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By-Bail, Frederick T.; And Others

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Effectiveness of the Cornell University two week program for post-graduate, inservice training of engineers in the construction industry is evaluated. An interview form was administered to program originators, participants, faculty, and employers of the participants, following the first of three annual sessions, held in 1967. The program received general acceptance by all involved, but participants felt that the immediate goal of updating practice in the construction industry needed to be clarified. It was felt that the group was too heterogeneous in engineering specialities, intellectual knowledge, and job position, effectively to accomplish program objectives. Little evidence of application of knowledge to on the job situations was found. It was recommended that: learning achievement in the campus session be assessed; faculty members clarify goals of their particular courses; the concept of home study be revised; on campus sessions be held to discuss field problems; use of different instructional techniques be explored; and informal group discussions be used during evening sessions. (Appendixes include the interview forms, and a listing of participating engineers, faculty, and employers.) (pt)

The Cornell University Program of In-Service Education for Construction Engineers: An Evaluation Report

Submitted to Dr. Julian C. Smith
Director of Continuing Education
College of Engineering
Cornell University

By:

Frederick T. Bail
Robert L. Bruce
Richard E. Ripple
Donald J. Treffinger

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INTRODUCTION

This study was undertaken at the request of the Director of Continuing Education of the College of Engineering at Cornell University. The purpose of the study was to evaluate the effectiveness to date of a program for post-graduate, in-service training of engineers employed in the construction industry.

As approached in this study, evaluation is not simply measurement of learning achievement. Nor does it consist of judging a program "good or bad." Rather, it has been approached as a problem of providing those who must make decisions about the program with an information base for those decisions. We have had therefore to go beyond learning achievement to attempt to estimate the degree to which the objectives have been achieved.

Further, this information had to be obtained in a short time and at a very early stage of the program. Specifically, the evaluators were selected in Spring, 1967, to evaluate the effects of the two week session held in January-February, 1967. This session was the first of three such annual sessions. As is so often the case in "real-world" evaluation, this study was undertaken precisely because the available information was less than satisfactory.

The basic objective of the training program, from the point of view of those who developed it, is to update practice in the construction industry - i.e., to narrow the gap between current knowledge and actual practice in the field. Thus, it follows that the ultimate criterion for evaluating the program will be

the application of relevant information in the construction industry. Several other assumptions follow from this:

1. The learning achievement of individual engineers is relevant only insofar as it is necessary for application. Learning does not, in itself, insure effective use.
2. Since application is explicit in the criterion, the extent to which the participating individual (or his company) affects practice in the construction industry is a significant variable, and should be evaluated.
3. An evaluation of the validity and relevance of the material taught should also be made, given the basic objective of the program.
4. The attitude of the participating engineer will, in part, determine both how much new material he acquires during the on-campus session and to what degree he applies and disseminates this material after returning to his job.
5. The job placement of the participant within his company, and the concommittant degree of authority and flexibility he is allowed, partially determine the extent to which practical applications are possible. Individual failures in this area may indicate either poor selection of companies for inclusion in the program or poor choices of participants

within the companies themselves. Widespread failure might cast doubt on the merit of the program as a whole.

Other objectives of the program appear to include encouraging the participants to look at common problems in new ways; the development of rapport between theoreticians and practitioners; and the maintenance and improvement of Cornell's reputation with the construction industry.

The evaluators attended one remedial session in May, 1967. This, together with extensive discussions with the originators of the program and a few of the participating faculty, helped them to transform the objectives stated above into general types of questions to be asked of participants, employers, and participating faculty:

A. Is the program making the desired impact on the industry?

1. Are the participants practicing appropriate knowledge gained from the program where this is feasible?

2. Is there contagion:

a. to other employers?
b. to other companies?

3. Have the participants taken initiative in innovation?

4. What attitude do the participants and employers have toward the program?

B. Are the participants the "right" people for the program?

1. Are the participants in the "right" positions to be effective?

2. Given that these are the right positions, do the selection procedures yield the "right" occupants of these positions?

3. Does program participation add to or detract from the engineer's status within the company? (Have relations with other engineers in the company changed since participation? If so, in what way?)

