

The Engineer in Management:
An Analysis of Career Paths Leading
To
Senior Management Positions in the Construction Industry

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by
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INTRODUCTION

→ The purpose of this paper is to research and explore management in the Construction Industry, particularly the various paths by which individuals have reached senior management positions and how these paths continue to influence their view of industry requirements. Casual observation of numerous managers within the industry has revealed that styles, attitudes, and aptitudes differ drastically though most are highly effective and professional people. No two (2) managers observed prior to beginning this research had the same background or experiences but all had reached high level positions indicating success. Of course individual differences also play a large part in achieving success so the path taken cannot be said to be to causal factor. Additional interest in formalizing these observations was generated by discussions with the project advisor, Dr. Leland Riggs, concerning the qualifications necessary to succeed in the industry as a senior manager. —————→ to p. 3

To begin this project the term "Senior Management Position" needed to be defined. For purposes of this paper a Senior Manager is defined as one who now or in a previous lower echelon position has or had the authority to select, evaluate, promote, or dismiss persons in the positions of Project Manager or Senior Project Manager.

To explore this subject four (4) distinct areas were discussed in an interview process. The first area covered the

subjects own educational and work history. Specific note was taken of the duties actually performed in the positions held as it became obvious as the interviews progressed that similar titles in the various companies did not necessarily denote identical levels of authority or responsibility.

Secondly the interviewer asked the subjects to evaluate his or her own experience. What were the primary lessons learned in each assignment and how important were they to future assignments as the individual advanced within the industry.

In the third stage the subject was asked to discuss the experience which they desired in a candidate being considered for a position as Project Manager or Senior Project Manager. Where they were willing the subject was asked to identify minimum, maximum, and median times an individual should remain in each of the areas of experience identified to gain proficiency but avoid over specialization or career stagnation.

The last subject discussed with each subject was their views and opinions of engineers as managers. Do engineers generically make good or bad managers? What are their general strengths and weaknesses as managers? What should an engineer do for self-improvement while in school or in early assignments to enhance promotion opportunities later in their career?

In order to evaluate the data gathered in the interview process and generate conclusions an understanding of the various

"typical" assignments is necessary. A brief discussion of these assignments and common variations is included.

Fig 1

→ The author's observations are summarized and conclusions drawn from these observations are provided. Suggestions for further research, for improving the effectiveness of the engineering curriculum, and for career development of individual engineers conclude this project. Theses. (SDW) ↗

CHAPTER I

POSITIONS WITHIN THE CONSTRUCTION INDUSTRY

In order to understand and evaluate the interview discussions (Appendix A) of experience requirements necessary to move into and succeed in Project Management and other more senior management positions in the construction industry it is first necessary to understand the subordinate positions through which an employee may have moved. The general duties of these positions and the skills which can be mastered while in these positions are similar from company to company but variations do exist.

ESTIMATING:

Estimating was a skill frequently discussed by senior managers in the industry. A general definition of estimating states that estimating is the process of preparing a statement of the approximate charge for work to be done by one ready to undertake the work [1]. In actuality estimating can be a very involved process.

Engineers involved in estimating as an entry level position are usually restricted to performing take-offs. This is the process wherein all the items shown on the construction drawings are counted and the individual items of material needed to construct the project are identified. This is a tedious process and most engineers are anxious to push on through this portion of

their career. During this period a young engineer will usually report to a senior estimator who will help them master the intricacies of construction drawings. The young engineer should learn where to find the various items of work on the drawings and how to separate large portions of the work into smaller segments that can be estimated using standardized production rates.

As a young engineer becomes more proficient at the estimating process he may begin to deal with sub-contractors. In today's construction industry much of the work done on a project is done by smaller firms which have specialized in certain types of work. It is common for large contractors to involve these sub-contractors in the estimating process by having them prepare bids for portions of the estimate. The young engineer may be asked to contact these sub-contractors, negotiate out what portions of the project the sub-contractor will perform if the company is awarded the contract and obtain quotes for the work.

The final type of estimating commonly done by more advanced estimators is termed conceptual estimation. This usually fits into one of two categories. In the first the estimator goes beyond pricing out quantities taken off the drawings and actually involves himself in planning how the construction will take place in the field. This allows him to modify his pricing to more closely reflect expected field conditions. In order to do this the estimator needs an excellent grasp of field methods and practices as well as a good working knowledge of the site where the construction will take place.

The second case of conceptual estimation generally occurs on what are called "fast track" projects. The firm is asked to develop a budget bid using partially complete plans. One of the subjects interviewed recalled a case where he was asked to prepare a bid based on a pencil sketch done on a piece of scrap paper. The owner did a rough floor plan, guessed at what square footage he would need, and gave some general guidance on the type of finishes he wanted in the building. The contractor was asked to submit an estimate from this while the architect, who was also present, was given the sketch to begin design. This is obviously the level of estimating which requires the most experience. The estimator must have a firm grasp on cost and pricing as well as construction methods and requirements.

Approaches to the Estimating Process:

In preparing a standard estimate a set of plans and specifications is given to the estimating group. The group does the take offs, prices out the materials, and chooses the production rates used to estimate labor costs. They pull out work for sub-contractors, contact the sub-contractors, and negotiate prices. The total of these parts are combined and then accelerated to allow for company overhead and profit and the final total is used for the bid price.

An alternative to the approach described above is now being used by many firms which refer to it as a team approach. In the team approach the project is assigned to a project manager or

senior project manager. This person is in charge of the estimating process. He determines the construction methods which will be used, which suppliers, and which sub-contractors. The estimating group still does the actual take-offs but these are reviewed by the project manager who provides guidance on who to contact for prices. The project manager prepares the sub-contracts and negotiates the prices with the sub-contractors he has selected. Whenever a question arises during the estimating process the project manager is the final authority. If the company is selected to construct the project the manager who supervised the estimating process is assigned to manage the project.

The advantage that firms using the team approach cite is the continuity it provides between estimating, planning the construction, and actual construction. Many cases were mentioned where cost problems in the field were blamed on the estimators having neglected to include necessary items in his bid price. This occasionally leads to a situation of finger pointing and arguments. This is completely avoided when the manager oversees both processes and it places valuable field knowledge at the disposal of the estimators during the bid process.

FIELD ENGINEERING:

Every senior manager interviewed stressed the importance of field assignments. There are many responsibilities which can be assigned to a young engineer in the field, each of which exposes the engineer to different aspects of construction.

Shop Drawings:

Shop drawings are required for many items of the actual construction process. The drawings detail exactly how a specific portion of the work will go together. These must be carefully checked and approved before the work is performed. Working on these provides the young engineer with specific experience on how the industry actually puts things together.

Quantity Surveys:

Periodically surveys of the actual work performed are needed because most construction companies are paid monthly based on actual work in place. Frequently young engineers are assigned to make these surveys of work in place. Doing this not only exposes them to the sequence of work that takes place but as they monitor the quantities from month to month they should begin to get a feel for actual production rates in the field.

Work Layout:

This is one of the few assignments that makes direct use of an engineers technical training. On most projects there is a requirement to make sure that important items of construction are correctly positioned. Although this work is not actual surveying it uses some of the techniques and skills of surveying. An example of this would be the grade checking that takes place on an ordinary road or highway project. Actual surveyors proceed ahead of the job and set boundary markers delineating the edge of the project. As the work proceeds and the road bed is either

raised or lowered field engineers pull off-sets from these markers to show the construction crews the beginning or ending of slopes, the proper elevation of the road at specific points, or to mark changes in road direction. In addition to using some of the skills the engineer developed in school this assignment is an early opportunity for the young engineer to meet and mix with the actual construction forces. It allows him to work with the foremen and workmen and to begin to develop the people skills which will later become so valuable to him.

Assistant Superintendent:

Occasionally a young engineer on his first field assignment will be given this position. The basic duties may include a mix of the things listed above but the real job description would be to do whatever the superintendent delegates. In this position the engineer will have an excellent opportunity to learn actual construction practices. Usually the superintendent will allow him to actually oversee small parts of the work so that he not only gets to learn that portion of the work but gets his first chance to develop supervision skills.

ASSISTANT PROJECT MANAGER:

This is normally the final step before an engineer is selected for the ranks of project management. In this position an engineer will gradually assume all the duties and responsibilities of a project manager as he develops his own style and skills. The engineer will be able to use the experience he gained in the preceding assignments as he becomes

more involved in purchasing, dealing with sub-contractors, setting schedules, and gets his first chance to work directly with the owner and architect. By now he should have developed his communication skills so that he will be ready to deal with the people involved at all levels of the project.

At least one company interviewed did not use this position. The manager interviewed said that he had never seen an assistant anything and he felt that one either was doing the job or they weren't. In his opinion the engineer should be given greater responsibilities in the other positions until he was deemed ready for project management responsibility. When he was ready he would be made project manager on a small project instead of being made assistant manager on a larger one.

PROJECT MANAGER:

Although the experience levels and responsibilities associated with this title varied from company to company the general concept of project management remained constant. This is the individual responsible for getting the project completed. He makes the purchases, coordinates the sub-contractors, the site, and the company work force. He deals directly with the owner and the architect to coordinate schedules and interpret project requirements.

On the lower end of the project management scale a project manager will have five (5) to seven (7) years experience and will run the administrative portions of the project. He and the

superintendent will work together with both reporting to a more senior officer of the company. Although the company may say that they hold the project manager responsible for the project he cannot be said to have true profit and loss responsibility since he only works with the superintendent and cannot directly supervise him.

On the upper end of the scale a project manager will be a more seasoned veteran of the construction industry with ten (10) to fifteen (15) years experience. He will actually be tasked with running the project with full authority over all phases of the project. The superintendent will report to him and the project manager will have sole responsibility for the profit and loss of the project. This approach seems to be more prevalent in the larger firms interviewed. This could be due to the greater size of their projects and the greater geographic spread of the projects.

CHAPTER II

CAREER PATHS OF SENIOR MANAGERS IN THE CONSTRUCTION INDUSTRY

Sixteen (16) senior managers in the construction industry were interviewed to determine what their path to the top had been. Summarized results of these interviews are included as Appendix A. Construction companies are greatly diversified in both their approaches to the industry and their actual organizations so diverse paths to senior management were expected and found during this process.

Education:

A summary of the undergraduate education of the managers interviewed is included as Table B-1 in Appendix B. Technical programs tend to dominate the sample accounting for 75% of the total. Technical programs of course include all the engineering disciplines and for the purposes of this paper also includes industrial management and building construction. The sole basis for counting these two curricula as "technical" is that the subjects interviewed tended to view these as technical.

Engineering dominated both the total and this segment accounting for 50% of the total and 66.67% of all the technical segment. This result was expected because of the large number of engineering graduates who chose careers in construction but also because of the normal flow of engineers into management which seems to occur. One study showed that 48% of engineering

graduates are in some type of management position within twenty-one (21) to thirty (30) years after graduation. [2] Additionally, salary progress has been showed to closely relate to movements into management by engineers. [3] This seems to confirm the feeling of one of the subjects interviewed who pointed out that only one (1) person gets to be the Chief Engineer for a firm so everyone else that wants to get ahead has to go into something else, management.

Also not surprising were the results of the survey showing post-graduate education, included as Table B-2 in Appendix B. In this case advanced technical degrees accounted for only 33.33% of the advanced degrees held by the subjects interviewed. The rest of the degrees were in the areas of business, management, law, and construction management. It is important to note that although the construction management degree was a Master of Science in Civil Engineering it was not accounted as a technical degree. This was based on the subjects own interpretation of the degree. He pursued and obtained the degree for the management courses and background which it would give him. Only his desire to keep the courses he took as closely related to construction as possible led to his choice of a MSCE rather than an MBA.

It was also interesting to note that one (1) manager had a degree in law to complement his technical undergraduate degree. He choose this instead of an MBA or MSCE because in his opinion it allowed him greater flexibility to choose the subjects he wanted and would be of greater benefit in the long run. He went

on to say that it was only one (1) year longer than most of the better MBA programs he considered which seemed a slight difference for the result achieved.

Positions Held:

Since an important assumption of the interview process was that only successful persons would be interviewed it was necessary to try and talk to the most senior person available for interview at each firm. All persons included in this study conform to the definition of Senior Manager as presented in the introduction. Table B-3 in Appendix B shows the distribution of the persons interviewed.

Registration:

Although many firms do have design groups it was expected that most of the senior managers would have come up through the operations end of the business. For this reason a high degree of professional registration was not expected. Surprisingly 50% of those eligible for registration were registered as either an Engineer in Training or as a Professional Engineer. Eligibility was based on graduation from an accredited school in an engineering discipline. The results of this sample, shown in Table B-4 in Appendix B are questionable however since 75% of those registered were from the same parent company, a company that stresses engineering backgrounds and professional development.

Actual Career Paths:

The actual career paths of everyone interviewed were remarkably similar with the one (1) notable exception being one (1) of the two (2) subjects with an undergraduate degree in business. She worked her way up to her current position through a strictly administrative path spending most of her time in either project accounting or in personnel management.

All other persons interviewed outlined basically the same career path after entering the construction industry. During their first few years in the industry they were shuffled between entry level field and office assignments while they were expected to learn both phases of the business. These positions and their duties were discussed in the preceding chapter. The primary technical skills that they were developing all revolved around costs and methods. Each was encouraged, and now encourages their subordinates, to use this development period to learn as much as possible about actual construction methods and practices. Each used this expanding experience base to develop an understanding of the cost involved in these methods.

There was one other slight variation in that one (1) of the subjects entered the construction industry later in his career after developing a successful career in the area of engineering sales. He went through the same basic progression as the others but he did so on an accelerated program as he was groomed to take over the marketing program for his firm. In spite of the fact

that he had been hired into a senior position he was still moved through the progression of estimator, in the field engineer, and project management that his peers experienced. Under-utilizing this valuable person for such a long training period only seems to reinforce the value of this diversified construction background to the firms in the industry.

Generic Career Path:

During the interview process each of the subjects interviewed was asked to discuss the important skills that an engineer desiring promotion to the ranks of senior management should master. They were also asked to discuss a progression through the industry that would most likely aid a candidate in developing these necessary skills. Based on this a typical generic career path reflecting that taken by most of the subjects interviewed can be developed.

Entry through year one (1):

Office: During this time period the engineer was reviewing shop drawings, doing take-offs to assist the estimator and developing a general understanding of the company, the industry, and construction drawings.

Year one (1) through year three (3):

Field: During this period the engineer was mastering a basic knowledge of practical construction methods. In most cases the engineer was responsible for

portions of the work being performed. He assisted in some field estimating and began his association with sub-contractors.

