

**EARLY CAREER PATTERNS OF ENGINEERS:
THE INFLUENCE OF THE CO-OP EXPERIENCE**

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January 28, 1993

Paper presented at the American Society for Engineering Education.

Funding for this research was provided by the Michigan Cooperative Education Association.

Recent studies that have examined the transition from college to the workplace have revealed that co-op participation has (1) leveled the playing field for those with less work experience by equalizing salaries; (2) enhanced starting salaries, compared to other engineering graduates with similar experiences; and (3) facilitated early socialization into the work place. Co-op participation clearly has decided advantages that influence early work experiences. But, do these advantages persist after entry into the workforce?

Cowin (1992) suggests, from information he has reviewed, that new engineers are treated very much alike during their first five years on the job. About the fifth year, a few engineers are selected for promotion into management while the others scurry to obtain new skills to keep in the game. This picture can be further confounded by recent changes in the labor market which have greatly altered the hierarchical structure of the workplace and redefined the relationships and contracts that previously existed. Whether bounded by a fraternal initiation system or tossed by the winds of change, engineers face challenges as they strive to meet their career aspirations. Do co-op experiences provide the boost someone needs to move along a chosen career path?

Once the game has been engaged, co-op experiences may continue to influence career advancement by accelerating promotions and salary increases. Or, they can be offset by other experiences and factors related to the work place, such as workplace learning. Little is known about the sustained impact of the co-op experience on the early careers of participants. This presentation presents evidence from a study that probed into the early careers of a group of engineers to determine if the co-op experience had any sustained influence on promotions, salary and career patterns.

METHOD

A modified cross sectional, time series design was employed to capture the employment patterns of recent graduates from Michigan State University. Participants for the study were selected from engineering graduates from the period of 1979 to 1990. Two selections were made. The first group was comprised of graduates who had returned starting salary information to the placement office upon graduation and were used in our study of starting salary (Gardner, Nixon and Motschenbacher, 1992). Added to this group were additional co-op participants from 1979 to 1989 who were unavailable for the salary report. The alumni office was able to provide 1196 valid addresses.

The second group consisted of randomly selected graduates who had not responded to the placement office's follow-up survey or who had been unemployed at the time. A separate random sample of 1990 graduates were also included. The decision to seek responses from a set of 1990 stemmed from a need to obtain a benchmark to determine if recall problems might exist with information on first job experiences. Approximately, 910 valid addresses were obtained for this group.

A survey instrument was partially adapted from the approach taken by Nicholson and West (1988) in their study of managerial job change. The instrument consisted of two parts: (1) review of work experiences while in college, skill development in undergraduate program, career evaluation and outlook, and demographic information; and (2) a detailed work diary, emphasizing the first job, current job and three job changes (promotions or responsibilities). For each position, information was sought on position within the organization, job title, salary, and selected sets of attitudes and perceptions. A final section obtained a career summary, including number of organizations worked for, promotions, job changes, and changes in job responsibilities.

The survey, accompanied by a letter from the college's Dean soliciting their support, was sent to the first group in early spring of 1991, via bulk mail. A reminder card was sent first class to all participants two weeks after the packet was sent. Six weeks later a second packet of materials was sent first class to all non-respondents. A total of 409 returns were received from group one (34 percent response rate) and 200 returns from group two (22 percent response rate) for a total of 609 returns.

RESULTS

Of the returned surveys, 600 were complete enough to be used in the analysis. Nine did not complete the diary. Missing data, causing the number of observations in some analyses to vary, appeared to be random and did not inject bias into the analyses.

Sixty-eight percent (68) of the respondents were men. The median age was 31 years, ranging from 25 to 40. Four respondents could be identified as non-traditional students for this period with ages reported above 40. Approximately, 65 percent were married or living with a partner, 32 percent were single and the remainder in a transition phase of their marital status. The number reporting that they had children was 227 or 38 percent.

The highest level of education obtained by 70 percent of the respondents was their bachelors in engineering. Hundred and two (17 percent) had earned a masters in engineering, 59 (10 percent) a masters in business administration (MBA), and 17 (3 percent) received doctoral degrees or degrees in law or medicine.