C. Is the content of the program the most appropriate, given the aims of the program?

1. Are the topics covered important and or appropriate?

2. Was the level of abstraction in the content about right?

3. Did the topics presented contain about the right amount of detail?

4. Did the instruction proceed at an effective rate?

5. How well did the actual instructional content compare with the content the participant expected?

D. Are the immediate teaching objectives being realized?

1. Are the participants aware of the kinds of know-

ledge and skills available?

2. To what extent are the participants convinced of the usefulness of academic knowledge, with regards to actual practice in the construction industry?

3. Are the participants motivated to study such theoretical material? If not, why not?

4. How well do the participants know the material which they received during the program?

5. Are the participants able to apply this knowledge? Do they think they'll be able to in the future?

6. Do the participants feel that the participating Cornell faculty have been readily accessible?

E. Are the techniques employed in the program effective?

1. To what extent does each technique (lectures, "homework," correspondence, etc.) achieve its intended end?

2. Which techniques do the participants rate as particularly helpful or particularly confusing?

3. Are the techniques employed efficient in terms of both participant and faculty time?

4. To what extent have the faculty explored the range of innovative instructional procedures (e.g., programmed instruction; computer assisted instruction)?

F. How would the participant change the program, if at all, if he were responsible for its future planning? Why?

PROCEDURE

An interview form was then constructed to focus on the previously mentioned questions. The form was designed to be adequately structured, so that certain basic questions would be covered, yet flexible enough to assure that unanticipated findings would not be overlooked. The form used in interviewing participants can be found in Appendix I. The participants who were interviewed, their respective companies, and the interview dates, are in Appendix IV.

It was also thought advisable to seek reactions from the participants' employers. Whenever possible, the evaluators interviewed the man directly responsible for sending the participant to the program. When this was not possible, discussions were held with someone above the participant in the organizational hierarchy; in these cases the "employers" interviewed had at least some understanding of the function of this particular program. This form constitutes Appendix II. The employers interviewed, their respective companies, and the interview dates comprise Appendix V.

Finally, the evaluators felt it necessary to seek reactions from the participating faculty; conceivably, the reactions and suggestions of the theoretician might be quite different from

those of the practitioner. Consequently, an interview form for the participating faculty was also constructed (see Appendix III). The instructors interviewed, the topics they covered in the program and the interview dates comprise Appendix VI.

Before summarizing and discussing the results of these interviews, a few of the major limitations of the findings will be presented. Though many of these constraints were unavoidable, many useful findings resulted from the evaluation. These limitations are only mentioned so that the context in which these findings are valid will be more clearly understood. First, the number of participants was relatively small (N=16); eleven participants were interviewed. Only eleven companies were represented in the program; six of these eleven were available for interview. These small numbers severely restrict our ability to generalize to this program in future years, or to other similar programs. Second, the program under study is less than a year old. Conclusive answers to many important questions are improbable at such an early stage. For example, participants have had little, if any, opportunity to apply new knowledge in actual practice, much less to pass on to others what they have learned. In some cases general, tentative answers necessarily had to be inferred from indirect measures. The last major constraint was the limited technical knowledge of construction engineering possessed by the evaluators. Formal evaluation of the program was initiated <u>after</u> the first two-week session; consequently, none of the evaluators attended any of the original sessions. However, as men-

tioned previously, all evaluators were able to attend the remedial one-day session in May. Also, the originators of the program were invaluable in helping the evaluators develop a basic understanding of the industry and its problems. Finally, as the evaluators visited actual job sites and interviewed the participants and their employers, a gradual awareness and a thoughtful modification of emphases in the interviews became possible.

In short, the constraints on this evaluation are very real and must not be taken lightly. Nevertheless, this evaluation may be quite useful in providing feedback to the originators, largely because of the prevalence of conditions upon which its major findings are based.