Year three (3) through year five (5):

Office: By now the engineer was expected to have a good feel for field conditions and practices. He was now more fully utilized in the estimating function in that he could make judgments on how actual construction would occur and was usually allowed to prepare and negotiate sub-contracts. He became involved in coordination efforts with all levels of the project and assumed more and more responsibility from the project managers.

Year five (5) through ??:

Office/field: The engineer was assigned to increasingly large projects as the Project Manager. He was expected to have a firm grasp of sound engineering principles, practical construction methods and practices, costs in the industry, and to have developed the sound management skills necessary to integrate these together to run a project.

CHAPTER III

SUGGESTED CAREER PATHS

In the preceding chapter a brief look at the actual paths taken by senior managers in the construction industry was presented. In this section the comments made by the interview subjects concerning desired experience and backgrounds will be examined.

Education:

Everyone interviewed stressed the importance of a strong background in practical construction. Even the one (1) subject who progressed up through the administrative ranks pointed to her time assigned to projects in the field and stressed that she had spent as much time as possible out on the jobs asking questions and learning as much as she could about the industry. This practical experience coupled with common sense and an ability to deal with people were the points most often stressed so it was difficult at times to sort out the educational background which the subject preferred when recruiting for their firm. Eventually during the interview each did state an opinion. These are shown as Table B-5 in Appendix B.

Interestingly 25% of the subjects did not place enormous value on a degree of any sort. They did say that a degree was a big help but that actual field experience and construction knowledge was more important and that they could teach the right

person the rest of the business if the person had those prerequisites.

Engineering was the preferred background for 44% of those interviewed. They felt that the technical knowledge that comes from this background gives the young engineer a good head start on learning the business. Of significant note is the fact that no non-engineer indicated a preference for an engineering degree for candidates they were considering for employment or promotion.

Building construction was the preference of 31% of the subjects. Both subjects with building construction backgrounds indicated this preference as did an industrial manager, a business major, and one (1) manager with no degree of his own. No engineers indicated this preference.

Entry Level:

The preference indicated by the largest block of subjects interviewed was for starting new personnel in the office before sending them to the field. Even those who themselves started in the field agreed with this starting point. The breakdown for this opinion is shown as Table B-6 in Appendix B.

The reason stated most often for starting new personnel in the field was lack of maturity. As it was often explained things move quickly in the field and there isn't as much time to analyze issues and have decisions reviewed before taking action. The general feeling among those interviewed was that most new hires

lacked the maturity and confidence necessary to do well in this environment. There are only two ways to learn in the field, either by mistake or by asking questions and going ahead with the work. Even a short period in the office could give a new recruit the time to develop the poise and confidence to be willing to ask the necessary questions to help them avoid some of the problems in the field.

Follow On Assignment:

All of the subjects were unanimous in their call for field experience as one of the first two (2) assignments. Initial field assignments involve a great variety of duties with the key to all of them being an initial exposure to field construction methods and personnel. New recruits in the field are expected to learn as much as possible about how things go together, production rates, and to begin developing their relationships with the people in the field.

Final Training Assignment:

After spending one (1) or two (2) projects in the field a young trainee will be returned to the office. He will now become more actively involved in the estimating process. His initial exposure was probably one of "door counting" with all of his work being closely monitored. Now he will be involved in selecting construction methods on which to base the estimate, in contacting sub-contractors, and in preparing and negotiating the sub-contracts. At this point he will usually begin to work with the architects and owners as an assistant to the project manager. By

now he should have developed enough experience in the industry that he is actively contributing to the firm. From this point he may be given a small project of his own to manage or he may be returned to the field to assist the project manager on a large project.

Summary of Desired Experience:

Although actual career paths varied the interview summaries in Appendix A clearly show almost unanimous agreement on requirements for promotion in the firms interviewed. The experience necessary is gained through alternating field and office assignments.

It was noteworthy that although most of the senior managers interviewed felt that engineers are ill equipped to move into management only one firm had an actual training program to help perspective project managers develop the management skills which all agreed engineers typically lack. The remaining firms seem to be relying on osmosis to imbue their young staff with basic management skills. Although good engineers have been shown to have the basic skills to allow them to develop management skills quickly it is not reasonable to expect them to develop these skills automatically. Indeed many engineers balk at moving into management because of the lack of confidence which could come from training.[4]

One company interviewed has established a formal training plan that takes approximately two (2) years to complete [A40].

This plan covers twenty-four (24) topic areas that the firm has identified as being key areas which must function properly for a project to succeed. This plan is briefly outlined in Appendix C.

CHAPTER IV

ENGINEERS AS MANAGERS

In concluding each interview each subject was asked to discuss his or her own opinion of engineers as managers. Did they think that generically engineers made good managers and what did they see as the inherent strengths and weaknesses of the engineering background for preparing individuals for careers as managers in the construction industry?

Strengths:

In general engineers were seen as being good prospects for management positions within the construction industry. They have a proven record for problem solving and for being able to apply themselves for an extended period just by virtue of having completed the engineering curriculum. These strengths and the fact that they are known for logical thinking and being results oriented were commonly stressed strengths. Having said all this the subjects interviewed went on to discuss the weaknesses of engineers at great length.

Weaknesses:

The weaknesses of engineers as discussed by the subjects interviewed can be grouped into three (3) areas. These are communication skills, personality traits, and knowledge deficits.

Communication Skills:

For years engineers have been accused of being unable to speak effectively and their writing has been viewed as being less well developed than their speaking skills. Each subject interviewed discussed this view and strongly agreed with it. Furthermore each subject went on to say that the inability to communicate effectively bars progress into management. Each subject thought that developing these skills was a responsibility which the universities should undertake.

Personality Traits:

Acknowledging the typical stereotype of the engineer most subjects felt that engineers were most comfortable working alone on technical problems. They felt that engineering attracts the type of person who is most comfortable in a dichotomous world of right and wrong answers. The fact that this type of person is the kind who finds their way into engineering was felt to be the reason that most engineers deal poorly with people oriented situations where things are not black and white. Engineers who adapt poorly to this situation were deemed to be inflexible and engineers in general were perceived to tend towards inflexibility. This was one reason frequently cited by the individuals who preferred building construction graduates over engineering graduates.

Dysfunctional people skills because of the perceived generic personality of engineers was the strongest deficit discussed by

the subjects interviewed. Again the firms wanted the universities to take the initiative to solve this problem. They felt that industry should be responsible for teaching their recruits the construction business not writing and public speaking.

Knowledge Deficits:

One subject interviewed said that young engineers should develop more world knowledge. The construction industry does not operate in a vacuum and is greatly affected by the politics and economics of the community it serves. Engineers who want to move up the management ladder were encouraged to study these issues and become conversant with public policy.

More often engineers and the engineering curriculum were criticized for having too narrow a focus. Almost every course involves solving technical problems. In the first interview the subject stated that so much time is spent solving problems that no one teaches the engineer to recognize that there is a problem in the first place. Again the firms look to the university to solve this problem. The most stated suggestion was for changing the curriculum to require courses in management, personnel administration, and finance in order to broaden a graduating engineer's knowledge and scope of vision before sending him out to industry. The fact that this would most likely increase engineering programs from four (4) to five (5) years was not seen as a problem by the firms though most engineering students would certainly not agree.

CHAPTER V

SUMMARY OF INTERVIEW RESULTS

The most frequently expressed opinion was that many of the strengths and attitudes that make a good engineer make a good manager but that this strength could also become a liability. This agreed with opinions expressed in the "Journal of Management in Engineering"[4]. Although the ability to think problems through logically and to focus on them in a task oriented manner is of great value to managers engineers are often cited as taking this approach to an extreme. When this happens and engineers focus on specific tasks too rigidly, looking for the "right answer" their strength does indeed turn into a weakness. The subjects interviewed noted this and supported past discussions which concluded that graduate level work is needed to provide management training that cannot be acquired in the undergraduate engineering program. Others who have examined this problem have developed sound conclusions as to the training which should be provided in such a graduate level construction management program.[5]

The subjects interviewed also discussed the fact that most engineers, like people in general, are more comfortable with what they know and what they are good at. In the case of engineers this leads to a tendency to concentrate on the technical and design aspects of a project at the cost of neglect to the bottom line and often leads to failure to deal adequately with personnel caused or related problems. Most subjects interviewed attributed

this to the fact that people who are attracted to engineering in the first place are more comfortable with numbers and do not like dealing with people. This seems to be a way of saying that managers are born and can't be trained, an old concept that is losing ground as more and more management training becomes available. Referring back to the summary of the preceding chapter only one (1) firm has developed an actual training program for its project managers. It is not surprising that in the absence of this help in broadening their skills many engineers in industry are stereotyped as not dealing well with the people resource on a project.[6] Further adding to this stereotyping is the fact that many engineers, mostly in other industries, are promoted based on technical competence in spite of a lack of management skills and training. As these people often perform poorly they further the image of engineers as poor managers.[7]

The firms noted did seem to partially recognize the fact that some engineers are not comfortable moving into management roles though they did not seem to perceive why. They attributed it solely to individual differences and did not recognize the role that training has in the process. It has been shown that early in their careers engineers develop what Feldman calls career anchors. The most common anchors being either managerial competence or technical/functional competence. These anchors are pivotal as an engineer makes career decisions throughout his lifetime.[8] If companies are really looking for ways to help their engineers move effectively into management they will have

to provide the training assistance to build managerial competence anchors.

CONCLUSIONS:

Although there is no way to pinpoint one (1) career path that will lead to a senior management position in the construction industry it is possible to identify the areas of expertise that must be mastered to succeed in such a position. Even though the title of the positions may vary from company to company the duties and responsibilities of the positions are fairly consistent. By studying these positions within each firm and comparing the experience which can be gained in each with the generic career path previously discussed and with the topic areas contained in Appendix C an individual can map out a path that will at least ensure his exposure to the necessary learning experiences.

An individual that earnestly desires to move into the management arena should exercise care that he does not spend too much time in one type of position during his first ten (10) years because variety in his experiences are a prerequisite for senior managers in the industry. It will certainly be necessary to balance short term results that might be achieved by moving up in one (1) functional area of a company with the long term career goals that moving from area to area may ultimately achieve.

It is also important that an individual concentrate on developing his own communication and management skills. These

areas are not developed in his undergraduate education and most companies try to develop these skills through osmosis even though this process provides as many bad examples as it does good ones. The individual who takes the initiative to identify his own weaknesses and over comes them will have a strong start on moving ahead in the construction industry.

RECOMMENDATIONS:

Universities cannot provide the management experience and broader educational perspective that employers want in a four (4) year undergraduate curriculum. They can however encourage undergraduates to use electives more wisely and to participate in outside activities that will help develop the skills needed in the construction industry.

Graduate programs can and should improve their approach in the area of construction management. More time should be spent on generic management courses and principles and less time on learning specific computer applications. It becomes apparent after speaking to only a few senior persons in the construction field that courses taught by experts in the field such as accounting courses taught by accounting professors are deemed more valuable in the long run than watered down versions of these courses taught by engineering professors. Construction management programs should therefore increase the number of courses taught out of the Engineering Department and should only teach the construction specific courses such as estimating, construction methods, and scheduling in the Engineering

Department. More emphasis should be placed on group projects and presentations to help develop the communication skills so frequently sought after by the industry.

In closing it is obvious that although engineering is an excellent background for managers in the industry it only provides a foundation on which an individual seeking success in management can build. In the long run managerial skills and communication skills will have a greater impact on an individual's success in this area than will technical excellence. The motivated individual will recognize this and develop himself in these areas in spite of the obstacles that a traditional engineering program places in his path.

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SUMMARY OF INTERVIEWS

SUBJECT: 1
POSITION: Vice-President
AGE: 39
SEX: Male
DEGREE: Industrial Management
REG: No professional registration

EDUCATION AND WORK HISTORY:

The company managed by this subject does not consider itself specialized but is most familiar with and has had great success building shopping centers, commercial office buildings, and motels. The company has annual sales between \$100M and \$110M with one hundred (100) salaried employees and between two hundred (200) and three hundred (300) hourly employees depending on the season and level of work underway. Approximately 15% of their work is sealed bid and 70% is negotiated with the rest being somewhere short of either end of the spectrum.

The subject has been with this company since his graduation in 1971 so he has not had the experience of company mobility realized by most senior people in the construction field. Most other subjects interviewed experienced a high degree of company mobility but this did not seem to be the norm for this company in that most of the other senior people in the firm had been with the company in excess of ten (10) years. The company considers itself a grow your own firm for senior personnel.

Although the subject entered the firm with the title project manager (PM), he spent his first couple of months doing estimates. The firm had just completed its first shopping center

which was also its first job over \$1M. The subject was involved in doing tenant work for this center. He did shop drawings, layouts, and cost estimates.

Following this the subject became involved in a facet of the company which dealt with metal buildings. His efforts included estimating the buildings, sales, and actual on-site construction for the customers. Several months later he took over his first project, a truck dealership in a nearby state. Although he had another more experienced project manager to teach him the trade he considered himself quite aggressive and said that he picked it up rapidly and was running the project for himself in a short time. He moved from this project to other projects including other dealerships and restaurants ever increasing in size as both his experience and the company's sales grew. He summarized saying, "I moved into project management without even thinking about it, it just came natural." He felt that he had to learn about the construction side of the business but he felt that the management side of it, the administrative and money side of it, had come easily to him.

After about six (6) years he was considered a senior project manager though the firm did not at that time use that title. The company had gone through a brief cut back during which some personnel had been lost so he was a senior based not only on his experience but also his longevity. The company had developed a reputation for its work and had begun to do an increasing amount of franchise work. With his experience in these facilities he

knew just what would be necessary for each new facility with only minor modifications depending upon the site. This allowed him to take over and run multiple projects. Simultaneous with this the firm broke out estimating into a separate department. Prior to this each PM had been doing most of his own estimates.

The company also began its early efforts in automation of administrative functions using computers. He was very involved in this effort. Although the actual work of developing programs to help the PMs and estimators was done by programmers brought in for that purpose, he played a key role in setting formats and guidelines for the use of the computers. He continued this early work as the programs grew and were phased together in the integrated system now used to control the company. He stated his opinions of automation saying, "I don't know how to do it any other way anymore. I mean some people don't use computers like we do and I don't even know how they know where they're at." Although he said that they also did computer scheduling his opinion and that of the firm was that "scheduling is more of an art".

He was promoted to Assistant Vice-President in just under ten (10) years as part of a move to get some of their senior PMs actively involved in sales. Along with this promotion came the authority to actually enter into and sign contracts for the firm. He was promoted to Vice-President at about the ten (10) year mark. Still actively involved in sales he once again was responsible for construction through a number of PMs assigned to

him. A primary function was to train these young PMs.