The distribution of respondents across engineering accurately reflected the overall distribution of students. Mechanical engineering, the largest program, accounted for 27 percent of the respondents. Civil and electrical engineering follow with 16 percent each, while chemical engineering, computer science and engineering arts accounted for about 11 percent each. Two smaller programs are agricultural engineering (3 percent) and a group which included material science, mechanics and operations research (3 percent).

Approximately, 21 percent ($n = 126$) of the respondents indicated that they had obtained no engineering related work experience during their undergraduate years. Those with work experience consisted of 36 percent with co-ops ($n = 210$) of which 74 (12 percent total

respondents) had two or fewer co-op experiences and 146 (24 percent) had three or more co-op experiences; 30 percent (183) had gained experience through summer employment; and 13 percent (n = 80) utilized internships. About 70 respondents indicated they had two or more different work experiences (i.e. co-op and summer employment). These respondents were classified by giving co-op top priority, followed by internships.

The summer employment group contained respondents who had participated in a special program with the automobile industry which was terminated in the early 1980s. The internship experience, an informal arrangement between the student and the employer and usually brokered by a faculty member or through the Career Development and Placement Office, is a recent development. Most internship experiences have occurred since 1987 and are particularly popular among computer science and mechanical engineering students.

The co-op group was divided into two separate groups, based on our findings that the number of co-op experiences was related to starting salary. This distinction was anticipated to be important in the analyses used in this study.

Employment Overview. In summarizing their careers up to the time of the survey, respondents indicated the number of companies they have worked for, the number of promotions they have received, the number of job changes that would not be considered a promotion, and the number of times job responsibilities have been changed even though a change in jobs did not occur. Table 2 reviews these basic dynamics.

While the number of organizations ranged from 1 to 8, 52 percent of the respondents were with the company that hired them upon graduation. Thus, the average was only 1.87 organizations. Approximately, 19 percent of the respondents had not received a promotion while 22 percent had received one. The range for promotions was 0 to 10, but the average of 2.17 revealed that most people have only had a few promotions since they entered the labor force.

Fewer respondents have been involved in job changes without a promotion (62 percent of those who answered) and in restructured job responsibilities (55 percent of those who answered). In these cases, it was likely only a few changes had occurred; however, multiple job shifts within a company were rather common for some engineers.

Comparisons were made between work experience groups, using ANOVA tests, to determine any differences. Co-op participants did not differ from the other groups on any of these employment characteristics. Length of time in the labor force explained the variance among these variables. Those who entered the workforce prior to 1982 have worked for more organizations, have had more promotions, and have made more job changes than those who entered later. There was no difference, however, for changes in responsibilities; everyone had experienced the same level of these type of changes.

First Job. According to job titles and responsibilities, coded by SOC Titles, 80 percent of the respondents were in engineering positions with the most common title being industrial engineer. An additional 9 percent were computer analysts or systems positions, 5 percent were in sales (sales engineer is common), 4 percent were managers, including owners of their own companies, and 2 percent worked in a variety of other jobs such as economist, lawyer, teacher, secretary and health technologist. Correspondingly, 56 percent of the respondents were employed by manufacturing firms, 13 percent by professional service firms, 10 percent by consulting organizations, and 9 percent by a government agency. The rest were spread over a variety of different organizations. The size of firm varied widely from 50 employees to over 100,000.

Organizational Level: *Hypothesis - With more relevant work experience, co-op graduates would be hired in at a higher level.*

Most of the new entrants were assigned entry level positions as an assistant engineer and a few at the slightly higher level of an associate engineer. The majority, 58 percent, started at the entry level and another 22 percent at the second level. Of the remaining 20 percent, most were hired in positions equivalent to a senior engineer or supervisor; the remainder were managers, usually in their own or a relative's organization.

Comparisons were made between work experience groups with no significant results being found. Based on the frequency distribution of organization level by work group, co-ops with three experiences have the lowest percentage of individuals starting at the third level or higher in the organization, 14 percent. All the other groups managed to place 20 percent or more at higher levels.

One factor that may contribute to this situation is the size of firm. Co-ops with three experiences tend to be employed by the largest firms: it can be intuited that these are likely to be more conservation firms with very structured progression steps that can not be bypassed, regardless of experience.