RESULTS AND DISCUSSION

A. Program objectives.

1. Basic goal of the program. As expressed above, the general goal of this program is to "update the construction industry." But the method by which this goal is to be achieved needs to be clarified. The program was allegedly designed to impart current theoretical knowledge to the participants; it was hoped that, over the three-year period, the participants would gradually become better able to apply this new knowledge. Insofar as this is construed to mean teaching specific new techniques for later applications by the participants themselves, participants, employers, and faculty alike said this method was unrealistic and overly optimistic. On the other hand, the vast majority

of participants, faculty, and employers felt that the specific purpose of this program should be one of "sensitization." That is, the practicing engineer should be alerted to new techniques, applications, and ways of looking at problems; the program should make the participant aware of new theoretical advances and sensitize him to possible practical applications.

This difference in emphasis may seem slight, but it has wide implications for the program itself. On the one hand, if theory is taught for specific, practical applications, then it is necessary that the participants thoroughly understand the material and are adept at working with the concommittant theoretical ideas, notations, and variations. The participants, employers, and faculty agreed that this method was both physically and practically impossible, at least for this particular program. There were such comments as: "You can't teach us statistics in two weeks." All concerned thought it impossible, in the time allotted, to cover specific theoretical content adequately for future applications. Many participants and employers expressed the opinion that, even if the time consideration could be overcome, this method still would not be practically possible. They stated that the particular job responsibilities of the participants exclude any possibility of making all of these applications. Most of the participants are in some way responsible for the progress being made on particular jobs. According to these men, it is not possible to concentrate on specific problems without neglecting the overall progress of the job. (Possibly, the initial program

concentrated on the wrong job position within the construction industry; this question will be dealt with in Section C.)

If, on the other hand, the function of the program is sensitization, the participants, employers, and faculty indicate that the program is not only physically and practically possible, but also desirable and worthwhile. The method of the program should then be to show the relevance and practical applicability of new techniques and theoretical advances to on-the-job problems. The industry must be convinced of the usefulness of the new knowledge for field applications. For example, some participants suggested sending in a few specific problems ahead of time and letting the instructor construct his examples in terms of these specific problems.

If the participant were convinced of the practical advantages of the new techniques, but did not know specifically how to apply them, he might more readily be able to turn to specialists (e.g., computer programers or statisticians available to the construction industry). Although it is not the purpose of this evaluation to speculate on the future practice of construction engineering, the subsequent demand and use of such specialists would appear to be a logical consequence of such programs. It is perhaps a long-range consequence that should be considered and prepared for. Even without the involvement of such specialists, however, the awareness of new techniques and methods may keep the participant from approaching commonly occurring problems with a rigid framework.

That this clarification of the method used in "updating the construction industry" would involve only a slight change of emphasis is evidenced by the fact that most participants, employers, and faculty felt that the immediate goal of the program was already one of sensitization. Participants and employers were thus understandably concerned that courses should emphasize practical applications, at the expense of theoretical detail. If the program's immediate goal is sensitization, future planning should take this concern quite seriously.

2. Acceptance of the program. The interview data show that most of the participants, employers, and faculty thought that this particular program was a good one. Most participants noted that this program, and programs like it, are excellent ways of keeping abreast of new developments in the field. For example, one participant commented: "It helps keep my brain out of the 'construction rut.'" The employers interviewed considered construction engineering a scientific field; since it is rarely practiced as such, they saw a strong need for programs of this kind.

B. Learning outcomes.

1. Applications of new material. First, since most participants were interviewed a few months after the initial on-campus session, it was difficult to assess the capability for application from actual reported applications. Second, it was impossible to say which, if any, applications were the direct result of the program, which were independent of participation in

the program, and which were a combination. Third, since, for the most part, the participants conceived the program's purpose to be one of sensitization, and not one of directly applying theory, it may be that few participants have even attempted such applications.