Lately he has had little involvement in actual supervision of production or in sales. Mostly he has been responsible for scheduling, quality assurance, and overview of the entire safety program. He has also been responsible for training eighteen (18) to twenty (20) PMs and approximately forty (40) salaried field personnel. In this function he sees every project the firm has at least every six (6) weeks. This not only lets him convey management support for the people in the field but it also allows him to get a feel for the relative strengths and abilities of all the people in the field. He likes to see what they are capable of and compare the different ways that people find to get things done. Based on these visits the subject has found that in many cases field operations people such as superintendents need more training than do the actual PMs. This is provided through outside seminars, in-house sessions, and through the use of several company manuals that the subject helped to develop.

CAREER GOALS:

The subject felt that the industry and the company are constantly changing and restructuring to stay competitive. The subject plans to stay flexible and change with his environment. He plans to stay with the same firm but would like to change the nature of his current assignment, specifically to be able to pursue more sales and get back in the operations line. He explained that the company had gone through a period when things grew rapidly. During this period everyone was very pressed and many new people were brought into the firm. Schedules were tight

and this resulted in a drop in quality. His present assignment has been one of boosting that quality. He stressed that he has done this through quality assurance vice quality control. Now that he feels that the firm has a good handle on this he is ready to move on to other things.

EVALUATION OF OWN EXPERIENCE:

When asked about the most valuable part of his own experience he prefaced his remarks with , "This is a people business, it's not a money business, it's not a thing business, it's not a materials business. It's purely a people business". His philosophy and that of the firm is that the most important ability is the ability to handle people one on one. They believe that these relationships are a necessity to any success.

For that reason he strongly feels that his most beneficial assignments were the ones involving negotiations. These negotiations could have involved sub-contractors, owners, or architects but each was an opportunity to hone the people skills already discussed. He elaborated saying that negotiations often would begin with the parties acting as adversaries so his skills had to be developed to allow him to turn the situation around so that things could get done. He defined his opinion saying, "the key to negotiating is the ability to talk to a stranger and sell him on both yourself and your company whether its a customer you're trying to sell on using your firm or a sub-contractor you're trying to sell on giving you a better price."

EVALUATION OF NECESSARY EXPERIENCE:

When asked about required experience for new PMs or senior PMs he said that the firm does have a slightly formal training program though it does vary some from person to person. He outlined the program saying that first new people estimate. He discussed his feeling on estimating by saying, "If you can't estimate you can't negotiate; you don't what you're buying; how much to buy; why you're buying it. You won't know what costs are. You won't know anything! You have to know how to do it and why you're doing it." His opinion was that to get a handle on this process somewhere around six (6) months is needed although a few may need less time. He did say that many people need more. He also felt that people who like to make things happen and may eventually move up to management positions will usually want to get out of this type of position as soon as possible. He also said that some people like it and that's OK. "We need good people in that area", he stated. His experience has shown that others just can't hack it and will eventually move out.

He continued saying that if the young estimators are progressing and doing good work the firm will try to move them out to work as an Assistant PM with a PM or Senior PM. Then the firm moves them to the field on a large project so they can see the day to day workings and get involved in resolving field problems. They get involved in reviewing shop drawings and making field changes. This is where the subject finds out what their people skills are because in the field they have to deal with every level of individual from the laborers to the owner.

In the field is also where they get their first brush with purchasing. The subject felt that they have to learn to buy smart. He went on to say that, "A lot of people say that, 'a general contractor, what do they do? They build things.' No we don't, we're professional buyers. We buy for a living so we have to be smart about what we buy and who we buy from. We are professional buyers and we spend a lot of money!"

EVALUATION OF ENGINEERS AS MANAGERS:

The subject stated that part of managing a project is understanding that a project is made up of three things, Cost, Time, Quality. You can have two of these but not all three. In his opinion engineers have good potential as managers because of their educational background. They are taught to systematically solve problems. They know the tools to use to solve a problem, but he did say that, "Sometimes they can't see the problems. They may understand when somebody tells them the problem and they'll go solve it, but to visualize the problem and realize it's their problem to solve is a little bit different for them. It's the engineer that can see the problem, I think, that's going to go somewhere." He justified these feelings by explaining that the training that an engineer is given always starts with, this is the problem. Nothing tells them how to realize if there is a problem in the first place. In the other schools such as Industrial Management students are taught various ways to analyze situations to recognize if there is a problem and what it is. Once a problem is identified, he said, "these students are taught to send it to engineering to get it solved."

The subject ended his interview saying that he always looks for an engineer that gets away from his technical skills and starts using his people skills to find out what problems the people around him have so that he can help solve them. The subject wants that engineer to spend his time helping the firm recognize and define problems. The firm can always give the problems to another engineer to solve once they have been defined.

SUMMARY OF INTERVIEWS

SUBJECT: 2
POSITION: Manager of Preconstruction Services
AGE: 44
SEX: Male
DEGREE: Bachelor of Science in Electrical Engineering
REG: Engineer in Training

EDUCATION AND WORK HISTORY:

The company employing the subject sees itself as a contractor which can do almost any project. It has annual sales of \$85M with over five hundred (500) employees on board at any given time. Approximately 50% of the work done by the firm is negotiated vice firm bid.

After receiving his Bachelor's Degree in Electrical Engineering the subject went to work in the Graphics Art Division of a major corporation. His duties at that time revolved around layout and sales of heavy printing equipment. He viewed this position primarily as one of marketing even though some engineering was necessary for each sale as equipment had to be custom fitted for each location. The firm only hired engineers for this position. The job required a great deal of travel and his territory extended over several states. After about nine (9) years he was approached and took a position with a European company whose equipment he had also been marketing as ancillary equipment to his main product line. His new position as agent for this firm also required his engineering skills for customizing and laying out equipment. He now traveled across the whole country and to Europe. He was in on the ground floor for marketing this company in the U.S. and developed the position

into one wherein he had an entire sales force under him marketing this firms product across the country.

Together with another engineer from the firm he left and established his own company which built and marketed a similar product but with some new innovations which they had designed. Again he found his engineering training critical because of the design requirements and the need to customize his product to meet various opportunities. About four (4) years ago they sold the company and he moved into the construction industry.

Until recently marketing had not been a defined and emphasized area in the construction industry and his company hired him for the specific purpose of moving the firm into an aggressive marketing posture. He feels that his engineering background is still useful in the area of pre-construction services where his marketing efforts are centered.

CAREER GOALS:

When asked about goals he said, "I think construction is a very wide open type of field and I expect to probably die in this field." He believes Atlanta has and will continue to have for some time many great opportunities. Even though things may slow down a little from time to time he thinks it will always pick back up. The subject wants to stay in this area in a marketing position where he feels he can direct traffic. He likes sales and enjoys the engineering aspects of construction. His company is growing and he wants to be a continuing part of that growth.

EVALUATION OF OWN EXPERIENCE:

He evaluated his own experience saying, "Sales is what I like to do. Out of marketing-slash-engineering comes, in my estimation, the best managers of people; the best principals of companies. Simply because the company cannot grow in any way, shape or form unless they have a good sales growth; a good marketing growth and there's no way for it to happen but with control and that control comes from the engineering side. I've seen companies that have a great spurt, a big spike in their growth and chances are they have troubles because they didn't have control of that growth."

EVALUATION OF NECESSARY EXPERIENCE:

He began his discussion of this area stating that there is some design required for young engineers in construction because even plans that are supposed to be complete are never complete. His example was negotiated work where plans don't spell out exactly how a thing goes together and so the PM must be able to talk construction with both the designer and the field people to resolve what will be done.

He said that a person in this firm starts in estimating. He continued saying about estimating, "We would prefer to have engineers if we can and we try to hire them over there. Good common sense is required in estimating besides being able to read a set of documents and that common sense, in my opinion, comes out of engineering. Engineering is a problem solving curriculum

and generally if you have good common sense you are a pretty good problem solver and can get through the engineering curriculum."

This firm likes to get young engineers out in the field for at least one complete project maybe about eighteen (18) months. Then they will usually act as an assistant to a good PM. They'll act as a liaison, do some field engineering, and then the firm tries to give them a small project like a strip center or a church. If they do a good job they get a large project of their own or maybe several small projects. The subject elaborated saying, "I myself was hired in to be the marketing and salesman for the company but I started out in estimating. I went out on a job and spent a year on the job. Then I was PM of a couple of water treatment plants and finally I was allowed to do what I do best. They kind of put me in a box for a couple of years till I learned the business and then they turned me loose."

EVALUATION OF ENGINEERS AS MANAGERS:

In his opinion, "Engineers have a way of looking at a thing as the whole and trying to solve the various parts of the puzzle and because of it I think he can run a company a lot better than some other type of graduate."

He felt that the primary weakness of an engineering background is the lack of a broad course outlook. He explained that engineers come out tunneled into a very limited area and they have to expand through the school of hard knocks. He thought that perhaps some management and marketing courses would

help the engineer choose his path better when he first gets out of school. He said that a good way to better prepare the students would be to try and put some practical aspects in the schools. Maybe make the degree five (5) years and add some type of course where the University places the student in a work environment and gives them college credit for their work. Students need to better understand the alternatives available to them with their degree so they can make better decisions coming out of school. As for long range career goals for engineers he said, "Only one person in a company is going to become Chief Engineer. There might be a couple of junior chief engineers and the rest are going to be grunts. They're going to be the engineers, they're going to be limited as far as income, as far as what they might do and so on. One person out of perhaps fifty in a company, that's not very good odds."

The strength of engineers, he felt, is their problem solving ability and their weakness is their lack of practical knowledge. They have been tunneled in for four years. They need to know more about the various paths that engineering open for them. He explained his view of the typical student saying, "They get out, the first thing they do is get a job as an engineer designing on the board, what a boring place to be. It drives them even deeper into their tunneling." He believes that part of the curriculum needs to include some finance, some management, things to broaden their awareness of what they can do.

He ended the interview saying, "English and writing skills

are so important to an engineer. They can't read worth a damn and they can't write worth a damn. There's a real need there and those ought to be basic things. No matter what, you ought to have to take those. The management, marketing, and finance things ought to be things where you have choices although you should have to take certain of the choices. Management has been bitching about that for years and I haven't seen anything change yet. Even if it extends the curricula to five (5) years these things are needed."

SUMMARY OF INTERVIEWS

SUBJECT: 3
POSITION: President
AGE: 44
SEX: Male
DEGREE: Bachelor of Science in Industrial Management
Master of Science in Systems Management
REG: No professional registration

EDUCATION AND WORK HISTORY:

The subject manages a company with approximately four hundred (400) employees and annual sales of \$200M. Although the company is diverse in its expertise it does mostly high rise commercial construction, hotels, and hospitals.

While in college the subject worked summer jobs in building construction. After a brief stint in OCS with the Navy he went to work for about a year and a half (1.5) with a consulting engineer for building construction. Most of his training and electives were bent towards Civil Engineering. He was originally accepted as a Civil Engineering student but he wanted more management in his studies so he switched to the IM major.

Next he moved back home and went to work for the largest general contractor in the area, a company with annual sales of \$15-\$20M. He took up where he had left from off his summer work. He started off in estimating, did expediting and moved into project management. After a few years of increasing responsibility he ended up running a job as a superintendent which he felt was a great experience.

The company was a family company which limited opportunities so he decided to make a career move. He moved south and went to work for another construction company as a PM and ran a number of different jobs including a twenty (20) story office building. About two-thirds of the way through an 850,000 square-foot office building he was promoted to operations manager to run all the construction operations for the company. In this position he was responsible for many large projects.

Work disappeared as the open shop market came along. Upper management in the firm changed and the new manager was someone who would, and rightly so, be in the position for a long time so when the opportunity came along to move to another firm in town and run the entire operation, he took it. This was a good learning experience but after a year he felt he did not fit into the corporate culture of the new firm.

He took an opportunity to move into another subsidiary of his previous firm which at the time was running under significant problems. They had a large amount of work underway and he was assigned to get the work completed and to find out what the problems were. In only four years the company had grown from a volume of about \$4M to a volume of about \$200M. He explained, "They had no business being there." He spent the next two years cleaning up what he called, "...poorly supervised, bad, bad jobs." He discussed the basis for the firms problems in that they had pulled in a lot of people with very little experience because of their rapid growth. He had to contract the organization and took

on very few new jobs while he battled to get the work underway completed. He said, "It was a tough job. That's where I got my doctorate! The job really put some age on me." He repositioned the company and contracted it down to about \$50M. He felt the firm hadn't managed the growth or change well. He felt this was because, "They forgot to say no, forgot to do a lot of things to control the growth of the company up front. It became very painful for a lot of people." He got them on the right track but was not enjoying the contraction and didn't like the opportunities that were resulting from the change in the company and it's parent firm so he began to look for other opportunities.

His dissatisfaction resulted in his move to his present company and the presidency he now holds. He feels the firm is in a controlled growth mode. He is concentrating on the recent change in the perception of the construction client as new emphasis is being place on the quality side of the time, cost, and quality triangle. Quality had slipped for a while in the industry but his firm is fortunate in that it had maintained its reputation for quality.

CAREER GOALS:

When asked about his goals he said, "I don't see any movement on my part. I got caught for a couple of three years where I was a mover and it was a good experience. Many companies have a different company culture. Technical knowledge becomes less and less important and it becomes people and style. I like where I am."

EVALUATION OF OWN EXPERIENCE:

He began his evaluation saying, "I think that to be a senior manager you have to have experienced all the different steps." He thought each one of his positions had been valuable because each taught him a new area of the industry.

He expressed strong opinions about estimating in particular saying, "Estimating is probably one of the key ingredients to knowing construction but if you're just in there taking off doors and counting them, you're really not learning anything. That's what estimating is to some people. They're wrong! If you're involved in evaluating styles, techniques or systems; you're taking off steel, concrete and rebar and counting it but you're also analyzing how to build it at the same time while working with people to help you; that's good experience." In his opinion an engineer has to understand the means and methods to build a structure.

He felt that one of the most important things a person shows in estimating is the discipline to do it. Coming out of school most engineers have a lot of technical knowledge but they need to show that they have the discipline to do what a company needs done.

He continued that the second dominate type of experience a person needs is to get out in the field. They can check shop drawings and begin to learn some of the practical things that their education lacks; how to set steel, the differences in

cranes, and the importance of what they're doing. He explained this by stating, "When they check shop drawings they don't have any idea of the impact if they miss a dimension. They don't understand that it's really going to mess up a superintendent and what he's trying to accomplish in the field. It's not only going to mess up the superintendent it's going to cost sometime in the future. We have to get them out so they can physically see that if they miss an imbed location, to chop it out, re-insert it, re-weld it, and patch it up is going to cost a significant amount of dollars. They have to realize that what they're doing is important."

