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Série Scientifique
Scientific Series

98s-15

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Canadian Engineers**

*Michel Tremblay, Thierry Wils,
Caroline Proulx*

Montréal
Mai 1998

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ISSN 1198-8177

Determinants of Desired Career Paths among Canadian Engineers^{*}

Michel Tremblay[†], Thierry Wils[‡], Caroline Proulx[§]

Résumé / Abstract

Cette recherche vise à étudier six orientations que les ingénieurs peuvent vouloir donner à leur carrière et à comprendre ce qui les amène à privilégier certains choix de carrière. Les possibilités de carrière retenues sont la voie de gestion, la voie technique, la voie de projet, la voie entrepreneuriale, la voie hybride et une nouvelle carrière. Une enquête par questionnaire a été réalisée auprès de 900 ingénieurs à travers le Québec, dont 403 femmes. Les résultats démontrent principalement que plusieurs des facteurs étudiés (principalement les facteurs individuels comme les ancrés de carrière et la scolarité) permettent de distinguer efficacement les ingénieurs qui désirent poursuivre une carrière en gestion de ceux qui aspirent à d'autres voies de carrière.

The goal of this research is to study five career paths available to engineers and to understand what leads them to prefer the management path to other career path possibilities (i.e. the technical path, the project-based path, the entrepreneurial path, and the hybrid path). A questionnaire survey was conducted using a sample of 900 male and female engineers from a large Canadian province. The main results show that several determinants under study (mainly individual-related factors, such as career anchors and education) effectively distinguish engineers who want to pursue a management path from those who choose other career paths, especially technical ones.

Mots Clés : Ingénieurs, carrière, voies de carrière, changement de carrière

Keywords : Engineers, career, career path, entrepreneurial career, career anchor

^{*} Corresponding Author: Michel Tremblay, CIRANO, 2020 University Street, 25th floor, Montréal, Qc, Canada H3A 2A5 Tel: (514) 985-4000 Fax: (514) 985-4039 e-mail: tremblam@cirano.umontreal.ca

[†] École des Hautes Études Commerciales and CIRANO

[‡] Université du Québec à Hull

[§] École des Hautes Études Commerciales

Introduction

In industrialized nations, an overwhelming proportion of employees, including engineers, work in a bureaucratic context (Kanter, 1989) where career advancement is linked to managerial responsibility. A recent study showed that almost one third of scientists and engineers left the technical career path for the managerial path (Biddle & Roberts, 1993). Nevertheless, this linear career model, centered on vertical mobility, does not suit all individuals. A number of professional workers consider promotion as an insignificant measure of recognition for their contributions (Bailyn, 1984; Kanter, 1989; Von Glinow, 1988). In addition, many engineers appear to be dissatisfied with employment conditions and opportunities for advancement (Rynes, Tolbert & Strausser, 1988). According to some authors, career paths are a key factor in understanding the reactions of engineers to career development policies and administrative procedures (Raelin, 1985; Gerpott, Domsch & Keller, 1988), suggesting that career management systems sometimes fail to meet employees' needs. In fact, employers have an interest in understanding engineers' career aspirations since career satisfaction influences attitudes and behaviors such as motivation at work, productivity and organizational commitment – factors that become strategic assets in an increasingly competitive environment. A better understanding of engineers' career aspirations and their determinants can help practitioners put in place career management practices that can enhance the efficiency of human resources management among engineers.

As a result, implementing an appropriate career management system for engineers involves understanding their career expectations. What type of career would they like to pursue? How do they see their career in the long term? How can one identify the engineers more likely to be attracted to a particular career path?

Up to now, the few studies of engineers' careers have mainly examined traditional career paths, namely managerial and technical paths. However, the competitive environment prevailing today has called into question the traditional structures in favor of other forms of career paths which have received little attention, such as the project-based path, entrepreneurial path, and hybrid path. To our knowledge, there has been no systematic investigation of interest in these five career paths, together with the motivations underlying the desire to switch from one of these five paths to another. The present study pursues two main objectives: 1) to extend the literature on what leads the engineers to orient themselves toward traditional career paths (managerial and technical paths), and 2) to explore the factors that induce engineers to pursue other career routes

(managerial vs. project-based, entrepreneurial or hybrid paths). To address these questions, a questionnaire survey was conducted on 900 male and female engineers.