Nevertheless, some positive results are present. One participant has taken the first steps in computing on-the-job costs, as outlined in an on-campus class. Others have discussed questions of insurance planning and labor relations with other company foremen. One man tried to put a few field problems into the context of the appropriate theories; although he did not solve the problems suitably, he commented that he can now more easily visualize similar problems from inception to completion. A few others reported not having attempted to apply anything from the on-campus sessions. Most employers found it "hard to tell this early" if there had been any changes in the participants' performance on the job. A few of them had noticed changes, but weren't sure whether these were the result of the program itself. One employer did comment, however, that his participant's efforts had become generally more "organized and scientific."

2. Continued participation in the program. Very few participants have decided not to continue with the program for the remaining two years. Only one employer interviewed was undecided as to sponsoring his participant for the remainder of the program. Most employers were satisfied with the program, and a few were considering sponsoring participants for subsequent three

year programs. All faculty members interviewed indicated that they would be willing to participate again, though there were problems of incentive which will be discussed later (see Section D, #1).

3. Future assessment of "learning outcomes." One of the basic problems of this evaluation was the assessment of how much course content each participant had actually learned and retained. The administrators were understandably disinclined to give "tests" on content, since the administrators and participants alike were interested in making the construction industry more efficient, not in rating a group of participants on "how well they learned their lessons." Even calling the off-campus material "asignments" or "homework" seemed to cause some uneasiness among the participants. Nevertheless, in order to obtain a more valid assessment of the program, the goals of the program must be compared to the outcomes of the program in some way. An evaluation of the program's effectiveness through indirect measures cannot be substituted for direct assessment, without some resulting loss in validity. In future programs, if the immediate goal is one of sensitization, then even taped informal discussions between the participants and the faculty and/or the administrators could yield a more valid assessment of learning outcomes than was obtainable from last year's session.

In the future, the program's administrators should consider such direct assessment seriously. Perhaps each participating faculty member could submit a list of objectives for his

course; these should, in general, be similar to those of the program itself. Then it would be known what to attempt to measure. The direct measurement itself could conceivably be combined with or concealed in the final evaluation of the program by the participants. Also, the respective evaluations could be left nameless; all other relevant information (i.e., years of schooling, age, type of construction company, etc.) could be included in the same evaluation sheet. This would provide data for statistical evaluation without the negative affect associated with "testing."

C. Participant selection.

1. Criteria: the problem of heterogeneity. This particular group of participants varied greatly in a number of respects; some of this variance was observed by both faculty and participants as obstructing the effectiveness of the program. Although the administrators did want to enroll a wide range of construction engineers, any selection at all was severely limited by the relatively small number of men who applied.

The participants were quite heterogeneous with respect to age, educational level attained, and the number of years out of school. There was no measure of intelligence available, but the reports of the participants and faculty indicate that there was considerable heterogeneity with respect to this variable as well. Combining these factors, it is probably unreasonable to expect that the lecturer or discussion leader could find an optimal level at which to present the material. The faculty and

participant interview protocols suggest that some people understood very little of what was said during the two weeks, while others seemed to grasp everything quite easily. (Unfortunately, as was pointed out in Section B, #3, no direct assessment of understanding was made; consequently, this judgment is made from a consensus of participant and faculty interviews.) Indeed, one faculty member thought that the heterogeneity of the group was the only major problem in the program. He stated that the differences in background, job position, and experience made it extremely difficult to conduct a class; he perceived large differences in the level of understanding exhibited by the participants. He also said: "Give me twenty men like _____ and we're in business."

There is also the problem of participant selection by the individual companies themselves. The employer interviews showed that it was not the particular job position of the individual which determined selection, but rather the individual's present and/or future importance to the company. Thus, neither the job position nor the perceived ability of the individual to deal with new ideas were used as specific selection criteria. Selecting as they did, the companies produced a group of men who varied somewhat both on job position and on their acceptance of new ideas in the industry.