He felt that those two elements are most critical but that in management less and less you look to your technical knowledge, the discipline by which you acquired that knowledge yes but not the specific course work itself. He was very straightforward when he said, "Quite frankly I'm more impressed with the building construction programs than I am with the engineering programs. They are far more practical. I hate stereotyping but they become more flexible in their ways of doing business than engineers." He likened engineers to doctors who for years were more concerned with lab work and diagnosis and are only now becoming concerned with patients as people. Engineers need more broadening of their personality and styles.

EVALUATION OF NECESSARY EXPERIENCE:

When his firm brings in a new person he said, "We try to tell everyone we would like to have them have experience in

estimating, experience at the job site, experience in PM and also an experience in the field as a field engineer or as assistant superintendent, but we don't put a track on it." Although he felt this was a good approach he also felt that the field is too competitive to be rigid in a track, you have to let individuals go where they have an opportunity. He also conceded that, "One of the catches to such a track is that if you start to do a good job in a certain area you may have a hard time getting out of it. You have to assert yourself sometime otherwise you'll find yourself in estimating for ten (10) years." He didn't want to set time limits to serve in each area before an engineer could reasonably expect to manage a superintendent with many years of experience and have that superintendent listen to him. Furthermore he thought it takes eight (8) to ten (10) years to really be able to be the PM on a large project. He generalized these thoughts saying, "I think I know when to promote an individual to a PM. That is when he is effectively communicating and has gained the respect of the superintendent, the architect, and the owner. When he has gained the respect of all three of those and they listen to him when there's a problem. Some fellows never get there."

EVALUATION OF ENGINEERS AS MANAGERS:

He felt that sometimes engineers are too technically oriented. He elaborated on this saying, "Our business is a people business and I have to deal with people such as the laborer or the labor foreman, although perhaps these days I don't get to talk to them like I used to, all the way through to the

architect. I've had to learn to communicate with every aspect of society." In his opinion many engineers don't have the communication skills. They can't communicate the problem in such a way to present it for an effective resolution. He agreed with a past comment on engineers abilities to recognize problems in that they are weak in identifying the problems present for themselves as well as communicating them. When it comes to problem solution he thought that engineers are excellent. He ended the interview saying that engineers can be inflexible. The example he provided was regarding structural engineers. He said that often when they were part of a team solving a problem if someone else on the team brought up alternatives to the ideas proposed by the engineer they often object.

SUMMARY OF INTERVIEWS

SUBJECT: 4
POSITION: Director of Internal Operations
AGE: 39
SEX: Female
DEGREE: Bachelor's Degree in Business
Graduate work at London School of Economics
REG: Serves on National Board of Directors for the
Construction Financial Management Association

EDUCATION AND WORK HISTORY:

The company employing this subject employs about one hundred seventy-five (175) others and provides professional construction management services of about \$18M annually. The firm feels it has the expertise to manage any type of project but has done mostly schools, correctional facilities, institutional construction, and hospitals. The subject serves with the President and performs most of the duties previously performed by the Executive Vice-President when the company used that title. Her duties include screening all new applicants and assigning personnel to existing projects. Although she does select and assign personnel to serve as PMs and Senior PMs she does not supervise these personnel once assigned.

She began her career serving approximately four (4) years as a Project Accountant with a firm in Washington D.C. She later moved to a similar position with another firm. Then she served a year as the controller for a developer. She left this position because of conflicting opinions on business practices.

She then went to work for her present firm as a project accountant. She spent six (6) months in this position before

being promoted to Assistant Treasurer. After six (6) months in this position the current President selected her to fill the position of Manager of Internal Operations, a position created when the President decided not to fill the position of Executive Vice-President.

She has held this position for four and one-half (4.5) years although the title has changed as the responsibilities of the position have grown. In addition to those duties already discussed she handles contracting, setting up Joint Ventures, coordinating with both hired and company counsels, and the budgets for all projects. She also sets procedures for all field administrative functions.

CAREER GOALS:

She would like to move the company into a posture wherein it would manage \$2B of construction annually and would receive approximately \$50M in fees. On a more personal note she wishes to remain a focal point for women in the field. She is the only female Senior Associate at this time and has always been at the forefront of the growth of women's roles in the field.

EVALUATION OF OWN EXPERIENCE:

She believes the principal benefit from her experience has been the growth of her people skills. She prides herself on her ability to deal effectively with people at all levels. She also values the management and problem solving skills that years in an environment of changing, versatile daily routine have developed.

She feels that her strong interpersonal skills are responsible for her proven record of selecting and placing the right people. In her opinion one of the key factors in a successful project is putting the right PM on the job to deal with the owner and the other principals. She feels that her ability to judge a person's character and people skills is a real asset in this. She values people who impress her as being in her words, "able to work effectively in an un-ordered situation."

EVALUATION OF NECESSARY EXPERIENCE:

She values good communication skills, both verbal and written. One of the next things she looks at in evaluating candidates is the dollar value of the projects they have done and to see how well they present what they really did on the project. She explained this by saying "If you look at the resumes of all the people who worked on the projects in Saudi they all claim all the work. Really there was so much going on that everyone had a small piece." She prefers a degree from an accredited construction program. She doesn't feel that there is one right track but she does feel that an engineer with executive management aspirations should learn as many facets of the work as possible in the first ten (10) years. She felt that six (6) to eighteen (18) months in each area would be sufficient.

She also stressed the importance of actually being in the field to see how things happen. She doesn't have a technical education but feels she has overcome this with time in the field.

She went out at every opportunity and in her words, "Spent so much time on the jobs following around people who knew what was happening that I have mud in my shoes that won't ever come out."

She also stressed the ability to do a good estimate. In her opinion to be a good manager you have to know where it (the money) goes. Particular importance should be placed on comparisons of actual to estimate. Scheduling is important in her view also. Junior people should spend time in job meetings to get a feel for what really goes on.

The most important part of field engineering to her is the time it allows for getting to know the people. She said these are the people who do the work and you have to be able to deal with them for the rest of your career.

EVALUATION OF ENGINEERS AS MANAGERS:

She felt that engineers have some inherent problems to overcome in order to become successful managers. They are too detail oriented and sometimes lose sight of the big picture. In her words they need to be able to let go of the details sometimes so they can do a better job of overall prioritization. Another problem she noted was that sometimes an engineer becomes too concerned with the project design and loses sight of the bottom line. She did feel that engineers as a whole did a better job than architects.

She also felt that engineers tended to be inflexible. They

look for things to be right or wrong and in her opinion need to be more practical. She felt that this could be helped with some general courses or seminars on management.

When asked her opinion of the statement made in interview one (1) about engineers being great at solving problems but poor at recognizing them she strongly agreed. She felt this was another way of saying that they get caught up in the details.

She strongly suggested elective courses or continued education in the areas of management, public speaking, and time management. She explained this by saying the engineering courses are all designed around individual effort and only help to weaken any people skills the student may have had. She ended the interview saying that engineers are more comfortable working alone in a dichotomous situation so they need to work hard to be effective managers.

SUMMARY OF INTERVIEWS

SUBJECT: 5
POSITION: President and Owner
AGE: 63
SEX: Male
DEGREE: Bachelor of Science in Civil Engineering
REG: No professional registration

EDUCATION AND WORK HISTORY:

The subject owns and manages a small construction company which for years has concentrated on small commercial and industrial projects. He is currently closing down his business as he prepares to retire. When he was in a full operating mode he employed about 76 people and did about \$10M - \$12M annually. His projects ranged from \$25K to \$7M.

The first eleven (11) years he spent in the industry were all with the same firm. He began as a field engineer but was also required to do extensive estimating. As his knowledge of field procedures grew he was moved into project management. At the end of his eleven (11) years he was managing the firm for the widow of the late owner. When she decided to close down the firm the subject and another manager in the firm started their own company.

They worked well together for about four (4) years, gradually building up their business until the partner passed away. The subject brought a new partner into the firm. They continued together for about three (3) years until they finally concluded that they weren't happy as partners. The subject bought out this new partner and continued alone until the present

time.

CAREER GOALS:

The subject found this question amusing in light of his present efforts to close down the business. He plans to work some few hours a week as a consultant, just to keep his hand in, but has no other professional plans.

EVALUATION OF OWN EXPERIENCE:

The subject found special value in his early time estimating and in the field. He believes that it is impossible to separate estimating from project management. He also firmly believes that engineers should spend as much time as possible in the field to learn the practical side of construction.

EVALUATION OF NECESSARY EXPERIENCE:

The subject smiled as he said that one of his relatives said that success was, "80% BS and about 20% hard work." He thinks this is true in construction also in that a successful person is one that can deal with people.

As far as required experience went he said that he had always been small so he had only hired young people a few times. He put them to estimating with an experienced person directing their efforts and then would put them into coordinating the projects they had estimated. He said that he never liked, "to split estimating and project management." This way they were familiar with the project and could see how it went together. He

felt that a PM should get out on the job site at least three (3) times a week.

EVALUATION OF ENGINEERS AS MANAGERS:

The subject felt that engineers have a leg up on many other fields for moving into management. He said, "The education is hard. The people that get through it have shown that they are willing to apply themselves." When asked about the weaknesses of engineers as managers he replied that he really hadn't noted any generic weakness that would apply to engineers in general. When he was asked his opinion of the statement from interview one (1) about engineers being unable to recognize a problem he strongly disagreed.

He said that he had always liked dealing with all kinds of people and that he felt that was a requirement for success. When asked about the people skills of engineers as a whole he answered that he didn't find them to be any better or worse than those of people in general. He did go on to say that in terms of being a good manager of construction he preferred people who had come up through the field or had been in a building construction curriculum. He said, "You need that construction background. I don't think that engineers or architects are qualified to run a job."

SUMMARY OF INTERVIEWS

SUBJECT: 6
POSITION: Senior Vice-President, Operations
AGE: 39
SEX: Male
DEGREE: None
REG: No professional registration

EDUCATION AND WORK HISTORY:

The firm which the subject helps to manage has annual sales of about \$50M and normally employs about one hundred (100) people. They can do just about any type of commercial construction but most of the examples which were noted were high rise commercial projects. About 60% of their work is negotiated and about 40% is bid.

When asked how he had worked his way into his current position the subject said laughing, "By default, I'm not qualified to do anything else." The subject was working a construction job while trying to attend night school. This was too demanding and did not leave any time for his family so he decided to quit school and concentrate on his career.

He first advanced to a position equivalent to that of a field engineer. He was timekeeper and a sort of Clerk of the Works. He worked for several sub-contractors in the area. He then became an assistant superintendent. Next he was moved into a position as an estimator for a general contractor. He started as a project estimator and then worked his way through the normal positions of senior estimator, project engineer, project manager, contracts manager, and then vice-president. It took about

fifteen (15) years to reach his present position.

CAREER GOALS:

The subject attributes some of his success to the fact that he always prepares and updates five (5) year plans. His current goal is to be executive vice-president or president of a large commercial contractor doing business in a small selected geographic area, (like Georgia and the surrounding states). He has already been exposed to working on a national level and doesn't enjoy it. Putting thousands of miles a year in on an airplane is not something he wants to do. His ten (10) year goal is to be Chairman or CEO of a similar construction company, preferably one that he helped to build.

EVALUATION OF OWN EXPERIENCE:

He felt that to do what he is doing every job he has held has been beneficial. He said that, "I think that the lack of an undergraduate degree has probably made me more aware of the fact that I need to absorb everything that I experience. I think that the jobs most important to me have been the field positions. As Senior VP of a company such as ..(Name deleted).. I deal with the superintendents, the foremen, as well as the people in the office. The people in the office tend to be more educated, they tend to be a little more professional people than the people in the field." He went on to explain that coming up through school and then usually moving straight into an office as an estimator makes it difficult for young engineers to learn to deal with the people in the field. In his opinion it's hard for someone

without the field experience in construction to get a superintendent to listen to him and believe him. He described this saying, "It's an inherent lack of respect. Not for you but for your experience." He said he had done the work and had supervised it and that experience is invaluable.

EVALUATION OF NECESSARY EXPERIENCE:

He felt that an engineer being moved into project management had to have shown the ability to think on their feet. He went on to say that their communication skills have to be above average. More specifically he said, "They have to have spent some time estimating. They have to have spent some time project engineering, handling the shop drawings and changes; shuffling the paper if you will."

He went on to stress communicative skills again. He said that a PM had to be able to deal with the owner, the architect, and the superintendent and that each of these would be a different type of person and relationship. He added that, "I think they have to have the ability to strategically think. I'm not sure that I can well define that for you, but it's to see a problem and to see an opportunity as well as a problem." Opportunities lie in every problem in his view of life and especially this industry where he says that every day consists of new problems.

He thinks that the best way to take a young engineer and

make him a project manager is to put him on a small project and give him a mentor to call upon. Not someone to tell him what to do but rather someone that can offer some advice and give him a sounding board for his ideas and with whom to check company policy. He said that this mentor wasn't a supervisor because all PM's, junior and senior report directly to him.

EVALUATION OF ENGINEERS AS MANAGERS:

His first reaction to this area was that an engineering degree is not valuable at the Senior PM or Vice-President level. He said, "I think there are good managers and there are bad managers. Some of them are engineering graduates and some of them aren't." He went on to say that early in the career an engineering degree is helpful, especially in design concept and development. About estimating he said, "In estimating I don't think an engineering degree helps a lot. I think you got to learn how to read the blueprints and you got know how to take off the quantities and you have to learn how to take off concrete."

He criticized most young graduates saying that new graduates want to go right into project management and be behind a desk and wearing a tie in the first five (5) years. He said, "There's really no interest in going in the field. If we don't correct that problem we're not going to have a successful industry. The twenty-first century scares me to death for our industry because

of that fact. Superintendents are getting old." He blamed the aging of the industry and said that the industry is not replacing those people in the field. Companies don't have the training ground in the unions that they once had and that is turning training into a big G&A expense.

He went on to say that if he were to do any continuing studies now or were able to get a degree he would want a business degree. He felt that senior managers are businessmen and spend most of their time on business problems. He also stressed that he had to spend a lot of time on human resources type issues, people issues. His opinion was that if a technical problem was big enough to get to him he was going to want a consultant on it anyway. Even if he could design the fix he wouldn't both from the stand point of increasing owner confidence by getting an independent solution but also from the liability point of view.

The subject was asked to comment on any inherent strengths or weaknesses engineers might have as managers. He said that there are some engineers that have become excellent businessmen but in general they do have problems in communication. He felt that they should actively work on being more well rounded.