Career paths for engineers

One career management strategy that is fairly widespread among scientific and engineering personnel is the dual career ladder. Since the 1950s, the evolution of careers towards managerial positions has proven to be an inadequate method of rewarding technical staff, and the creation of a dual career ladder for professionals was proposed to allow promotions along either a technical ladder or a managerial ladder according to individual aptitudes and interests (Shepard, 1958). Despite the initial interest in this career strategy, it ultimately spawned disillusionment (Bailyn, 1991; Raelin, 1987; Allen & Katz, 1988). The technical path, which often involved a high degree of specialization, did not meet the expectations of all engineers, especially those who wished to retain a technical component in their career while taking on certain managerial responsibilities. Other avenues, such as project-based careers, were explored in order to respond to the expectations of engineers and the needs of organizations. Surveys by Allen & Katz (1988) and McKinnon (1987) have shown that where clear preferences were expressed by individuals, the project-based path was considered more advantageous than the managerial and technical career paths. In addition, engineers can go beyond the possibilities offered by organizations and embark on an entrepreneurial career by starting their own business.

Since the career paths available to engineers are diverse, it is important to present a brief overview of those identified in the literature, namely the managerial, technical, hybrid, project-based and entrepreneurial paths. The **managerial path** is a traditional option, whereby a successful engineer is granted recognition by being assigned to jobs with increasing amounts of responsibility. In this case, the engineer gradually drops technical issues to concentrate on control, organizational, and supervisory activities. Engineers are considered to pursue a **technical path** when technical activities remain at the center of their career. Organizations that recognize technical career paths allow engineers to climb a technical ladder. Although the **managerial** and **technical** paths are clearly distinguished in the literature, this does not always seem to be the case in the labor market (Goldberg & Shenhav, 1984; Cordero & Farris, 1992). In a **project-based path**, engineers are involved in a succession of technical projects which broaden their technical skills, instead of specializing in a particular sector. Although this path provides no real progression and is not

defined by formal guidelines, it seems to attract a large proportion of engineers (Bailyn, 1991; Allen & Katz, 1989; McKinnon, 1987). Furthermore, some engineers may experiment with a range of paths, including technical, management or project orientations, without opting for a definitive career path or an irreversible career direction. This means that they follow a fourth career path, namely a **hybrid path**. The **entrepreneurial path** is taken by engineers who start their own business. With decreasing job security and the major restructuring of many large corporations, the entrepreneurial path has gained in popularity. Companies would do well to study this type of career path, since engineers who start businesses may become competitors as well as collaborators (Page, Stephens & Tripoli, 1992).

Determinants of desired career path

Why do engineers choose one career path over another? As previous studies have explored mainly the managerial and technical paths, the review of the literature on the determinants of career orientation and the ensuing hypotheses will focus on these two paths. However, given the limited information available on the project-based path, entrepreneurial path, and hybrid path presented earlier, these career routes will be compared with the managerial path for exploratory purposes, to assess if these other career patterns have their own inherent logic. In this study, two groups of career path determinants will be discussed: 1) determinants related to the individual, and 2) determinants related to the context in which the individual works.

Individual-related determinants

Socio-demographic variables. Several studies have shown that as engineers get older, they are increasingly likely to hold managerial positions, whereas younger engineers tend to be employed in technical capacities (Biddle & Roberts, 1993; Kerr, Von Glinow & Schriesheim, 1977; Ritti, 1968). However, it is by no means clear that the interest in management increases with age. In fact, the proportion of engineering students and engineers with 15 years' experience who would like to be promoted to managerial positions is the same (Rynes et al., 1988). As technology evolves quickly, it is possible that the management path is viewed as a means for the engineer to counter the obsolescence of his or her technical skills and expertise which increases with age, while benefiting from more advantageous work conditions. Hence, the following hypothesis:

- H1: The more engineers advance in age, the more they want to orient themselves toward a managerial path (rather than toward a technical path).

A second socio-demographic factor that has been studied is gender. Although some studies have observed that female engineers have professional interests similar to their male counterparts (Musella, 1990; Bailyn, 1987), and that they share their male colleagues' desire for promotion within the managerial path (Shenhav, 1991). However, some researchers have suggested that female engineers are more attracted towards technical career paths for two reasons: these paths are more compatible with the family responsibilities for which women are still largely responsible (Evetts, 1993; Evetts, 1994), and organizations are less likely to promote female engineers to managerial positions

(Chapman, 1990; Evetts, 1993). This leads to the following hypothesis:

- H2: Female engineers want to orient themselves more toward technical career paths than male engineers (and less toward a managerial path).