The administrators should consider stating the goals of the program clearly to the companies and urge that only men with goals compatible with those of the program be sent. Future sel-

ection by the program's administrators should also be more restrictive, accepting only those men who demonstrate superior ability in dealing with new theoretical ideas. Perhaps, for example, pre-participation interviews or recommendations could be used to eliminate those who do not meet basic standards. The administrators should also consider limiting participation to those men within a narrow range of job positions. They should further consider restricting future programs geographically, for reasons presented in Section D, #2.

2. Subgroups within the construction industry. According to the participant interviews, there was a dichotomy within the group which affected the program even more adversely. Many participants indicated that there were two distinct subgroups: (1) the "heavy and highway" engineers and (2) the "process" and "building" engineers. Many noted that the concerns of the first sub-group are often quite different from those of the second sub-group. These men indicated that the differences between these two sub-groups outweigh the similarities and that attempts to seek the common denominator are probably not feasible in such a program. Future planning should consider either dealing with one sub-group only or establishing parallel but separate programs for the personnel in the two sub-groups.

D. Instructional techniques.

1. The role of the faculty in the program. The participating faculty members were generally well received by the participants. However, the participant interviews revealed two

criticisms regarding the faculty. First, the participants indicated that some of the problems presented in class were not analogous to typical on-the-job problems. They thought that some way should be found to familiarize the participating faculty with construction problems as they occur in the field. Second, many participants thought that certain courses were poorly organized.

The problem of greater faculty involvement is crucial. Ideally, the faculty could visit actual job sites; if they revised their material according to their observations, it would be more relevant and meaningful to the participants, and a more effective dialogue between theoretician and practitioner could probably be established. Certainly, numberous job site visits are beyond the financial scope of the program. Furthermore, the faculty were also opposed to such a suggestion for personal reasons. As one professor pointed out: "This program did not help my own development [as a professor]." Another professor stated the problem more clearly: "There are no academic rewards in teaching such a program; positive rewards are all financial or psychological." However, an alternative procedure was suggested to which the faculty members interviewed responded much more favorably. Prior to the on-campus session, a half-day or full day workshop for the faculty could be instituted. In such an introduction, an administrator familiar with actual field problems could sensitize the faculty to the kinds of problems with which these engineers are actually concerned. One faculty member commented that he would

know much better what to teach and how to teach it if he were given specific information (e.g., job position, influence within the company, type of construction company, years on present job) about each participant. Perhaps short film clips could even be utilized. With such an introduction, plus a familiarity with the general goals of the program, it is logical that the participating faculty could then present their material in a more relevant and convincing way.

The weak organization of content within some courses should be corrected. The faculty member should make clear to the participants from the beginning the objectives of his course. He should also prepare a brief working outline of the topics to be presented; this should be given to the participants well ahead of the actual presentation. Not only would this eliminate much unnecessary note-taking, but it is also preferable from a psychological point of view. Simply stated, a person can learn and retain mew material more easily when he has some understanding of the overall organization of that material. Some participants stated that they could not follow some material when it got too confusing, and hence they were often unable to sustain interest. Other participants noted that, in some courses, they were able to take complete notes, but were unable to comprehend the main ideas when they later reviewed the material.

In summary, it seems that some sort of meeting is necessary for the faculty before the on-campus session. It should also be made explicit what is expected from the faculty; the prepara-

tion of working outlines for the participants and a statement of course objectives should be the minimum requirement.

2. "Homework," "tests" and review sections. A revised procedure for "homework" assignments should be sought, according to the participants. A few participants suggested that, since they have schedules which allegedly prohibit studying for long periods at a time, the "home study" should involve less theoretical material which could be more easily read intermittently. Some men might have used their long and tiring work schedules as an excuse for not doing the work; but at least one participant reported studying two other books trying to comprehend the "home study" material and being unable to do so because he didn't have long, uninterrupted periods for concentrated study.

