

# The Training and Professional Success of Engineers: an Empirical Study

M. L. GOLDSCHMID\*

Swiss Federal Institute of Technology, CH-1015, Lausanne, Switzerland

*In a large-scale study of over 800 engineers and architects, involving both questionnaires and interviews, we explored various components and possible origins of professional success, such as the quality of university training, extent of post-graduate training, work experience, personal qualities and important life events. Grades obtained during study do not predict professional success, whereas certain life events (for example, marriage) and personal characteristics (for example, leadership, perseverance and ability to communicate) represent important factors.*

## INTRODUCTION

THE purpose of the study was to find out how engineers define professional success and which factors contribute to it [1]. We were particularly interested in identifying the relationship between professional success and the quality of training, personality and experience [2, 3]. We also explored the reasons for their field of study, their actual employment and satisfaction with their careers [4, 5]. In a subsequent study [6], where we added a test of personality (CPI), we compared the professional success of engineers and architects with that of four other professions: doctors, lawyers, economists and psychologists (the total sample included more than 3400 subjects).

## SUBJECTS AND METHOD

In the present study, over 800 engineers and architects who graduated from the Swiss Federal Institute of Technology in Lausanne between 1946 and 1987 completed an extensive questionnaire which focused on the following variables:

- university education (type of study, reasons for choice of discipline, satisfaction, etc.)
- post-diploma training (duration, form, content, number of courses, etc.)
- professional activity (tasks, choice of employment, work conditions, problems at work, etc.)
- personal qualities (interpersonal, leadership, ability to communicate, energy, etc.)
- life events (marriage, children, friendships, etc.)
- satisfaction with career ('subjective' index of professional success) and
- demographic variables such as age, gender, etc. and 'objective' indices of professional success

\* Professor of Psychology and Higher Education. Former and founding president of the Swiss Educational Research Association.

(income, number of subordinates, responsibilities and status)

The results of their academic performance during their studies (preliminary and final exams, GPA, etc.) were recorded from the registrar's file.

## RESULTS

Since the space provided here does not permit a complete presentation of all results [cf. 4 and 5], selected findings follow.

### University education

One could assume that one's professional success would, at least in part, depend on the type and quality of the academic training one has received. The results indicate indeed that our respondents rate the value of their diploma as the most important factor of satisfaction (3.4 on a 4 point scale). They have no difficulties in finding attractive positions. Other elements rated favorably included the scientific competence of their teachers (3.3) and the theoretical level of their training (3.2), whereas the quality of their training in the human sciences (1.7) and the development of their entrepreneurial spirit (1.5) was judged rather low.

Their choice of engineering was largely influenced by their interest in science and technology (3.5), wanting to create something new (2.9) and good high-school grades in science (2.8), whereas the prospect of stable employment (1.8), wishing to contribute to science (1.8) and the influence of teachers (1.7) were felt to be less important criteria.

### Professional activities

Our respondents indicated that they spend almost 50% of their working time in some form of communication (writing, meetings, reading, phoning, etc.). They do not feel particularly well prepared for these activities, nor do they especially enjoy them (compared, for example, with planning

and teaching). The diversity of tasks (3.6), on the other hand, is a source of great satisfaction and judged to be most important by almost 70% of the sample.

#### *Professional success*

By far the most important component of professional success for the respondents is their satisfaction with their own work and career. Salary is only mentioned in fourth place behind opportunities to evolve and the possibility to create.

When we look at our four more 'objective' or external criteria of professional success, we find that responsibilities, income, decision-making power and number of subordinates are closely related and follow a similar progression, being of course highest for our oldest graduates (3.3) and dropping off much more rapidly than the index of 'internal' success (2.8) for the most recent graduates.

By far the most important reasons given by the respondents to explain their professional success were personal qualities (18%) and perseverance at work (15%). Surprisingly, training was behind, and close to chance (12%)! Overall, personal and internal characteristics were judged to be far more important (over 60%) than external ones.

A large majority of respondents indicated that they are satisfied with their own professional success and their working conditions.

#### *The relation between academic and professional success*

It turned out that none of the indicators of professional success, number of subordinates ( $r = 0.06$ ), income (0.09), decision-making power (-0.02), responsibilities (-0.03), satisfaction with work success (0.05) and importance attributed to success (-0.04) were significantly correlated with the overall grade-point average (as recorded during their studies at the university).

A comparison of three subgroups of the total sample, 10% best academic performance, 80% average and 10% worst, confirmed the finding: no statistical differences were found among the three groups for any of the above six criteria of professional success.

We then compared nine groups differentiated as to their professional status with regard to their academic performance. Overall, the differences observed were small except for the university professors who had significantly higher GPAs (preliminary 8.53, intermediary 8.28 and final exams 8.80 on a 10-point scale) than all other groups. For the directors, for example, the 3 GPAs were 7.47, 7.41 and 7.97, respectively; for the engineers 7.26, 7.30 and 7.91; for the assistants 7.32, 7.38 and 8.16; and the independent (those who now own their own firms) 7.29, 7.32 and 7.81. The last group's GPA was significantly lower than all others.

Comparing three subgroups of the total sample, separated by their 'objective' and 'subjective' pro-

fessional success (10% highest, 80% average and 10% lowest), did not reveal any significant differences with respect to their academic performance.

Taking the level of their own personal satisfaction with their careers into account, there were again no significant GPA differences among the highest satisfaction (10%), average (80%) and lowest (10%) groups.

