	[1.6]	[1.7]	[1.6]	[1.5]	[1.7]
III.2.	**3.9**	**5.6**	**4.9**	**4.7**	**4.3**	**4.7**
[S.D.]	[2.0]	[1.3]	[1.7]	[1.8]	[1.6]	[1.7]
III.3.	**5.1**	**5.8**	**5.3**	**5.0**	**5.6**	**5.3**
[S.D.]	1.6]	[1.0]	[1.5]	[1.6]	[1.2]	[1.4]

ATTACHMENT L / Item Key for Center Results of Pilot 1991-92 Surveys of ERC Graduates Working in Industry Settings (Center Identities Masked)

V EMPLOYMENT RELATED INFORMATION

1. How many job interviews did you have following your ERC experience?
3. How many of your job interviews were with companies affiliated with the ERC?
4. How many of your offers were with companies affiliated with the ERC?
5. How many offers of employment did you have following your ERC experience?
7. How many of the following have you authored or co-authored? Please check all that apply:

   a. Internal technical reports
   b. Technical reports published by industry.
   c. Technical reports published in prof. journals.

VI DEMOGRAPHIC/DESCRIPTIVE INFORMATION

1. How long were you associated with the ERCs' university?
2. How long were you associated with the ERC?
3. What is your age ?

ATTACHMENT L / Center Means and Standard Deviations For Pilot 1991-92 Surveys of Master's & Ph.D.'s Graduates Working in Industrial Settings (Center Identities Masked)

Center Number		1 (N=16)	2 (N=17)	3 (N=34)	4 (N=27)	5* (N=15)	OVERALL (N=109)
V.	**Employment Related Information**						
V.1.		**8.0**	**7.8**	**3.7**	**4.8**	**7.3**	**5.9**
	[S.D.]	[7.5]	[6.3]	[2.6]	[12.7]	[5.5]	[7.7]
V.3.		**2.2**	**2.7**	**1.3**	**0.9**	**0.8**	**1.5**
	[S.D.]	[2.2]	[2.7]	[1.2]	[1.9]	[1.3]	[1.9]
V.4.		**0.9**	**2.5**	**0.8**	**0.9**	**0.5**	**1.1**
	[S.D.]	[1.1]	[3.0]	[0.8]	[1.9]	[0.8]	[1.8]
V.5.		**2.7**	**4.7**	**1.7**	**1.8**	**2.9**	**2.6**
	[S.D.]	[1.4]	[2.0]	[1.3]	[2.3]	[2.0]	[2.0]
V.7.a.		**2.2**	**3.8**	**3.6**	**4.6**	**3.1**	**3.5**
	[S.D.]	[1.4]	[2.3]	[2.4]	[7.5]	[4.5]	[4.2]
V.7.b.		**1.0**	**1.8**	**1.6**	**3.0**	**1.3**	**1.8**
	[S.D.]	[0.8]	[2.4]	[1.6]	[3.6]	[1.0]	[2.1]
V.7.c.		**3.8**	**3.3**	**3.3**	**1.7**	**2.3**	**3.1**
	[S.D.]	[2.4]	[3.3]	[2.3]	[2.6]	[2.3]	[2.7]
VI.	**Demographic/Descriptive Information**						
VI.1.		**52.3**	**56.3**	**67.5**	**66.3**	**59.0**	**62.0**
	[S.D.]	[24.7]	[13.0]	[27.7]	[36.4]	[27.6]	[28.1]
VI.2.		**27.9**	**37.2**	**41.5**	**35.4**	**26.2**	**35.2**
	[S.D.]	[13.7]	[11.5]	[20.3]	[15.1]	[10.0]	[16.5]
VI.3		**28.6**	**29.5**	**30.1**	**31.2**	**28.9**	**29.9**
	[S.D.]	[4.1]	[2.2]	[3.9]	[5.1]	[5.8]	[4.4]

ATTACHMENT M / Item Key for Center Results of Pilot 1991-92 Surveys of ERC Graduates Working in Academic Settings (Center Identities Masked)

I PROFESSIONAL PREPARATION

How valuable was your association with the Engineering Research Center (ERC) in terms of providing you with opportunities for:

a. establishing useful associations with a variety of university faculty.
b. learning about research.
c. participating in hands-on experimental engineering.
d. establishing useful associations with industrial researchers.
e. How valuable was your association with the Engineering Research Center (ERC) in terms of providing you with opportunities for participating in systems oriented research.

II PROFESSIONAL SKILLS

Rate the extent to which you feel the ERC met (or did not meet) your expectations in helping you develop the following skills and knowledge:

a. gaining technical knowledge that is useful in academia.
b. learning the practical "tricks of the trade" useful for conducting research.
c. developing cross-disciplinary teamwork skills that are useful in academia.
d. gaining a broader perspective of research that is useful in academia.

III COMPARATIVE VALUE OF YOUR ERC EXPERIENCE

1. How did your participation in the ERCs' program compare to the rest of your educational activities:

   a. other research opportunities.
   b. other outside work/internship experience.

2. Do you think that your ERC experiences have given you a competitive edge over other students seeking jobs in academia following graduation?