The direct assessment of learning achievement was discussed in Section B, #3. It would probably not be in accordance with the aims of the program to give "tests" on "home study" material, especially if understanding of on-campus material is directly measured. This means that "off-campus" material would have to be relevant and stimulating enough to require only an informal assessment of achievement.

The review session which was held for some participants in May, 1967, was essentially an afterthought of the administrators; it was undertaken because some participants were unable to complete the "home study" material. Although it was undertaken as a remedial measure, most participants reacted favorably to the idea. A few of these men suggested restricting the program

geographically so that occasional weekends during the year could be devoted to on-campus sessions for the discussion of "home study" material. More important, other problems could be discussed at such sessions; it seems reasonable that this procedure would also increase the interest of participants and sustain rapport with the industry.

3. Innovative instructional techniques. Most of the on-campus session consisted of lectures and discussion sessions. Although some innovative techniques such as computer-assisted instruction may not be practical or desirable for such a program, other techniques probably are. For example, if an instructor wanted to be sure all participants had a basal comprehension of some topic, programmed instructional materials might well be utilized. Or, if the administrators wished to show the participants the relevance or effectiveness of some new piece of equipment or some new device, in-class or on-the-job demonstrations could probably be arranged with the particular manufacturer. In addition, it may be valuable to seek additional audio-visual aids to supplement classroom instruction. Such supplementary techniques are both psychologically valid and especially useful in a program of this nature.

E. Program administration.

1. Mechanical organization of the program. Faculty, participants, and employers agreed that, on the whole, the arrangements made by the program administrators were suitable in all respects. A few participants made minor complaints about the

housing arrangement; one man suggested that single rooms be provided for the participants. The participants stated that correspondance from Cornell was excellent, both efficient and informative.

2. The co-operation of the program's faculty and administrators. Both in terms of the mechanical structure of the program and especially in terms of faculty accessibility, the co-operation of Cornell was excellent, as perceived by the participants and their employers. They felt that the staff visits to their individual job sites were particularly helpful and stimulating. Many participants also reacted favorably to the job site visit made by the participants and staff during the on-campus session.

3. Evening sessions. A summary of interview protocols indicated that the occasional evening lectures and problem sessions should be eliminated or changed; most men were quite intellectually exhausted by evening. It was the general feeling that this time could be more effectively utilized as individual study time or for informal interaction among the participants.

4. Informal discussions among participants. It became evident through the participant interviews that these engineers had very little, if any, contact with men in similar positions from other construction companies. All participants commented that the professional, or "out-of-class," discussions held among participants from different companies was a valuable aspect of the program. One man even stated that the program was "worth

going to for this [function] alone."

SUMMARY

The purpose of this study was to evaluate the effectiveness to date of the Cornell program for post-graduate, in-service training of engineers employed in the construction industry. The evaluators interviewed the originators of the program, the participants, the participating faculty, and the employers of the participants. Limitations on the validity of this study were noted.

(1) General acceptance was given to this program by participants, employers, and faculty. It was recommended, however, that the immediate goal of the program be clarified; the interviews also indicated that a slight change of emphasis in the program is necessary.

(2) It was recommended that learning achievement in the on-campus session be assessed in some way; there must be some means of estimating the degree to which the program achieved its immediate goal. Little evidence of application of knowledge obtained during the on-campus session was found, and these applications were indirect; it is possible that the interviews occurred too soon after original participation for this evidence to have been obtained.

(3) Future selection procedures must take into account the heterogeneity of the first group. The inclusion of both "heavy and highway" and "building" and "process" engineers was somewhat of an obstruction to the program's effectiveness, according

to many participants. Some faculty members also felt the group was too heterogeneous with respect to such variables as intellectual knowledge and job position.

(4) It should be made explicit what is expected from the participating faculty. An introductory session should be held with these men to clarify the goals of the program and to alert the faculty to typical field problems. The faculty member should prepare a brief outline of the subject matter to be covered; these outlines should be distributed to the participants well in advance of the actual class. The faculty members should also make clear to the participants the goals of their particular course(s). The concept of "home study" should be revised, and the administrators should consider occasional on-campus sessions to discuss field problems. The possibility of using different instructional techniques should be explored.