His reaction to the comment made in interview one (1) about engineers not being able to see the problems was positive. He said that he had not thought of it in those terms but that it rang true for him. He also said that it seemed to go back to his comment on strategic thinking. You promote the people that can

not only identify the problems but that also view them as opportunities.

When asked what the usual company procedure was for training someone who they viewed as being on track for an eventual position as a PM or Senior PM he replied, "I say this somewhat humorously but the first thing we do is brainwash them and eliminate all his engineering." He continued saying, "Most guys resumes coming out of school look the same. The guy that really stands out is the guy who has interned." He explained this by saying that he wanted someone who had either co-opted or worked summers in construction, done something to show an interest in the industry. After they are hired he said they went to either estimating or to the field as a field engineer, about six (6) months in each. He thought that the problem with this is that you get these guys, put them in a slot and come to depend on them. Sometimes it becomes hard for the company to get their supervisors to let go of them.

Referring back to his earlier statements about the careers engineers want he said that most want to go into project management. These guys move on to positions as project engineers and later move up to PM. He felt that very few wanted to stay in the field to move up through the superintendent ranks. He said, "When you find one that does, boy you got to treat him right. You have to help him." He summarized saying that regardless of the degree the experience needed is the same. They have to move around and do the different things to learn the business. He

also said that it would help if they had a little broader base. He emphasized how much just a little knowledge in accounting would help. He went on to name marketing, business administration, and human resource management as other areas that engineers should study.

The subject was questioned about his earlier comments on needing some engineers to stay in the field. When asked if taking this career option limited their possibility for future promotion he hedged his answer. He acknowledged that taking this path would prevent them from getting a lot of the administrative training that would make them competitive for future promotion to positions as vice-presidents but he went on to say that superintendent salaries were competitive with those of the vice-presidents.

SUMMARY OF INTERVIEWS

SUBJECT: 7
POSITION: President and Owner
AGE: 38
SEX: Male
DEGREE: Business Administration
REG: No professional registration

EDUCATION AND WORK HISTORY:

In addition to his undergraduate work the subject also has had some continuing education in the areas of surveying and blueprint reading but says that most of his real education has been on the job training over the years. He now owns and runs a small construction company with annual sales of approximately \$22M. He has twenty-four (24) salaried employees and about one hundred (100) hourly employees at any give time. His work is evenly divided between bid and negotiated work. Although he doesn't see his firm as being specialized he says his firm does do a lot of work involving hospitals, shopping centers and parking garages. He also said that they get a lot of the projects that no one else really wants to fool around with. He said that, "If something is pretty weird and screwed up it's the kind of thing we usually get." He summarized saying that his firm, "is a good middle sized construction firm that's very financially stable."

His first position in the industry was as a laborer in the family firm. He worked in this capacity through high school and college. After graduation he worked as time keeper and what he called "flunky" for about a year. Next he was made superintendent on a small project. After that he was given other

small projects to supervise. After about two (2) years he was moved into the office where he did combined duties as estimator and project manager for some public utility work. He continued as a project manager and began to slowly assume more responsibility for the firm until his father stepped down and left him to run the entire operation.

CAREER GOALS:

He plans to slowly continue to grow the firm. He wants to keep things under control during this process and just do more of the same things they have always done.

EVALUATION OF OWN EXPERIENCE:

He said that there is no substitute for experience. He found his time actually working with the construction in the field and the time he spent estimating to be the most valuable. He said that dealing with people was also very helpful. He went on to explain this saying that he finally had realized that after a while the problems were all the same it was just the people that kept changing. He said that about five (5) years ago he realized that he really didn't know what he was doing and that he guessed that was maturity.

He said that lack of an engineering degree had not been a problem because what he had always done had been management.

EVALUATION OF NECESSARY EXPERIENCE:

He usually doesn't hire people that he has to train from

scratch. He said that he was too small to be able to afford to train someone so he tries to hire people that already know what they are doing. People in his firm have to do both estimating and project management because the company is small. Most of his PMs do their own estimates. He says that he is really just looking for someone who is willing to learn and is ready to do the job.

He sees his project managers as being more experienced then most because he wants them to actually run the project. He says they have complete responsibility for their projects and the superintendents work for the project manager.

EVALUATION OF ENGINEERS AS MANAGERS:

He said that he didn't know if most of the managers that he deals with are engineers or not. Those that he does know about tend to, in his words, "get bogged down in the details. They can't see the forest for the trees." He went on to say that engineers have a tendency to over analyze a situation. He feels that in construction sometimes you have to just get on with the work. It cost more to try to keep analyzing the situation then to just do the work the way its been done before. Unless it's a big problem he felt that there usually wouldn't be enough return to justify the time and cost of continual analysis.

SUMMARY OF INTERVIEWS

SUBJECT: 8
POSITION: Construction Manager
AGE: 48
SEX: Male
DEGREE: No College Degree
REG: No Professional Registration

EDUCATION AND WORK HISTORY:

The subject manages the construction operations for the Atlanta office of a large national construction company. The Atlanta office contributes about \$250M to the company's annual total of almost \$1B. The Atlanta office has 40 salaried personnel and a large number of hourly field personnel. The level of field staffing varies greatly but is often as high as one thousand (1000). The company can do most types of commercial construction but according to the subject likes concrete framed buildings.

The subject graduated high school and entered the service. After a brief stint in the service he went to work for his present firm as a laborer. He then advanced up through the ranks as a carpenter, carpenter foreman, assistant superintendent, job superintendent, project superintendent, project manager, senior project manager, and finally into his present position as construction manager. This progression took thirty (30) years.

CAREER GOALS:

His goals at this time are to continue to grow his skills and get better at the position he is in. He has no aspiration to be a Vice-President, in fact he said the company had discussed this with him and he had ask that he not be considered for that

position as he is happy and feels himself best suited where he is.

EVALUATION OF OWN EXPERIENCE:

He said that, "Communication and people skills and having a good memory are as important as anything you can have. Seminars in management have helped." He said the most difficult part of his career had been in his transition into management, specifically, "communications, telling somebody how to do something instead of just doing it yourself. It's real important to check back and make sure that they did understand."

EVALUATION OF NECESSARY EXPERIENCE:

He pointed out that many good PMs come up through the field ranks and not just from engineering. He say that, "Ideally you'd like a combination of both. A guy that's had some experience of all phases of construction, a balance of them and not just straight engineering and no field work."

When asked about the existence of an informal company career path or training plan he replied that this firm had an actual training plan for project managers. The firm picks from the ranks of their project engineers and from the superintendents based on the individuals performance. They enroll these promising individuals into a formal training program within the firm that last about two (2) years. This time is spent in the office and instructors in various subjects are brought in to teach sessions that often last two (2) or three (3) days each.

At the beginning of the program the participants are given an outline of the areas to be covered in the program and they are asked to do a self evaluation of their strengths and weaknesses. Based on these appraisals the time spent on each area can be tailored to the individual. They also have other employees of the firm do these appraisals. Based on these appraisals the firm will often have these other employees attend pertinent classes with the formal trainees. The firm has also found some value in having existing PMs attend some sections as a refresher. When asked about the expense of providing two years of training of the type the subject responded, "It's more expensive not to!" One reason for the firms feeling that this intensive training is necessary is that in this firm the superintendents work for the PM. The PM is given sole responsibility and authority for the project and its profit and loss.

New engineers hired by the firm are not considered for PM training right away. Usually they spend six (6) months to a year as either an office engineer or as a field engineer then they switch and do the other for a similar period. Office engineers check shop drawings, expedite materials, assist in coordinating with sub-contractors and with the field and assist in coding time cards. They also get their first brush with estimating in taking off quantities and checking prices. Field engineers help establish line and grade and doing whatever else the superintendent asks them to do. Then they serve as a project engineer or assistant superintendent.

The final evaluation on selecting candidates for the PM program hinges more on personal qualifications than technical. The subject said that he looks for, "a guy that's aggressive. He's got to be dedicated to the job, it takes more than an eight (8) hour day. He's got to have those skills that I talked about as far as communication. He's got to relate well to other people. The work experience takes care of itself."

When asked about durations for the various positions he said that time in grade is really controlled by the project duration. He would like to have someone complete a project once assigned so people often get locked into a position for an extended period even though they might master the position and be ready to progress in a shorter period. In general he felt that a young engineer needed two (2) to three (3) years in the office, of which he needs at least a year in estimating, and equal or greater time in the field. He said that it would be very unusual to consider anyone for the PM program with less than (5) years experience.

EVALUATION OF ENGINEERS AS MANAGERS:

He immediately identified communication skills as being a real weakness. He explained that most of an engineers experiences and training before he actually moves into management involves matters that can be considered black or white and the attitude this develops makes it difficult to deal with people issues which are grey at best. He agreed with the comment made

in interview (1) saying that it was just another way of saying what he had said. Engineers are used to seeing things as right or wrong so they often can't see potential problems which result from people issues until the problem results in an actual technical problem of some type.

He also thought that engineers have some real assets as managers that give them a head start for moving into management. The technical skills help but mostly its the confidence in himself that the education and getting through the education gives the engineer.

He advised student and other young engineers to work on their communication skills. Get into writing courses and public speaking. Take management courses or seminars and try to get some time management training.

SUMMARY OF INTERVIEWS

SUBJECT: 9
POSITION: Executive Vice-President
AGE: 34
SEX: Male
DEGREE: Bachelor of Science in Civil Engineering
REG: No professional registration

EDUCATION AND WORK HISTORY:

The company managed by this subject is involved in all types of commercial construction and has annual sales of approximately \$60M. The firm has sixty (60) salaried personnel and between two (2) and three (3) hundred hourly personnel. About 35% of their work is negotiated, about 45% comes off selected bid lists, and the remaining 20% is bid work.

When the subject first graduated he went to work as a field engineer for a specialty company doing bridge work. He worked for this firm for one (1) year. He decided to leave for two (2) reasons. First he found the pace of large heavy construction of this type too slow to suit his taste. He also left because the firm was a small family run firm with no real plans to expand so promotion opportunities were limited.

Next he moved to Atlanta and went to work for a large commercial contractor. He was much happier with the daily changes and faster tempo involved in this type of construction. The firm had an informal training program into which they placed him. He spent about three (3) months in estimating. Following that he went out as field engineer and assistant superintendent on a small project which he had helped to estimate. This project

lasted fourteen (14) months. His next project was a short one lasting only seven (7) months but the superintendent left the firm one (1) month into the project so the subject took over and ran the entire project. He said, "That was a great experience because I had control over what was going on and had been left with a lot of problems and had to figure out the solutions. There's a lot of satisfaction with being the superintendent. I enjoyed that."

After completing that project he went back to the office and spent the next six (6) months estimating. He said that he just did one estimate after the next. In his word, "I was doing the whole estimate, pricing, quantity count, the whole thing." Then they made him PM on one of the projects where he had done the estimate. He said, "The old superintendent (from his first project) was my superintendent so we had kind of switched roles on who worked for who." That was the first in a long series of jobs as PM.

After a few years of this he was promoted to senior PM and ran several projects at a time with other PMs reporting to him. He continued with this firm for a total of about nine (9) years. His final assignment with that firm was a large complex including a shopping mall, hotel, and office building. He was on this project for about eighteen (18) months and had three (3) PMs on the job. It was at the conclusion of that project that he moved to his present firm.

This firm is a new company and he has helped it grow. During this growth phase he has done a little of everything from estimating to project management. Now that they are established and have a full staff his role has evolved into that of Executive Vice-President.

CAREER GOALS:

He wants to run more of the company. He wants to take over the Atlanta office, (currently the only one), and play a key role in their expansion as they make plans to open other offices.

EVALUATION OF OWN EXPERIENCE:

He says that the lessons he learned on his first project as assistant superintendent are among the most valuable. He said that his superintendent on that job was an "old salt" who taught him a lot about construction and getting things done in the field. He said that it was in those first two (2) projects that he really started learning about managing people and "getting things done through people."

He said that another key phase was when he first started managing projects as a PM. He thought that this involved a whole different type of people that he had to learn to deal with and demanded a different approach. Both of these approaches are necessary.

He went on to discuss the technical side of what he had learned on various projects such as how to deal with the

situations that develop when a job is fast-tracked and designs are not completed. He also mentioned the complexities of high rise construction on tight sites. The general direction of his discussion was that each project had different demands and offered new opportunities to learn more about the actual business of construction.

He was particularly excited about the lessons he had learned in helping start the new firm. How to start a business, bonding, dealing with banks. All things that had not been part of his job before but all valuable lessons that helped him to develop his management skills.

EVALUATION OF NECESSARY EXPERIENCE:

The first topic discussed in this area was estimating. He strongly felt that estimating should come after some field time. He asked, "How can you estimate something that you've never seen?" He felt that after some time in the field an engineer would have an idea of what would be involved in the work so all they would need would be was some help in how to best pull the work off the drawings and organize it so that it could be priced.

Based on this opinion he felt that the experience he would want for someone who was being considered for a position as a PM would be similar to his own. He would want them in the field getting real hands on experience for at least one (1) and preferable two (2) complete projects. Next he would want them to spend six (6) to twelve (12) months estimating. After that he

would assign them to a PM to get the basics of project management, the means and methods of staying organized and what to look out for. This would take three (3) to four (4) years before someone would be ready to run their own small project. He admitted that this was probably fast but he felt that this type of fast track is necessary to attract and keep the type of highly intelligent motivated people he wants. He also pointed out that although the PM is responsible for the project from an administrative view he does not supervise the superintendent so he does have some experience working with him to draw upon. He felt that it would take another six (6) years to get ready for a move up to senior PM.

EVALUATION OF ENGINEERS AS MANAGERS:

He felt that the majority of people who move into engineering have a numbers mentality. He said, "They're comfortable with numbers, they like things that they can work out on paper. The problem with engineers as managers is that very few of the real problems you encounter can be worked out on paper. Most of them have to be worked out through people. Dealing with people is the whole game!" He went on to say that because engineering is the type of education that attracts numbers people you have to sift through them to find the ones that are also real people persons. He continued saying, "When can you find the right guy it's a dynamite education for a manager."

His reaction to the point made in interview one (1) was one

of strong agreement. He said that the people who would get ahead would be the ones who get off the individual details and see the whole picture. He felt that most engineers are task oriented and this is not necessarily good for management.

He went on to say that students and young engineers should concentrate on their ability to work. Everything you do goes on your track record of performance. He said that the grades aren't as important to show what you learned as they are to show that you have the ability to buckle down and get the job done. This shows that someone is willing to work hard to achieve their goals.