Tenure: *Hypotheses - A. Graduates who had no work experience would remain in their first position longer than others. B. Co-ops would remain in their first position longer than others, except those with no work experience.*

These hypotheses were based on the expectation that (1) with no prior experience, new labor force entrants would need to take more time to learn the ins and outs of the workplace while in their first job; and (2) with co-op experience, these entrants would be placed in more challenging positions that would keep their interest longer. Results showed that the average tenure in the first job was 26.46 months or just over two years. For those respondents who were still in their first position, the length of time was slightly over 40 months. If a respondent was promoted within the company, this usually took place at around 22 months. If an engineer accepted a new position in a new organization, they tended to stay in their first position about 25 months.

Significant differences were found among the work groups on this characteristic. Those with no experience stayed in their first job nearly a half-year longer than others, if they moved at all. Those in the "no experience" group who were still in their first job, had been there nearly a year longer than others in this category. Co-op participants, in general, tended to stay in their positions longer, especially those with three or more experiences.

Further analyses broke out the work groups by their entry into the labor market. A labor market entry variable was created with those entering the labor market between 1979 and 1982 in one group, those from 1983 to 1986 in a second, and those from 1987 to 1990 in the third. A significant difference occurred among work groups in the 1979 - 1982 period. "No work experience" and co-ops were in their positions longer than interns and summer employment. For "no work experience," the time was nearly double or approximately two years; for co-ops the difference was ten to twelve months.

A final analysis examined only those who changed position by date of labor market entry and work group. For those entering prior to 1983, the length of time in their first position was two years for summer employment and interns to nearly four years for those with no work experience. While most of those who changed companies had a slightly shorter tenure in their first job than those who were promoted, the exception was the co-op group with more than three experiences. Co-ops who eventually changed companies in order to obtain a promotion or change job responsibilities did so some eight months after those who had sought an internal job change.

For more recent job market groups, the amount of time spent in the first position has dropped noticeably, particularly for those leaving for a new organization. For the most recent graduates, those leaving for another company did so by eighteen months, irregardless of work group or academic major. Those with "no experience" and summer employment changed even sooner, at about 14 months. Those who moved internally did so at about 22 months; the exception being those with "no work experience" where the move occurred at 29 months. Chemical and civil engineers were particularly prone to moving quickly to a new company, at about 13 months.

Salary: *Hypothesis - Co-op graduates would have the same salary in their first position as other work groups.*

In our original starting salary, this hypothesis proved false. This study uses a different mix of respondents; plus, the reported salary for the first job may reflect the salary at the time a job change was made, rather than the range asked in the question. Nevertheless, ANOVA tests showed that the reported salary in the first job adjusted to 1979 dollars, was higher for the co-op group with more than three experiences than all other groups. This co-op group was significantly higher than those with "no work experiences" and summer employment groups. The largest portion of variation in salary was accounted for by academic major; co-op with three experiences' contribution approached significance (.10) after accounting for academic major.

When examining trends by labor market entry, co-ops with three experiences held a decided advantage prior to 1987. Since 1987, salaries across all work groups were nearly the same. A similar trend was also observed in our starting salary study.

Expectations: *Hypothesis - Co-op graduates would select a job that closely matched their expectations.*

Because of their extended experience in the workforce, co-op graduates were expected to evaluate their job opportunities and select a position that matched closely with their expectations. Respondents were rated on fourteen work characteristics as to their importance in being a part of the job they accepted after graduation. Comparisons between 1990 graduates and all other years found no differences; problems of recall may be present, but not large enough to bias the responses. The factors were rated similarly by all work groups, academic majors, and time entered the workforce. Table 5 presents the factors according to their ratings.

In evaluating their first job, respondents were asked to rate how well this job provided the work characteristics they desired before labor market entry. No matter how the data were sorted, unmet expectations predominated in the first job. Table 6 illustrates just what happened, reporting those characteristics with ratings difference significant at .01 level. None of the "very important" characteristics were met. Their first jobs did provide more of the "somewhat important" characteristics, fringe benefits and compatibility with outside interest. (Unfortunately, work was their outside interests, as will be discussed below.) If a characteristic is not mentioned, the expectation was met to the level desired.

Reaction to the Workforce. Respondents were asked to evaluate nine dimensions of the work environment. They were first asked to indicate whether they were surprised at what they found, the direction of their feelings (positive, negative, or neutral) and a brief description of what surprised them. Two areas receive positive responses--the people they worked with and their performance. The latter area surprised respondents the most; they quickly overcame their anxiety about their performance, they actually did better than they expected. Of course, as many commented, "I had to learn to evaluate myself."