(5) The administrative details of the program were carried out efficiently and effectively. The co-operation of Cornell in all aspects was considered excellent by participants and employers. The informal discussions among participants was an important contribution to the success of the program. The few evening sessions that were held should probably be changed to such informal group discussions among the participants.

APPENDIX I
INTERVIEW FORM
FOR PARTICIPANTS

1. Why did you attend the Cornell program? (what were your objectives?)

2. How were you selected to attend?

3. a) If you had not been a participant in the program, but knew as much about it as you do now, would you be interested in participating? Why or why not? (Probe Problem Sensitivity.)

   b) Is the program a good idea in general? Why or why not?

   c) Would you recommend the program for others in positions similar to yours? Why or why not?

   d) What changes would you desire to have made in the program for the benefit of those just beginning it? Why?

4. About the content of the course:

   a) What do you think is the central idea, if there <u>is</u> any, which served as the principal objective of the program?

   b) If yes to A: How did specific courses contribute to meeting that objective? (Go through by courses)

   c) If A is not seen clearly, go through subject areas separately. Discuss course objectives. Can a central objective be deduced?

   d) Has the central objective been met, all things considered? Was it important enough to warrant the emphasis given it? (expand.)

e) Were practical considerations (stressed too much, too little, or adequately) in courses? Discuss.

5. Teaching techniques and Materials:

a) Discuss each:

1. Correspondence with Cornell

2. Arrangements while on Campus

3. Work load while on Campus

4. Present work load (Probe Motivation.)

b) Did courses progress too (slowly, rapidly; at approp. pace) for you? Discuss specifics.

c) Were the courses (detailed enough; too much; too little)?

d) Were the courses (interestingly theoretical; too theoretical; not theoretical enough)?

e) Was the schedule efficiently maintained? Compare what actually took place with your expectations for it.

f) Is too much expected outside of class, too little, or enough? (Expand and discuss.)

6. Interpersonal Relationships in the Program

a) Did you feel (positive, negative, neutral) about the other participants while on campus? Explore: shared interests, professional discussions, common reactions to program, social activities.)

b) Has your participation had any effect on your feeling about Engineering Education in general?

c) Discuss personal Faculty-Student relationships (include in class, extra-class, site visits,etc.)

d) How does your employer feel about the program? Has your relationship changed in any way as a direct or indirect result of the program? Explore.

e) How about your co-workers in your company? Explore.

f) Do you have any opportunities to discuss the program with representatives of other corporations? Explore.

7. Have you applied anything you've learned? What? Do you think you've learned some things you will actually be able to apply?

8. If you were to become responsible for the planning of such a program, how would you change it? Explore.

9. Summarize: outstanding strengths, weaknesses.

Content

Instruction

Follow-up supervision

Acceptance

Was the Participant:

warm (cordial)----------cold (aloof)

calm, at ease----------tense, nervous

spontaneous----------rehearsed

Summary of interview reactions:

APPENDIX II

INTERVIEW FORM FOR EMPLOYERS

I. Occupation-definition of the participant's occupation within the company.

II. The relative competence of the participant within his position in the company.

III. A) Do you feel the _____ of the participant has (improved, declined, stayed the same) since his participation in the program?

1. job performance
2. number and quality of ideas
3. social relationships (status)

B) Is the company using any of ideas P's brought back?

IV. Has you confidence of the participant changed since his participation in the program? In what way(s)?

V. Do you think the construction engineering industry has a need for such a program? Why/why not? Do you think your company has a need for such a program? Why/why not?

VI. What would you consider the best ways to change such a program in the future?

VII. A) Would you send a participant to such a program again? Why/why not?

B) If so, would you send someone like this person or someone from a different position of the organizational structure?