He concluded by saying that he had noted one problem and that was expectations. He said that when someone comes out of college, "they are on the top of the world. They've been the seniors, they've conquered a great university and now they're ready to go to work. In business things don't move that fast. Instead of quarterly advancement and reports it's yearly or longer so they get frustrated. A lot of guys coming out of school go through a period of frustration and it's difficult for us or any company to overcome this." He said this was not as big a problem in manufacturing as it is in construction. He attributed this to the fact that on a line you can have someone spend a few months at the beginning of the line learning that and then just move them to the end to see that part. This would allow a new engineer to see the whole process rather quickly. He said this was not the same in construction because the only way

to move from the beginning of the line to the end was to hang around until the project completed. He felt that engineers had to go through several of these long projects to learn the process and achieve their long term career goals. Because of unreasonable expectations on how fast they can move ahead, he felt some good people get fed up and leave the business.

SUMMARY OF INTERVIEWS

SUBJECT: 10
POSITION: President
AGE: 39
SEX: Male
DEGREE: Bachelor's Degree in Building Construction
Law Degree
REG: No professional registration

EDUCATION AND WORK HISTORY:

The firm managed by this subject derives approximately 60% of their annual sales of \$125M from hospital and other related health care facilities. The remaining 40% comes from all types of commercial construction. The firm has fifty (50) salaried personnel and about four hundred (400) hourly employees. Based on number of jobs about 70% of their work is negotiated and about 30% is bid work. If the number was based on dollar volume instead of number of projects, bid work would be much higher because of the large size of some of the projects the firm has won.

After receiving his undergraduate degree the subject entered into law school. He began working in the construction industry on a part-time basis during his last two years of law school. After graduating he went to work for that same company as a project engineer. He stayed with the firm and worked his way through the usual progression of field and office assignments into a position as project manager.

After about seven (7) years he reached the position of Division Manager in which he had responsibility for multiple jobs

and for multiple people. A short time later the company restructured and started an open shop company. He moved into this new organization as the number two (2) man in which position he was responsible for operations. About one and a half (1.5) years ago he was promoted to his current position as president.

CAREER GOALS:

He wants to consolidate what he is doing now, learning more about what it means to run a company. He wants to continue to grow the company. In seven (7) years they went from zero (0) to \$125M annual sales and he thinks that he can continue this trend.

EVALUATION OF OWN EXPERIENCE:

When asked why he decided to enter the construction industry in an entry level engineering position after completing law school he replied, "Being young and thinking someday I could run my own construction company and go out and do the kind of work I wanted to do I said that a technical background is good but really I want to know how to run a business." He explained that he had considered doing graduate work in building construction but was advised against this. He went on to say that he considered getting an MBA but that after looking at the course work at a couple of schools he decided that wasn't what he really wanted either. He continued saying, "I looked at (Name deleted) Law School and saw where I could take tax law, labor law, and I could take contracts; all the kind of things that would come in handy in running a business. I saw that law school would only be one more year so I said we'll see. Maybe I won't make it all

three (3) years. Fortunately I was able to get a summer job and then I just stayed with the company. My intention was never to practice law and if I had I would have practiced some type of construction law, but I feel the background in law has been immensely helpful in understanding the business problems." He went on to say that as he progressed and became more of a manager his technical skills had taken more of a back seat to his other skills.

He continued his evaluation of his own career saying that in this business you have to be able to make decisions and you can't look back all the time. He did say that you should be aware when you make a bad decision and that you should learn from it but you have to keep making decisions. He also stressed learning to evaluate people, knowing when to rely on people and when you can't. He said that it was important to be able to identify a person's strengths and their weaknesses so you can adapt yourself to shore up their weakness and let them run with their strengths.

EVALUATION OF NECESSARY EXPERIENCE:

He said that starting out, a new engineer has to work with shop drawings and the field so that they can learn what it takes to build a building and how it all goes together and what the problems are. From there what will enable someone to get ahead is how they learn to deal with people. He also said that he felt it was important to try and match the individual with the company. He felt this was difficult because he views his firm as being a different type of organization since it is "employee

owned and employee operated." To aid with this he likes to hire people after they have been out of school for two (2) to three (3) years so that they can have a better idea about what they want to do and so that they will have more reasonable expectations. What he wants is someone who is willing to work for an opportunity.

When he does find someone with a couple of years general experience that matches the company profile he likes to start them on a small project, \$0.5M to \$1M, and let them try to run that project. He likes to see what they can do. He said that although they would be running the job they would be project engineers and would have a good PM help them out but he likes to see how far they can go with it. He also likes to see what questions they come back with. He will do this for two (2) or three (3) small projects, ones that will turn over quickly so they can see a quick overview of the construction process. He went on to explain that in his approach of putting them on small projects they get to see how everything goes together. He felt that the engineers that get put on large projects at that junior stage only get to handle a small part of the project. He said, "They get very good a one specialized part of the process but they don't understand the whole thing." He said that these engineers would be in the office doing the buying and that type of function and the superintendent would be responsible for the actual crews. When asked about the field engineering position he said that a lot of the things done in the field at other companies such as checking shop drawings are done in the office

here so these new employees are also getting exposed to that facet of the business.

When his firm is working on a bid job the estimating is done in estimating. Whenever it is a negotiated job the firm takes more of a team approach in that a Senior PM is responsible for the estimate, he picks the sub-contractors and usually deals with them himself. Estimating assists him but he insures the estimate is made based on how he will build it. He did not stress estimating experience at all for young engineers being trained in the firm. When asked about this he said that again he had a different philosophy then the norm. He attributed this to the fact that estimating is done for the firm in the holding company. He did say that this might change as the firm gets bigger.

In discussing career paths in the firm he said that the entry position was one of project engineer as already discussed. This position usually lasts for three (3) to five (5) years. Then they become an assistant PM for another two (2) to (3) years. During the first two steps they do all the things that a PM might do but they do it as assigned with a high level of supervision. At the Assistant PM level they will start handling more of the coordination with the architects and owners. This gives them the chance to develop their people skills. After three (3) to (5) years as a PM they might become a Senior PM which is a new level for the firm. This would be someone who could run one (1) very large job completely on their own.

As far as actually hiring someone right from school he looks for a degree from an accredited school, preferably a degree in Building Construction. He also looks for something that shows that the person is really interested in the industry, summer jobs in construction. He said that he had a hard time with a resume where someone graduating with a degree in building construction or engineering had spent their summers as a life guard.

EVALUATION OF ENGINEERS AS MANAGERS:

When asked about engineers as managers he said that they were like anyone else. The technical background can only take them so far. If they don't have the verbal or written skills they aren't going to get ahead and generally engineers will be weak in this area. He also said that he used to think that he could take someone with a good technical background and help them develop these skills but now he thinks that the colleges should put more emphasis on this while they are in school.

His reaction to the problem identification statement made in interview one (1) was one of agreement. He attributed this to poor communication skills. He felt they just don't become aware of many problems early enough when they might be very minor because they don't understand what the people around them are really doing. He said that, "A lot of times they just don't listen."

He concluded the interview saying that this is a hard business. He went on saying, "You have to be willing to go out and get your shoes dirty and go out in the mud. If you don't enjoy that part of construction you're never going anywhere. In construction a lot of people who don't put forth that effort while they're getting their schooling are going to be sorely disappointed when they get out because it's not a glamour business."

SUMMARY OF INTERVIEWS

SUBJECT: 11
POSITION: President
AGE: 33
SEX: Male
DEGREE: Bachelor's Degree in Structural Engineering
Master's Degree in Structural Engineering
Master's Degree in Business Administration
REG: Engineer in Training

EDUCATION AND WORK HISTORY:

The subject is President of a large parent company with five (5) divisions employing about fifteen hundred (1500) persons. The various divisions engage in a wide variety of businesses in addition to construction. He was recently promoted to that position and has not yet handed down the duties of his past position which was President of the Construction Division of the company. As President of the Construction Division he ran five (5) different construction companies. The Construction Division had annual sales of about \$70M and employed about two hundred (200) people. He felt that the firms were best at concrete work and usually did low to mid-rise construction.

His first job after completing school was as an Assistant Project Manager on a large (>\$21M) project. In this position he worked on site in the field for about a year. Near the end of that year he was offered a position with his present firm as a PM. He decided to make the move because he thought his promotion potential was limited with the first company and that he would have more opportunity at his present firm.

By the end of his third year with the firm he was a Senior

PM and Construction Manager with three (3) other PMs reporting to him. During his fourth year he was promoted to Vice-President, a position he held for three (3) years. Two (2) years ago he was promoted to President of the Construction Division. One (1) month ago he became President of the parent company.

He stressed the fact that in a relatively small company that has multiple divisions such as the one he now runs many other things happen to expose you to the various company operations. He also felt that the company environment had been important. Because of the company owner he felt that many of the barriers that would have existed in other firms which might have restricted his ability to do all that he was capable of did not exist at his present firm.

CAREER GOALS:

His goals at this time are to move his company and its divisions forward. The firms have been growing and he wishes to advance that trend. He felt that his strongest goals dealt not only with his goals for his company but more with his contributions to the community. He said that he measured his success less in financial terms than in terms of the example he could set for others. He said that many of the stereotypes that exist today present a false image and he wants to provide an alternative to them.

EVALUATION OF OWN EXPERIENCE:

He repeated his feelings that the most important thing in

his background was the combination of engineering and business. He termed this combination "unbeatable." He went on to say that the construction business is one of the toughest and that he thought anyone who could just stay in the business was a survivor and that anyone who could consistently make a profit in it had his complete respect.

EVALUATION OF NECESSARY EXPERIENCE:

He stressed a balanced background between estimating, office duties and field work for anyone who wanted to be moved into project management.

He said that he would start someone out in one of three positions, either estimating, office engineer, or field engineering. He said that they would move between these assignments for about five (5) or (6) years. After this time if they had the balance of field background and the administrative experience they might be ready to be a Project Manager.

He felt the real key to determining if someone is ready to be a PM is their communication skills. He said that they have to be able to communicate with all the social and economic levels present on a project. They have to present themselves well since they are really selling themselves all the time. He went on to say that he felt the mark of a good manager was the ability to get others to internalize their work, to want to do their best out of an inner sense of pride in their work.

He also explained that he had trouble promoting anyone who had strictly an engineering background. He said that they had to show an interest in developing themselves by studying part-time or just taking some management seminars. They have to broaden their horizons and try to get a handle on basic management skills, basic finance and accounting.

EVALUATION OF ENGINEERS AS MANAGERS:

The subject attributes his rapid progress in the industry to the diversity of his education. His MBA covered both finance and accounting so he has a wide background of information to draw upon. He went on to say that, "Until I took the MBA program I had tunnel vision. I thought the world began and ended with engineering. Now I don't under estimate the value of the engineering curriculum in that the engineering program keeps you solutions oriented so you normally are logical and quick thinking when it comes to problem solving. The only problem with that is management decisions are 80% - 90% issues relating to people. Unless you take some sort of broader brush in terms of the social sciences you're really not prepared to deal with people issues." He felt that the tunneling he remembered in his own background is common across the board for engineers unless they have made a conscious effort to broaden their background into other areas.

He did say that he had seen good results with engineers as managers because they are logical thinkers and less likely to act on impulse. This same strength could be a liability in his opinion because it sometimes makes an engineer inflexible. They

are used to seeing issues as black and white and to having a right answer. In his words, "they are used to punching it into a calculator and if the answer comes out 3.15 it's right, if it doesn't it's wrong." He said that this approach obviously doesn't work with people.

He closed the interview by commenting on the remark made in interview one (1). He said that he strongly agreed with the comments made if he could specify people problems. He felt that engineers did a good job at recognizing the technical field problems but that they often didn't pick up on the ones that related to the people involved in the project.

SUMMARY OF INTERVIEWS

SUBJECT: 12
POSITION: President
AGE: 45
SEX: Male
DEGREE: Bachelor's Degree in Building Construction
REG: No professional registration

EDUCATION AND WORK HISTORY:

The subject manages a group within a major construction company which employs about five hundred (500) persons. The groups for this firm are broken down based on geography and type of construction. With the exception of centralized estimating, finance, and data processing each group works as a separate company. His group contributes about \$60M of the company's total annual sales of \$240M performing mostly retail and special use construction. He defined special use as being things like Civic Centers or large auditoriums.

The subject spent about three (3) years with the Marine Corps after graduating. His goal was never a career in the military but he did find the leadership training beneficial. He went to work with his present firm about two (2) months after leaving the Corps. He has been with the firm continuously for most of the past twenty (20) years except for about a year and a half (1.5) period when he left to work with a developer in his home town.

The firm did not have a formal training program and was at that time a small construction company. He entered his firm as a timekeeper on a large project. He performed in this capacity for

about six (6) months at which time he was moved into the office to do tenant work estimates for a high rise office. He did this for about eight (8) months.

Next he did the Civil work estimates for another large project the firm was working on. He then moved out on that project as the field engineer but he ended up as the assistant superintendent. Basically he said that he took over and ran the site work since he was so familiar with the requirements because of his work on the estimate. He also did a lot of the field engineering and layout work. He continued on the project as the tenant coordinator.

Then he went back into the office for a few months as an assistant project manager before being given his first project as a PM. Next he moved to a branch office as a Senior PM. A short time later he took over as the operations manager for the office. He was in this office for about four (4) years before being moved to another branch office for two (2) more years. He worked in yet another office for about a year and a half (1.5) before being brought back to the home office as a Vice-President.

CAREER GOALS:

His immediate goals are to continue to improve his performance as a Group President. He also stressed the enjoyment he received from training the young people he was able to bring into the firm.

EVALUATION OF OWN EXPERIENCE:

He said one of the most beneficial things he had done was to stretch his ability and knowledge. He hadn't done this by continuing education although he did say that he had attended quite a few management seminars. Mostly he had stretched himself by taking the various general contractor licensing exams in the various states where he had worked. He said that this had not been necessary for his job but had been a good opportunity for him to continue his professional growth and give him a different perspective on things.

He said that it would be difficult to point to any one factor in his background that had helped him but he did think it was important to find a company in which you could be comfortable. He explained saying that you had to be able to take pride both in your own work and that of the company as a whole. He felt that each company has a set of values and it's important that you be able to respect those values.

As far as actual things learned in his various positions he pinpointed the ability to converse with all the people. He said, "You got to not be bashful about asking questions when you don't know. Sometimes you lead with your chin a little bit and I guess we all take the risk of being caught short and getting a little bit embarrassed but you got to put those things aside and if you don't understand go ahead and delve into it."

EVALUATION OF NECESSARY EXPERIENCE:

He said that his firm worked a lot in a team work atmosphere so you had to be able to communicate with people. Hard work and the ability to persevere are things he looks for when he is selecting people. He also said that he preferred someone who had majored in building construction over a civil engineer. He explained saying, "I would lean more towards building construction than civil engineering. Not that the building construction graduate that I have seen is any smarter or anything it's just that his background is a little more general." He went on to say that he thought engineers were more comfortable in a number crunching environment.