3. Overall, how would you rate the quality of the time that you've spent at the ERC?

ATTACHMENT M / Center Means and Standard Deviations From Pilot 1991-91 Surveys of Graduates Working in Academic Settings (Center Identities Masked)

Center Number		1 (N=30)	2 (N=6)	3 (N=13)	4 (N=17)	5* (N=0)	OVERALL (N=66)
I.	**Professional Preparations**						
I.1.a.		**4.5**	**4.5**	**4.2**	**4.8**		**4.5**
	[s.d.]	[2.0]	[1.8]	[1.8]	[1.2]		[1.7]
I.1.b.		**4.6**	**4.1**	**4.3**	**4.9**		**4.6**
	[s.d.]	[1.4]	[1.7]	[1.3]	[1.7]		[1.5]
I.1.c.		**3.7**	**3.5**	**4.6**	**4.4**		**40**
	[s.d]	[1.5]	[2.0]	[1.4]	[1.9]		[1.7]
I.1.d.		**4.6**	**4.3**	**4.8**	**4.5**		**4.6**
	[s.d.]	[1.9]	[2.7]	[1.7]	[4.7]		[1.9]
I.1.e.		**4.7**	**3.2**	**4.9**	**5.1**		**4.7**
	[s.d.]	[1.8]	[2.2]	[1.6]	[1.5]		[1.8]
II.	**Professional Skills**						
II.1.a.		**4.5**	**3.8**	**4.8**	**5.8**		**4.8**
	[s.d.]	[1.7]	[2.6]	[1.9]	[1.1]		[1.8]
II.1.b.		**4.0**	**4.5**	**4.6**	**4.6**		**4.3**
	[s.d.]	[1.9]	[2.8]	[1.7]	[1.7]		[1.9]
II.1.c.		**5.1**	**4.3**	**5.3**	**5.3**		**5.1**
	[s.d.]	[1.6]	[2.3]	[1.6]	[1.1]		[1.6]
II.1.d.		**5.4**	**4.7**	**5.8**	**5.6**		**5.5**
	[s.d.]	[1.6]	[2.7]	[0.8]	[1.2]		[1.5]
III.	**Comparative Value of Center/Department**						
III.1.a.		**4.1**	**4.7**	**4.3**	**4.6**		**4.3**
	[s.d.]	[1.5]	[1.0]	[1.3]	[1.8]		[1.5]
III.1.b.		**3.7**	**4.0**	**4.4**	**4.0**		**3.9**
	[s.d.]	[1.6]	[1.6]	[1.7]	[1.6]		[1.6]
III.2.		**4.2**	**4.2**	**4.6**	**4.3**		**4.3**
	[s.d.]	[1.9]	[2.5]	[2.1]	[2.0]		[2.0]
III.3.		**4.9**	**5.3**	**5.4**	**5.5**		**5.2**
	[s.d.]	[1.2]	[1.5]	[0.8]	[1.3]		[1.2]

* Data collection at this center, by decision of the PI, was limited to graduates employed by industry.

ATTACHMENT M /Item Key for Center Results of From Pilot 1991-91 Surveys of ERC Graduates Working in Academic Settings (Center Identities Masked)

V EMPLOYMENT RELATED INFORMATION

1. How many job interviews did you have following your ERC experience?

3. How many of your job interviews were with companies affiliated with the ERC?

4. How many of your offers were with companies affiliated with the ERC?

5. How many offers of employment did you have following your ERC experience?

7. How many of the following have you authored or co-authored? Please check all that apply:

   a. Internal technical reports.

   b. Technical reports published by industry.

   c. Technical reports published in prof. journals.

VI DEMOGRAPHIC/DESCRIPTIVE INFORMATION

1. How long were you associated with the ERCs' university ?

2. How long were you associated with the ERC?

11. What is your age ?

ATTACHMENT M / Center Means and Standard Deviations From Pilot 1991-91 Surveys of Graduates Working in Academic Settings (Center Identities Masked)

Center Number	1 (N=30)	2 (N=6)	3 (N=13)	4 (N=17)	5* (N=0)	OVERALL (N=66)
V. Employment Related Information						
V.1.	**3.1**	**3.8**	**4.5**	**3.2**		**3.5**
[s.d.]	[2.7]	[3.7]	[3.5]	[1.7]		[2.7]
V.3.	**0.6**	**1.2**	**1.1**	**0.1**		**0.6**
[s.d.]	[1.0]	[1.3]	[1.3]	[1.3]		[0.3]
V.4.	**0.5**	**0.8**	**0.7**	**0.0**		**0.4**
[s.d.]	[0.9]	[0.8]	[1.0]	[0.0]		[0.8]
V.5.	**2.2**	**2.6**	**2.6**	**2.1**		**2.3**
[s.d.]	[1.9]	[1.7]	[2.3]	[1.2]		[1.8]
V.7.a.	**3.6**	**2.0**	**5.6**	**4.6**		**4.1**
[s.d.]	[4.7]	[1.7]	[5.8]	[3.9]		[4.7]
V.7.b.	**1.7**	**1.0**	**0.0**	**7.8**		**3.0**
[s.d.]	[2.1]	[1.4]	[0.0]	[13.0]		[6.5]
V.7.c.	**3.4**	**2.5**	**4.8**	**4.5**		**3.8**
[s.d.]	[2.9]	[1.6]	[2.8]	[2.4]		[2.7]
VI. Demographic/Descriptive Information						
VI.1.	**60.5**	**59.5**	**63.5**	**61.8**		**61.3**
[s.d.]	[30.0]	[24.8]	[22.4]	[32.1]		[28.3]
VI.2.	**32.9**	**37.2**	**41.5**	**30.1**		**34.1**
[s.d.]	[15.4]	[22.6]	[19.9]	[11.6]		[16.3]
VI.11.	**30.4**	**30.0**	**31.6**	**32.6**		**31.2**
[s.d.]	[3.8]	[2.9]	[3.4]	[3.8]		[3.7]

* Data collection at this center, by decision of the PI, was limited to graduates employed by industry.