APPENDIX III

INTERVIEW FORM FOR PARTICIPATING FACULTY

1. (a) What subject-matter did you teach?
   (b) How long were you with the participants?
   (c) Did you require outside work of any kind from the Participants?

2. How well structured was the program? (i.e., Were you given prior to your participation, any indication of what the program's directors wanted you to accomplish?)

3. (a) Did you set a goal(s) for yourself, prior to participation? Was this goal(s) different from the goal(s) the directors expressed to you?
   (b) Did you expect to talk to the participant as students, practicing engineers, or as something else? Or was you main interest in the complexities of the material to be presented?

4. What was your actual experience with the participants? Was it different from #2 and/or #3?
   (a) Was your emphasis on practical applications or theory?
   (b) How much detail did you go into?
   (c) How much material did you cover vis-a-vis your expectations?

5. Estimate the intellectual ability of the participants:
   (a) Do you think this was a particularly homogeneous or heterogeneous group?
   (b) Was the intellectual level higher, lower, or the same as expected?

6. Did you understand the aims of the program? If not, do you now?

7. Do you feel there were any communication problems between yourself and the participants? (i.e., in terms of different expectations, etc.?)

8. How do you feel regarding the feasibility of this (or a similar program)? Do you have any suggestions, refinements, etc? General reactions.
   (a) General feelings toward faculty contact with the practicing industry? For example:
      (i) Would you rather take part in a program with one-shot lectures or one with continuing contact for a period of time?
      (ii) Perhaps this was the right type of program with the wrong group; maybe, for example, design engineers should be participants.

9. Do you feel that any lack of field experience on your part inhibited communication with the participants? Reactions towards, for example:

(a) actual field trips
(b) a short preparatory talk with someone like Prof. Blessis (maybe with something like short film clips of actual problems as they occur during practice.) Other suggestions?

10. Given the necessary intellectual handicaps under which the participants must operate, do you see the need for such things as very rough outlines of your talk, given out a day or two ahead of time? These would act as sort of "organizers in advance" to the participants. Maybe short advance assignments as well? Other suggestions?

APPENDIX IV

Participant Interviews

Participant	Company	Interview Date
Robert E. Yeager	Vipond & Vipond, Inc.	7/26/67
Paul R. Lloyd	Vipond & Vipond, Inc.	7/26/67
John S. Seely	Vipond & Vipond, Inc.	7/26/67
Carl M. Knowles	Bechtel Corp.	7/28/67
John F. Judski	Vincent J. Smith, Inc.	7/31/67
S. Murray Rust, III	Rust Engineering Co.	8/14/67
Sigvard O. Hallgren	Savin Bros., Inc.	8/29/67
Richard M. Ullery	Rust Engineering Co.	9/6/67
Thomas J. McCambley	D.W. Winkelman Co., Inc.	9/12/67
William J. Delaney	D.W. Winkelman Co., Inc.	9/19/67
Warren C. Nerz	Savin Bros., Inc.	9/28/67

APPENDIX V

Employer Interviews

Name	Company	Interview Date
Mr. P. Vipond	Vipond & Vipond, Inc.	7/26/67
Mr. Lake	Bechtel Corp.	7/28/67
Mr. J. Smith	Vincent J. Smith, Inc.	7/31/67
Mr. M. Bailey	Rust Engineering Co.	8/14/67
Mr. H. Savin	Savin Bros., Inc.	8/29/67
Mr. C. Curtin	D.W. Winkelman Co., Inc.	9/12/67

APPENDIX VI

Participating Faculty Interviews

Name	Cornell Position(s)	Interview Date
George H. Blessis	Assistant Professor of Civil Engineering	11/20/67
Richard H. Bernhard	Assistant Professor, Industrial Engineering and Operations Research	11/20/67
Henry P. Goode	Professor, Industrial Engineering and Operations Research	11/20/67
Sidney Saltzman	Assistant Professor, Industrial Engineering and Operations Research; Research Associate, Computing Center	11/20/67
George W. Brooks	Professor, Industrial and Labor Relations	11/27/67