No significant GPA differences were found either among those scoring highest (10%), average (80%) and lowest (10%) on the personal qualities index (see below). Furthermore, no significant gender differences emerged with respect to academic performance when the respondents were students. Those graduating between 1971 and 1980 for example obtained a mean GPA of 7.73 (women) and 7.62 (men). The figures for those who graduated between 1981 and 1987 were 7.30 and 7.51, respectively.

In line with the finding that independent engineers had lower GPAs than employed engineers, we also obtained significantly lower GPAs for engineers working in the private (7.54) compared with those in the public sector (7.67).

Those working in training (7.99), computing (7.72) and research and development (7.69) had higher grade-point averages than engineers in marketing (7.52) and production (7.34).

A consistent and statistically significant hierarchy of academic grades showed up for personal working within the Swiss Federal Institute of Technology (those who had remained in or returned to their alma mater): GPA (obtained during their undergraduate studies) for professors 8.68, for research associates 7.94 and for assistants 7.58! A marked difference was also found between all those working in the alma mater (GPA = 7.76) compared with those working in industry (GPA = 7.56).

Finally, we were interested in determining whether the relative importance attributed to professional success by the respondents was related to their academic performance during their undergraduate studies. No significant differences emerged between the lowest (7.62) and the highest (7.63) groups.

#### *Post-diploma training*

The overwhelming majority of our respondents (87%) had participated in some form of post-diploma training which they judged to be indispensable in order to meet the job requirements. This could be expected, since they work almost exclusively in technical areas. Interestingly, though, it was their subsequent training in non-technical areas (law, management, etc.) which was found to be associated with their level of professional success.

#### *Personal qualities*

As mentioned before, the respondents indicated that personal qualities were a very important factor in explaining professional success, much more so,

for example, than academic training. It is therefore interesting to analyze more closely which different attributes contribute to success.

The respondents were asked to rate themselves on 15 personal qualities (leadership, communication, creativity, adaptation, etc.), as well as giving an indication of the importance they attributed to each characteristic. The results show that management qualities (directing personnel, making decisions, delegating), interpersonal aptitudes (communicating, establishing relationships), self-confidence and independence were judged to be very important.

The 15 ratings were then combined into a global (4-point) scale in order to obtain an index of their overall personal qualities. Statistically significant differences with respect to this personality index emerged when we compared the respondents on the 'objective' index of success (4-point scale): 2.91 for the highest 10%, 2.58 for the average (80%) and 2.12 for the lowest 10%. For the 'subjective' index of success (4-point scale) the pattern was very similar: 3.39, 3.02 and 2.62, respectively, as well as for their judgement of their own satisfaction (4-point scale): 3.24, 2.92 and 2.77, respectively. The respondents were also asked to rate the importance—to them—of their professional success (4-point scale). Here too significant differences emerged: 3.13 for the highest on the personal qualities index, 2.66 for the average and 2.41 for the lowest group.

The correlation between the respondents' personal qualities index and their 'objective' and 'subjective' professional success was 0.28 and 0.24, respectively ( $p = 0.001$ ).

### CONCLUSION

Professional success, as far as our respondents are concerned, is very much a matter of personal satisfaction with one's work and career. Salary and material conditions are less important in defining success. Empirically, though, our 'objective' index of professional success composed of four criteria (income, number of subordinates, status and responsibilities) was found to be correlated ( $r = 0.32$ ,  $p = 0.001$ ) with the 'subjective' index (internal satisfaction).

The respondents judge personal qualities and perseverance at work to be more important than university training in explaining their own professional success. Leadership, the ability to communicate and self-confidence are among the personal attributes related to professional success.

Logically, success at work is also a function of age and experience. The year of graduation is in fact correlated 0.56 ( $p = 0.001$ ) with the 'objective' index of success, but only 0.19 with the 'subjective' one.

Academic performance, on the other hand, was not related to any of the indices of professional success. Exam grades obtained during university studies do not necessarily predict professional success. The criteria for evaluating performance in academia obviously do not correspond to those used in industry.

What are some of the implications of the results, particularly for engineering education? For one thing, we might reflect on and explore giving more weight to performance indicators other than exam grades. Projects, papers, technical proposals, research and development work, practice in industry etc., i.e. independent and experiential learning, might constitute the basis for more relevant assessments, feedback and educational progress and reduce the divide between academic and professional work.

The importance of personal qualities in one's career underlined by our respondents represent another challenge to the engineering educator. The inclusion of more human sciences (management, psychology, philosophy, etc.) in the engineering curriculum would be helpful, but also more frequent use of teaching methods which permit dialogue, participation, reflection, presentations by students, discussion etc., i.e. approaches which would enhance the students' personal development.

Our almost exclusive focus on facts, on the rational and on the technical instruction often to the detriment of affective, ethical, moral and personal considerations is in stark contrast to the respondents' emphasis on communication, leadership and interpersonal relations.

Finally, with regard to career planning, it would seem appropriate to attribute more weight to internal satisfaction rather than external criteria (salary, working conditions) in light of the respondents' insistence on subjective considerations and their wish to attain an appropriate balance between their personal and working lives.

Further research is called for, especially to better elucidate the transition from academia to the profession and to determine the long-term effects of university instruction.

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P. E. NÜESCH\*

FEANI, 4 Rue Mission (Maison des Sciences XXV) - 1000 Lausanne, Suisse

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\* P. E. Nüesch is Professor, President of SEFI, 1990/1.