Two areas received as many positive ratings as negative: training and supervisors. Either the training was terrible or it was very good. Likewise, their supervisor was helpful and friendly or the supervisor was absent, unfriendly, or unapproachable.

Four areas received a higher number of negative responses than positive ones. Taken in order of highest negative concern, they were communication from higher levels, personal lifestyle outside work, general atmosphere of the workplace, and nature of the work expected to perform. Nearly 85 percent of the respondents harshly critiqued the communication received from higher levels of management. Co-op graduates provided the most negative responses on lifestyles and the type of work being performed. Table 7 provides examples of the descriptions provided by the respondents.

Current Position. The type of organization that respondents worked for in their current position (at least one job change) was very similar to the pattern observed in the first job (55 percent in manufacturing, etc). A major shift occurred in job title, only 61 percent remained in engineering classifications while 22 percent were managers, including ten who owned their own business, 8 percent were computer analysts, 5 percent were in sales, and 4 percent were in various jobs including attorneys, teachers, health, economist, statistician, and financial analyst. The other noticeable change was the movement to working for smaller firms.

Organization Level: *Hypothesis - Co-op graduates would have moved to higher levels, likely managers, than other groups.*

Results from ANOVAs of organizational level by work group showed no significant difference among the groups. Co-ops with three experiences had moved to the third level or senior engineer level, similar to other groups, except for interns which were about one level behind. When examined by time in the labor force, co-op does not stand out in any meaningful way.

Factors that did affect the level in the organization were academic major and number of positions held. Mechanical and electrical engineers tended to be at lower levels than the other groups ($F = 4.153, p .003$); a pattern which held across all the time in labor force groups.

The more positions a person held, the higher in the organization that person was. For example, if an engineer was in his or her second position, they were at the third level; by the fifth position, the engineer would be at level five or a management position. This is a logical progression and not unexpected. This pattern suggest that it is important to make job changes a part of ones career plan; something that may be missing in many co-op plans.

Tenure: *Hypothesis - Co-op graduates will be in their current position the same length of time as other work groups.*

Respondents reported that they have been in their current position for approximately two years. All work groups with the exception of interns had tenure of this length. Interns had only been in this position seventeen months.

Over the three labor force entry groups, no anticipated differences were found. Those entering prior to 1982, have been in their current position about three years, except for those who have been in only two positions, whose tenure was over six years. Respondents who entered between 1983 and 1986 have been in their position about two years. For more recent entrants, the tenure was just shy of a year.

Tenure did vary by number of positions held, decreasing with more positions reported. Those in the co-op greater than three experiences group had the least tenure in the early groups (just under three years) while having longer tenure in more recent years. Looking at academic majors,

interns and co-ops greater than two tended to have the shortest length of tenure in their current position, across all time periods.

Salary: *Hypothesis - Co-ops would have higher salaries than other groups.*

While not statistically higher, co-ops with three experiences did receive higher salaries in their current position. This pattern prevailed over all labor market periods. Probably the most interesting finding was the absence of any salary difference by academic major. Chemical and civil engineers made nice gains to catch and surpass mechanical and electrical engineers. Engineering arts and computer scientists also closed the gap, remaining only about \$1,000 behind the other majors.

An interesting diversion was made by adjusting current salary to 1979 dollars for comparison with starting salaries. Comparisons showed that co-ops maintained their lead by growing at a modest 3.6 percent per year (only salaries of those with "no experience" grew at a slower rate). Interns from 1979 - 1982 saw gains of about 7 percent per year. Other groups advanced at about 5 percent per year.

Expectations: *Hypothesis - In moving into new jobs, work characteristics would come into alignment with initial expectations.*

In many respects, a better match between expectations and actual work characteristics should occur as an engineer shifts to new positions. Respondents reported more than they expected of their "somewhat important" characteristics, such as fringe benefits and fit with outside interests; plus more opportunities to express their creativity and higher quality upper management. The number of characteristics where expectations were not met fell; however, key factors, such as challenging work, advancement opportunities, and ability to obtain higher earnings, were still less than expected.