When asked about possible career paths he said that his firm doesn't necessarily take the routine approach. He said that each one of his people was expected to be able to do some of their own estimating even though they do have centralized estimating. He said that the first assignment for a new employee would be as a project engineer.

Project engineers are in the field and basically assist the PM. They spend two (2) to three (3) years in this position doing various things delegated by the PM such as expediting material, some light estimating, reviewing shop drawings and attending scheduling meetings. A big part of their work might include updating the construction drawings on negotiated fast track projects. Usually they would be assigned responsibility for some part of the project like maybe the miscellaneous steel.

Their next position would be as an assistant project manager. In this position he would continue to do the things delegated by the PM. He would be given more responsibility and would begin to become involved in the full range of project management responsibilities. He would prepare purchase orders, prepare and maybe negotiate some sub-contracts. At some time he would take over scheduling and begin to interface and help coordinate with the owner. In this position he will also be somewhat involved in estimating.

EVALUATION OF ENGINEERS AS MANAGERS:

In general the subject said that his gut feel is that building construction graduates are more likely to succeed as managers in the construction industry because their education is less technical and is more practical. He felt this makes a building construction student more flexible in the long run and allows them to adapt to dealing with people more easily than an engineer. He went on to say that his experience was that engineers are more comfortable in a situation dealing with numbers and with issues with right or wrong answers.

When asked for his reaction to the problem identification statement made in interview one (1) he partially agreed. He went on to say that it wasn't that an engineer couldn't identify a problem but that he thought it was more of a case where they couldn't anticipate a problem. He said that they are more detail oriented so that sometimes they can't see the forest for all the

trees. He said that this was particularly true when it comes to people problems. He added that it wasn't because they couldn't deal with people but that he thought that the majority of engineers just don't care to deal with people problems. He explained saying that engineering is a numbers game and that people tend to gravitate towards the things that they like and are comfortable with and that was why they went into engineering in the first place. He closed the interview saying that in general engineers are technically oriented and that was why they choose that curriculum in the first place.

SUMMARY OF INTERVIEWS

SUBJECT: 13
POSITION: Senior Vice-President
AGE: 42
SEX: Male
DEGREE: Bachelor's Degree in Civil Engineering
Master's Degree in Soils Engineering
Degree of the Imperial College, (DIC), in Soils Engineering
Master's Degree in Construction Management
REG: Professional Engineer
Member of the South African Council of Engineering

EDUCATION AND WORK HISTORY:

The subject began the interview explaining that a DIC is a research equivalent to a master's degree. The master's degree is awarded for course work. A DIC is awarded for field research work. Though difficult it is possible to pursue both degrees simultaneously and that is what the subject did.

The subject is Senior Vice-President for a major group within a large corporation. His group is responsible for commercial building, maintenance and operation contracts, government contracting and land development. The corporation he works for does other types of construction also employing about four thousand (4000) people world wide with annual sales around \$400M. His group has about one hundred and ten (110) salaried personnel and a core group of about two hundred (200) hourly personnel. This core group is used to start up projects and then the staff is filled out based on the total level of effort needed. He said that currently about one-third (1/3) of his work is negotiated because his firm is a new entry into the commercial building segment.

He began his career overseas in his homeland. During his first ten (10) years, what he called the formulative years of a career, he says he moved around quite frequently between jobs and assignments. He said this was a conscious decision on his part and a big effort to get as wide a variety of experience as he could. He went on to say that whenever a company needed someone to go anywhere he would take the assignment. He admitted that this was rough on his family and that they didn't like it but he thought it was the best thing to do at the time. He did everything from estimating to field work. He had moved into project management after about ten (10) years when he joined his present company.

This firm moved him to an office they had in South America as Assistant Manager for the office. In this position he said he did everything from estimating the projects to running them. He also collected the money from the projects and did anything else that was necessary. About eight (8) years ago the firm moved him to their main offices in the United States.

He began his career in the U.S. as an estimator, did some more field work and was then advanced to project management. He did a succession of increasingly complex projects and was finally assigned to the first commercial building project in which the company was involved. Next he was made Vice-President of the newly formed Commercial Building Group which he now runs as Senior Vice-President.

CAREER GOALS:

His goals are to keep progressing like he has. He wants to get increasing responsibility and authority as his group continues to grow. He would like to increase his negotiated work to approximately two-thirds (2/3) of his total work.

EVALUATION OF OWN EXPERIENCE:

He thinks he owes his rapid rise over the past decade to the diversity of experience he gained during his first decade in the industry and of course to the diversity of education he received in his three (3) post-graduate degrees. He thought the management and finance courses he got in the Construction Management program have been especially useful over the years.

One of the biggest lessons he said he learned over the years is the value of the people with whom you work. He explained this saying, "Your ability to perform is only as strong as the weakest link in your organization. You have to look after everyone from the lowest laborer on up." He said that it takes a lot of work to stay in touch with every level of a job but that it was necessary even at his current level. He said that a PM needed to try and spend 75% of his time in the field on his projects.

EVALUATION OF NECESSARY EXPERIENCE:

He began this section saying, "To achieve maximum competency I believe you should be a generalist for four (4) or five (5)

years, maybe even longer, before you want to start to specialize."

He said that his firm liked to hire engineers right out of college so that the company could instill its values into them. Referring back to his first statement he said, "It takes about four (4) or five (5) years to be in a position where he knows what he would like to do. We try to give him as broad an experience as we can, estimating, project management, construction management and administrative management and he can eventually make up his mind after he's done all those things. He's going to be better at what he prefers so we try to push him in that direction.

He said that a new engineer would usually start in estimating where he would spend one (1) to one and one-half (1.5) years. This would let him get to know the company and meet the people. Next he would be moved to the field, on a project he helped estimate, as an office engineer for about the same length of time. In this position he would be reviewing shop drawings, doing quantity take offs, and other duties of that level.

After that an engineer would be moved to a large project for the duration, normally about three (3) years. He would be either the project engineer or the field engineer. The project engineer assists the superintendent on the administrative functions and coordination but he reports directly to the PM. A field engineer is more involved with the actual construction process, he reports

to and assists the superintendent. A field engineer does whatever the superintendent needs done from actually running portions of the work to establishing the layout of the work.

The subject commented that, "Usually after four (4) or five (5) years he is reasonably well-rounded and is definitely contributing to the company. The first year or two (2) you carry him really." He said that it takes about seven (7) years before someone has the level of experience needed to run a project as the PM. He said that this firm is PM oriented and really gives the PM the authority the title carries. The PM runs the job. The superintendent works for him and he has complete responsibility for the profit or loss generated by the project.

EVALUATION OF ENGINEERS AS MANAGERS:

The subject began by saying, "They think logically and clearly and that's a requirement for management."

He did go on to say that there are definite failings in that they want to do most things themselves and want it done to their own standard of perfection. He continued saying that managers must be able to delegate, really they have to compromise their values to a certain extent. He explained that comment by saying, "No one else can ever do it just like you would. Engineers must be willing to relinquish some of their control to be a good manager." He went on to say that most engineers tend to view things as black or white and that while this is a good trait for working out problems in your mind it is a disadvantage for dealing with people. He felt that engineers are more dogmatic

than they should be.

He concluded the interview saying, "The pluses definitely outweigh the disadvantages but it also does not say that a good engineer is going to be a good manager. The skills are different."

SUMMARY OF INTERVIEWS

SUBJECT: 14
POSITION: Vice-President and Chief Engineer
AGE: 55
SEX: Male
DEGREE: Bachelor of Science in Civil Engineering
REG: Professional Engineer

EDUCATION AND WORK HISTORY:

The subject is the Vice-President and Chief Engineer of the international division of a major construction company. As such he is in charge of all projects the company does outside the continental United States. Internationally the firm does about \$250M annually with sixty (60) permanent employees and up to fifteen hundred (1500) employees depending on the projects underway. He says the company can do any type of construction except tunnel work. He says they lack expertise in that area so they prefer to avoid it.

When he completed school he left his homeland and re-located to Canada where he went to work for one of the largest of the U.S. construction firms. He ended up staying with this firm for twenty-one (21) years. He spent ten (10) years in Canada, nine (9) in the U.S. and the last two (2) in Saudi Arabia. About ten (10) years ago he moved to his present firm.

During his tenure with the first company he said that he followed the usual track for new engineers. He started out in the field as a field engineer on a tunnel project. When asked about his duties as a field engineer he replied, "The field engineer was just one step up from a surveyor. At that time the

project managers were usually the old superintendents and had come up through the ranks not through engineering. I think that is changing, you see more engineers coming up to project management. That's changing, I know it's changing. The engineer was just the guy who had to set the line and grade, keep them straight. I went through the ranks of painting the tunnel face every eight hours before a blast. I did that for about six (6) months before I went to see the boss and told him that I didn't go four (4) years to become a painter. He shoved me up on a road in northern Quebec in the freezing winter."

He continued to outline his career saying that his next assignment was to the office as a junior engineer and estimator. After about five (5) years total experience he became a project engineer. After about five (5) more he became an Assistant Project Manager. In that firm at that time it took about fifteen (15) years total experience to become a PM. Between the time he became a PM and the time he had twenty-one (21) years with the firm it went public. He said the firm lost its personal touch. He felt that he had gone as far with the firm as he could with the new management so he moved over and joined his present firm which was starting to grow and expand. He spent ten (10) years with the firm estimating projects for overseas and running them.

CAREER GOALS:

He said that he wanted to run one more large overseas project. He wants to estimate it and then build it. Sometimes, he said you end up with the estimator and the PM pointing fingers

at each other over a job but that doesn't happen when you do both. He said he gets a lot of satisfaction from making a project happen so he wants to do it one more time before he retires. Professionally he said that he had gone as far as he wants to go.

EVALUATION OF OWN EXPERIENCE:

He said that theory is one thing but actual practice is something else so he thought the field time was very important. He also stressed that good old common sense was something else that was needed to succeed in construction.

He went on to say, "I think I made a mistake staying twenty-one (21) years right out of school with one company. I think a young engineer out of school should, for say the first ten (10) years, go two (2) years from one place to another and get the variety within the companies. Variety is the spice of life and that's the only way you learn. Staying with one company all the time you only learn the one company's values and that company's way of doing things. It may be right or wrong but you'll never be in a position to judge whether it's right or wrong."

He concluded saying that office time is also very important for a number of reasons but I think 75% of your time should be in the field if you want to be a good PM.

EVALUATION OF NECESSARY EXPERIENCE:

He repeated what he had said before, that both field and

office time are needed. He said that you have to know how the construction goes together to be able to plan and evaluate things from the office and you have to know the administrative side and how the estimate went together to be able to evaluate your results in the field.

He said that he thought a young engineer should start in the office. He explained by saying that the only way to learn in the field is by mistake or by asking questions and just doing the work. He said it took a certain type of individual to do this so the office time was a chance for an individual to learn a little about the business and develop some confidence before they go to the field. He thought that a couple of years should be spent in the office before someone went to the field.

He said the actual time needed in the field for a first stint really depended on the person. He said it would come naturally for some and they could go back to the office after about six (6) months and be able to contribute. He did feel that this field time was necessary before doing any real estimating.

When asked about estimating he said that too many young engineers use the books and manuals to pick production rates. "Really," he said, "you need the field experience first to know what it takes. Every field condition will be different and you have to have been in the field to know how to judge this." He went on to say that a good estimator has to be flexible, imaginative, and must have good common sense. He stressed, "Book

estimates are worth nothing."

EVALUATION OF ENGINEERS AS MANAGERS:

In discussing management in construction he said that being an engineer helps but that mostly it's just management. What he really thought was absolutely necessary was someone extremely knowledgeable in construction equipment and methods.

He noted that one thing he considered a problem is that engineers are coming out of school and saying that since they are engineers they want to go right into project management. He said that about 25% of what they learn in school is the maximum that they will ever use. He thought that he put more stress on things that show the persons character and how hard he would work than to technical classes when he checks resumes.

He went on to say that he thought too many engineers he had dealt with were too technically oriented. He said that they think they can solve everything on a piece of paper and that approach doesn't make a good manager. He said that construction management is really about people and sometimes you almost have to be a house mother to those people.

He also said that he thought engineers that are considering management careers should really strive to get some management training early on in their education or career. He repeated, "The majority of good project managers I have seen were not engineers although that is changing."

When asked about the statement made in interview one (1) he agreed. He went on to explain that a project manager has to be two (2) steps ahead of the project. Engineers, he thought, do a good job once a problem develops to the point where they can set down and analyze it but they don't do well at anticipating them because most of them are due to people. He went on to say that the ability to analyze a problem can sometimes be a disadvantage. Construction schedules are tight and often there isn't enough time to do the kinds of analysis that engineers want to do.

He concluded saying that one other tendency among engineer managers is over reliance on modern tools. He pointed out that the modern manager is surrounded by computer applications that are supposed to help him but that they are only as good as the information in them. "Garbage in, garbage out", he said. He continued saying that often it can take the better part of day to keep these things up to date on a fast changing construction project and the manager really needs to be spending that time managing the project. He concluded saying, "Engineers really like these tools and it's hard to get them to turn them loose and get out in the field to really make things happen."

SUMMARY OF INTERVIEWS

SUBJECT: 15
POSITION: Vice-President and Executive Assistant to the President
AGE: 63
SEX: Male
DEGREE: Bachelor of Science in Civil Engineering
REG: Professional Engineer

EDUCATION AND WORK HISTORY:

The subject helps to manage a major corporation involved in construction and many other areas relating to the construction industry. World-wide construction revenue for this firm are about \$400M involving about four thousand (4000) employees. He said that he thought any firm would like to do 100% negotiated work but that wouldn't be healthy in the long run because the bid work keeps you competitive. He went on to say that he would like to decrease his bid work from it's current level of about 65% to only 50% of his total.

He began his career with the Alabama State Highway Department. He said that he had held the usual progression of positions in his tenure with that agency. He began in the design section, did some field construction and then progressed through a variety of field and office assignments. He was the Chief Engineer of the Department when he left to join his present firm twenty (20) years ago.

He began working in construction operations when he joined the firm. In spite of his years of experience and all the time in the field he already had, he said that he learned a great deal about construction during his first few years with the company.

CAREER GOALS:

He laughed at this question and replied that, "At sixty-three (63) you don't make career goals. What I want to do is concentrate on developing all the young talent within the firm during my time left in the industry."