As Table 9 points out, co-ops with less than two experiences and interns appeared to have made the best adjustments. Co-ops with more than three experiences have the most remaining unmet expectations; three of which were "very important" to them. The unfilled desire for higher earnings by co-ops with three experiences and those with no work experience correlates with the finding on salary growth: these two groups experienced the lowest annual gains in salary.

Other Observations Regarding Expectations:

- Civil engineers were better able to bring their expectations into alignment. Mechanical engineers, computer scientists, and engineering arts graduates had the most difficulty.
- Mechanical engineers particularly found their work unchallenging and without advancement opportunities.

- Graduates who have been in the workforce longer have had more positive adjustments; but still remained unfilled in terms of advancement opportunities and higher earnings potential. The newest entrants, as would be expected, were still having problems matching their expectations and work characteristics.

- Simply changing to a new position does not immediately improve things. However, those who in their first move went to a new company found more challenging work, clearly specified tasks, and higher quality senior management. Moving within a company did not appreciably improve the match between expectations and work characteristics.

DISCUSSION

This study was designed to probe into the career paths of engineers who have recently entered the labor market with the intention of comparing the outcomes of co-op participants with other engineers. As the various layers enveloping the careers of engineers were pulled back, co-op experiences appeared to have little influence on career progress in comparison to other types of work experiences. The exception was salary where co-ops maintained their salary advantage, even though the gap was closing. Throughout the analysis, co-ops tended to do better in their career than those who had no related work experience prior to graduation.

Several factors may influence the early career paths of engineers in general and in particular, those engineers who participated in cooperative education programs. For discussion purposes, these factors are highlighted:

- Similarity of early careers. Cowin is correct in describing the early work experiences as fairly uniform for everyone. There is little differentiation among engineers based upon prior experience and other characteristics. Engineers start at the same level, with the same titles, doing the same kinds of work. This initiation process sidetracks careers and does not provide a mentally healthy environment for many young engineers.

- Changing structure of the economy. The loss of the hierarchical organization, replaced by a web of interlocking smaller firms, has not translated into a similar change in the hierarchical progression of careers. To move a career forward in a web structure, a worker needs to change positions on a more frequent basis. This is especially true if the goal is to receive higher pay, to gain new skills, and to be more creative. The workplace contracts have also been altered, especially concerning longevity, unemployment, team membership, etc. These changes require changes in work expectations as workers develop their career.

- From this study, engineers appear to have difficulty in shedding their hierarchical career plans. While they have shifted jobs to better match with their expectations, many "very important" expectations have gone unmet. With the exception of challenging

work, the ability of an organization to meet these expectations may be limited. The problem is compounded for co-ops because of the proclivity to remain in a position longer than they should. Movement through the web does garner rewards.

- **Work assignments.** Best described as dull, routine, and boring. Recognizing that there are a number of routine jobs that have to be filled, employers need to better match candidates with available positions. If employers seek out the "stars" for every position, they are essentially putting out these engineers' fires. Throughout their early career, co-ops are particularly frustrated by the lack of challenge in the work they do.

- **Lifestyles.** An area which needs to be explored further concerns the problems graduates have in adjusting to the world away from college. Why do co-op students express more concern over their ability to make new friends?; develop a life outside work?; and, to budget their resources wisely? It is possible that co-op students rely on their on-campus time for social development; losing the opportunity to begin to develop social relationships outside of work. Even in light of these problems, the search for balance between work and outside activities is the most difficult. The tendency is to make work all consuming.

- **Size of firm.** Only briefly mentioned in this report, size of firm may be an important determinate of careers. Co-op participants tended to accept jobs with the largest employers. In Michigan, this usually means the automotive industry. Preliminary analyses found that the careers of engineers at the largest firms tended to develop slower. The engineers that began to shift into smaller firms saw more rapid progress in their career. At this point, the evidence fits with our understanding of the changing structure of the economy mentioned above.

This study, despite its shortcomings, presents useful insights into the early work experiences of engineers. Michigan State engineers may not be typical of other engineering students, primarily because so many have been drawn to the automotive industry: an industry continuing to undergo enormous change. These changes have affected the early career patterns of many engineers. The cross-sectional design also presents problems in interpreting events across time. Ideally, a longitudinal study would be more appropriate to measure these type of changes. With the changing economic structure, important factors that are currently affecting careers may have been omitted from the survey. However, the willingness of these engineers to provide so much information about their careers offers encouragement for continued study on these important issues.