EVALUATION OF OWN EXPERIENCE:

He thought that the most beneficial part of his background was having a good handle on design principles and having a good working knowledge of materials. He also stressed the importance of time in the field. He said that a good on hands knowledge of constructions methods is essential.

EVALUATION OF NECESSARY EXPERIENCE:

He said that twenty (20) years ago when he first came to the firm part of the recruiting procedure was to fly prospects around in the company plane and show them various projects the firm had underway. Now he thinks this was a mistake because these people would end up frustrated after twelve (12) to eighteen (18) months when they weren't where they thought they would be with the company. He said that now a big part of the process is explaining and stressing the hardships of the industry to recruits. He tells them about missing family functions, working through the night when it's cold and wet, and being away from home for extended periods. He thinks that the people who can't deal with these realities don't need to be talking to his

company anyway. He went on to say that since he had started taking this approach the company has "a good deal of stickability."

When asked about career paths he said that the company has a flexible informal one because they hadn't been happy when they tried to use a formal one. He thinks it's better to give young people the opportunity to move up and perform whenever an opportunity presents itself. He did say that it was important to move the people through the various sections of the company.

"Estimating", he said, "is certainly a good part of the make up of a good man. Understanding pricing and cost is the basis of all the rewards you get. If you don't understand costs you're going to have a pretty tough time in the construction business."

He also felt that a good "smattering" of engineering is necessary to keep their engineering talents at hand just so they can tell when they've got hold of a bad proposition from an engineering standpoint. He explained that there are engineering problems that need to be solved in the construction business so he wants to make sure everyone has at least a brief exposure to the company's engineering section. He also said, "A very good training place is in the field offices where you do purchasing and administrative work as well as rubbing elbows with the field people."

When asked about length of exposure to the various functions

he began with estimating. He thought that a young engineer could get a fair idea of what they were doing after working on eight (8) or nine (9) projects. He thought that would take six (6) to twelve (12) months, maybe a little longer, depending on the size of the projects.

The said that his engineering section did design and build work and some straight design work. Occasionally they get involved with some field engineering when that gets very complex. He thought that a young engineer should remain in this area long enough to perform at least one complete engineering task. He felt this would last for about six (6) months.

In his opinion in the field as a project engineer is a good place to start a new engineer. He would make them responsible for quantities, doing certain engineering functions to support the superintendents construction efforts and for doing some of the field estimates.

He concluded by saying that it would take at least ten (10) years to be ready to manage a fairly complex project in the \$5M to \$6M range.

EVALUATION OF ENGINEERS AS MANAGERS:

When asked about engineers as managers he said that on the whole they make good managers. He supported this saying, "Just look at senior executives around the country and you'll find an inordinate number of engineers in those positions. They've been

supplanted somewhat by lawyers in the past ten (10) to fifteen (15) years but I think that trend is even changing back towards people with more operating experience. Engineers are pretty well equipped to be good managers."

He felt that an engineers strengths lie in his understanding of materials and how things go together. He felt they are pragmatic and use numbers rather than subjective opinions sometimes when the numbers are more nearly right than a subjective decision might be.

He stressed communications as a weakness. He said that engineers are also weak in social science skills. He did offer some sympathy to students saying that there is only so much that can be put in the curriculum in the time allowed. Ethics was one area that he said could be stressed in the engineering courses. He agreed with the statement from the first interview and added that he attributed this to the fact that engineers are more task oriented than they should be at times.

He closed the interview by stressing what he called "world knowledge". He said that Civil engineering as the name suggest is engineering to serve the public. To do this, in his opinion, a good understanding of the public needs is required. He felt that young engineers should concern themselves with the entire human process. He explained saying that politics are a big part of the civil engineering process as is the socio-economic environment which exists for the industry. He also stressed the

value of time spent in the various professional societies to help develop the needed understanding of these issues.

SUMMARY OF INTERVIEWS

SUBJECT: 16
POSITION: President
AGE: 48
SEX: Male
DEGREE: Bachelor's Degree in Industrial Engineering
Master of Business Administration
REG: No professional registration

EDUCATION AND WORK HISTORY:

Until recently the subject was both President and owner of his own construction company. A short time ago he joined with a larger holding company which is involved in numerous business ventures. He remained in the position of president of the new construction company which they formed. This new firm specializes in construction for the aviation industry and considers itself a market niche company. They perform several functions for the aviation industry. They do the actual construction, they provide project management services, and they provide consulting services for project development. They have annual sales of \$120M generated by approximately one hundred (100) total employees. He said that bidding helps him keep abreast of the industry and what pricing is. He also said that it helps make the clients more comfortable that you can give them a competitive price. He said that currently they negotiated about 70% of their work.

The subject began his career in a large manufacturer. He had co-opted with two different manufacturers while in school and went to work for one of those at graduation. He was hired as what the manufacturer called an internal consultant. Each of the

various divisions of the major manufacturer ran as almost independent entities. The internal consultants were staff personnel who were used to do management analysis and provide support to these divisions. It was a program to train their new management recruits and it provided graduate level support to their existing managers. The subject thought it was a great job because he didn't just write reports. He made recommendations and then got to stay and oversee implementation of those recommendations. He stayed in this position for one (1) year.

He left that position and came to Atlanta and went to work with a friend who had opened a commercial contracting company. He stayed with this firm for three and a half (3.5) years. He headed up the marketing efforts for the firm but because the firm was so small was also involved in all phases of the operations and construction. He did estimating, field supervision, and project management. He said that he initially felt challenged by his lack of a civil type background but that he had been able to overcome this by studying manuals, trade journals, and other available reference sources in addition to spending as much time as possible in the field. He said that, "Construction is like any other business, the more you know about it the better you will be at it."

It turned out that the subject and his partner had different goals within the industry so they parted ways and the subject started his own firm. He remained independent for eighteen (18) years. He felt that he had approached the business a service

company not as the creator of a product. He went on to say, "What we sold was management, management of the construction process. I felt that then and still feel that today, that that's really what our business is." He also said that he felt that the line between construction management and general contracting was really becoming blurred these days. He explained, "In my mind if you give someone a guaranteed price, either a lump sum or a guaranteed maximum price, than you really function as a contractor. A construction manager theoretically is the owners agent. It's kind of a cost plus arrangement."

He said that his concept had always been to get the big corporate clients and keep them. He wants their repeat business. For an example he named one of the major airlines and said that they had at least one project underway for that company every day for the past twenty (20) years.

CAREER GOALS:

He wants to continue to build and develop his company along the lines of his original organizational concept. He thinks his firm will grow rapidly because he sees great opportunity in the niche where he has positioned his firm. They already have several offices and large projects across the country. He wants to increase the amount of consulting services and other services that he provides to the industry in addition to the management and construction services.

EVALUATION OF OWN EXPERIENCE:

He felt that his MBA had been the most valuable thing in his background. He went on to explain that this was due to the fact that he had started his own company so soon after graduation. Without the background in finance and accounting, the training in dealing with financial institutions he would have had a difficult time getting started and staying afloat in the initial period. The personnel programs he had studied were also invaluable in his opinion. He went on to say that personnel programs should definitely be emphasized more for anyone that wants to be a manager. Everyone will have a good technical background, he said, but the ability to hire people, to evaluate them, and to manage them is the most important part of any business.

The most challenging part of his career and the part that has influenced him the most has been the fact that he has constantly pushed his limits as a manager. When he started his own firm, which was a challenge in itself, he quickly started up branch offices in several other major cities. He stressed that being able to step up one more management level to manage multiple sites had been a whole different level of difficulty, but it was this type of self development and stretching which he felt had paid off the most in experience over the years. He went on to say that you have to go through this if your going to grow.

EVALUATION OF NECESSARY EXPERIENCE:

He said that he has occasionally hired new engineering graduates. He said that he wanted someone with a good technical background because he felt they understood the industry quicker. He also said that he looked at personality. He wanted someone who was obviously personable and energetic with lots of enthusiasm. He said he needed these traits because he is in the management business so he deals with people all the time. He said a typical job for his firm has an owner representative and an architect representative on the job site at all times.

He continued saying that although every job they have is customized because of the nature of the aviation industry his firm is trying to standardize their approach to the business. He said that most of this is bringing good sound project management to the table. Part of doing this is giving his people the right background to draw upon by putting his new people in the various functional areas in the company. He usually starts them in estimating and then moves them to computerized scheduling. He said that computer literacy is important but seems to be a given among graduates these days.

The entry level position in the field after this office experience is project engineer. In this position the engineer would be doing contract and sub-contract administration. He would also be responsible for reviewing the shop drawings and all the other submittals. A lot of their time will be spent in job

meetings and coordinating with the various people involved to learn the basics of project management.

After this the engineer can help pick his path. Most want to move up to a position as a Project Manager but some prefer to move back to estimating and some want to stay in the field as a superintendent. He even has a few full time schedulers.

He went on to stress communication skills. He said, "I think that when someone meets one of our people, they are the company."

EVALUATION OF ENGINEERS AS MANAGERS:

He felt that he couldn't really generalize across the board on engineers as managers. He said that a lot of engineers say that they are interested in management but really they're not. They are more interested in the technical part of the job. He did think that they have at least one generic strength in that they have to be logical thinkers to have made it through the curriculum. He thought they know how to do a step by step analysis and that this is important but the most important part of management is dealing with the people.

If there is a weakness in the technical background he thought it would be the tendency to make the engineer think that there is a right answer. He went on to say, "You can quickly analyze the problem and have about a 96% accuracy rate for your solution or you can spend three (3) days and increase your

accuracy level from 96% to 98% and that's just not worth it. Sometimes the engineer gets so focused on the problem that, well I guess the phrase is he can't see the forest for the trees."

He discussed the aging of the field force. He said that the demographics he has been studying point to a difficult time in the industry over the next twenty (20) years. He said that he tried to encourage young people into the field assignments and that they stress the importance of these positions but without a great deal of success. He thinks the young people graduating today want to be in the office punching their computers.

TABLES

TABLE B - 1

UNDERGRADUATE EDUCATION	
TECHNICAL DEGREE	
CIVIL ENG	6
ELECT ENG	1
IND ENG	1
IND MGMT	2
BLDG CONST	2
TOTAL	12
BUSINESS DEGREE	2
NO COLLEGE DEGREE	2

TABLE B - 2

GRADUATE EDUCATION	
TECHNICAL	3
BUSINESS	4
LAW	1
CONST MGMT	1
TOTAL	9

TABLES

TABLE B - 3

OFFICE HELD	
COMPANY OWNER	3
PRESIDENT	5
VICE-PRESIDENT	5
OTHER	3

TABLE B - 4

REGISTRATION				
ELIGIBLE		TOTAL	% OF TOTAL	% OF ELIGIBLE
	ENGINEER IN TRAINING	1		
	PROFESSIONAL ENGINEER	3		
8	TOTAL	4	25	50

TABLES

TABLE B - 5

EDUCATIONAL PREFERENCE FOR NEW RECRUITS				
SUBJECTS DEGREE	SUBJECTS PREFERENCE			
	BLDG CONST	ENG	FIELD	NO PREF
ENGINEERING		7	1	
BLDG CONST	2			
IND MGMT	1			1
BUSINESS	1		1	
NO DEGREE	1		1	

TABLE B - 6

PREFERRED ENTRY POSITION			
SUBJECTS OWN ENTRY	ENTRY		
	FIELD	OFFICE	EITHER
FIELD	2	4	4
OFFICE		5	1

APPENDIX C

One of the firms interviewed has developed and is in the process of updating a formalized training plan for project managers. This plan was developed by a senior officer of the company at the request of the President of the firm as part of the President's strategic plan to improve company growth and enhance profitability.

To develop the plan the executive in charge asked what things had to go well for a project to be a success. In developing his list of areas that should be included for study he didn't limit his scope to issues that directly affect efficiency or costs. He wanted to take a broader outlook and include items that serve as catalysts for other project functions and also items that may not directly affect operations by their presence but which would have a negative effect by their absence. To assist in identifying topics the firm surveyed one hundred (100) senior project managers to see what areas they felt should be stressed in such a course. The company then went a step further and commissioned two (2) very extensive studies of their past projects. They had outside consultants pour through their records to identify good and bad points on past company projects. One (1) of the studies covered three (3) years of projects and the other covered five (5) years of projects. The result of this line of reasoning, the survey and the studies was a list of twenty-four (24) topic areas which are covered by the training plan.

APPENDIX C

To actually develop the material for the topics the firm took a unique approach. They brought in professionals to teach them how to teach but they developed the actual courses in-house. The way they did this was to have the executives of the firm identify the company's leading expert for each of the topic areas. This expert was then tasked to put together the actual course material and a training objective for his assigned topic. Once this was completed a panel of three (3) other company resident experts on the topic reviewed his work and assisted him in putting together the final product. The final product for each topic was a conversational narrative of the topic in a project setting. Items covered included who is involved on the project site from the lowest level of the project to the highest, and how the topic affects each level of workmen on the site. The aim was to make the presentation universal in its appeal so that it could be used by superintendents, field engineers, any level of project management, and of course prospective project managers in training.

Since the firm is geographically spread out the firm has elected to provide traveling instructors to cover some of the material on site in the field for fifteen (15) of the topics. Other material for these and the remaining nine (9) topics will be covered in self-paced instructional manuals and video-tapes. The program is envisioned as a two (2) year program that will be used by many levels of the company. The firm has developed a

APPENDIX C

self-evaluation questionnaire to identify weaknesses in their employees so that these employees can take advantage of applicable classes and course material even if they are already Project Mangers or have not been selected for the program. One (1) west coast office interviewed stated that they had fourteen (14) people in the program. Three (3) were already project managers and the rest were young people in the company who were on their way up.

The company interviewed now feels it has the best program available for training personnel to succeed in construction management. In many ways they feel that they are on the leading edge of this type of education and therefore are considering plans to copywrite their program.

The topic areas covered in the program are:

1. Corporate Knowledge
2. Personnel
3. Estimating
4. Insurance
5. Equipment Planning and Resources
6. Scheduling
7. Cost Control
8. Procurement
9. Field Office Management
10. Safety

APPENDIX C

TOPICS FOR PROJECT MANAGER TRAINING CONTINUED

11. Quality Assurance and Quality Control
12. Labor Relations
13. Contract Administration
14. Management Theory and Practices
15. Field Engineering
16. Engineering Administration
17. Construction Planning, Organization, and Methods
18. Supervision of Direct Labor
19. Supervision of In-direct Labor
20. Supervision of Equipment
21. Supervision of Sub-Contractors
22. Productivity and Methods Improvements
23. Construction as a Business
24. Insurance Risk Management

In the short time allowed to study this program it seems to offer great possibilities as an example for graduate level Construction Management programs. Further research into its implementation and results would be a worthwhile area of study.