Education also seems to be an important determinant of career orientation. Engineers who wish to pursue their careers in the managerial path often study for an MBA or take management courses after earning their undergraduate engineering degree (Hall, Munson, & Posner, 1992; Rynes, 1987; Steiner & Farr, 1986). Nonetheless, doctoral-level training has also been associated with a desire to work in a technical field (Allen & Katz, 1992), although other studies have linked doctoral studies to a strong likelihood of holding a managerial position (Goldberg & Shenhav, 1984). This suggests the following hypotheses:

- H3a: Engineers who hold an MBA want to orient themselves more toward a managerial path (and less toward a technical path).
- H3b: Engineers who hold a graduate degree in science want to orient themselves more toward a technical path (and less toward a management path).

Professionalism. Professionalism can be defined as an attitude towards the profession that varies in intensity from one individual to another (Kerr et al., 1977). The work of Gouldner (1957; 1958) underlined two distinct orientations among professional engineers: the "local" orientation and the "cosmopolitan" orientation. The local orientation is characterized by a low level of commitment to and identification with the profession, coupled with a high level of organizational loyalty. This orientation induces individuals to seek organizational recognition, and is thus associated with engineers whose careers are oriented towards management (Gerpott et al., 1988). In contrast, a cosmopolitan orientation is associated with a high level of commitment to and identification with the profession, coupled with a low level of organizational loyalty. As a result, individuals with a cosmopolitan orientation are more likely to seek recognition within the scientific community, and a cosmopolitan orientation is associated with a desire to work in a technical path in which individuals are able to contribute to the advancement of science (Gerpott et al., 1988; Goldberg & Shenhav, 1984). Thus, the following hypothesis may be proposed :

- H4: The higher the level of engineers' professionalism, the more they want to orient themselves toward a technical path (and less toward a managerial path).

Career anchors. The theory of career anchors proposed by Schein (1978; 1985) suggests that all individuals have career anchors which correspond to the main goals pursued through their work. Studies have shown that the career anchor is a useful means of assessing the professional aspirations of individuals and their work orientations, and thus a highly relevant factor for predicting desired career paths (DeLong, 1982; Igbaria, Greenhaus & Parasuraman, 1991). The main career anchors identified to date are: the management anchor, technical anchor, independence anchor, security anchor, quality of life anchor, entrepreneurial anchor, and service anchor. It has been demonstrated that engineers who opt for a managerial path have a stronger management anchor, and those who opt for a technical path have a more highly developed technical anchor (Igbaria et al., 1991; Rynes, 1987; Rynes et al., 1988). These studies tend to show that the career anchor influences the types of employment sought by individuals, and consequently their desired career path.

- H5a: The more engineers have a strong management anchor, the more they want to orient themselves toward a managerial path (and less toward a technical path).
- H5b: The more engineers have a strong technical anchor, the more they want to orient themselves toward a technical path (and less toward a management path).

Other individual determinants. The individual determinants discussed above are those that have received the most attention in the literature on career orientations. However, other individual characteristics can also influence the career paths of engineers. For example, the desire for promotion seems to be important for engineers in the managerial path, but less so for those in the technical path (Bailyn & Schein, 1980). *Several studies suggested that career orientation influences career-related behavior and career strategies (Gould & Penley, 1984; Rynes et al., 1988; Aryee, 1992).* If working harder is often used as *an individual* career strategy, then a link may exist between the work-time investment and the career path preference. *While the study of Rynes (1987) has shown that engineers in the management path are more likely to work longer hours than engineers in the technical path, Aryee (1992) found no significant*

difference between respondents with a managerial career orientation and those with a professional/scientific orientation in the use of work involvement strategy. The review of literature on these two determinants suggests the following hypotheses:

- H6: The stronger engineers' desire for promotion, the more they want to orient themselves toward a managerial path (and less toward a technical path).
- H7: The greater the engineers' work-time investment, the more they want to orient themselves toward the management path (and less toward the technical path).

Work-related determinants

The influence of the work context on career orientations has received considerably less attention than the impact of individual characteristics. Since contextual factors have an influence on attitudes and behaviors, an examination of their impact on career orientation seems justified. Although several context-related factors can be linked to career orientations, our study is limited to an examination of the impact of organizational types, plateau forms and context-related attitudes toward employment.

Organizational types. Several researchers have established links between organizational types and chosen career paths. For example, Taylor (1979) demonstrated that public-sector organizations tended to attract engineers with a technical orientation, while private-sector firms were preferred by engineers with a management orientation. However, engineers working for a small- or medium-sized private-sector firm, apparently favoured the technical path over the managerial path. It appears that engineers attracted by the managerial path look for large private-sector firms because of opportunities for promotion, whereas the degree of independence offered by small businesses and the advantageous conditions of public sector employment explain the appeal of this sector among engineers who opt for the technical path. Thus we may formulate that:

- H8: Engineers in the public sector want to orient themselves more toward a technical path (and less toward a managerial path).

A second type of organization that has not been examined directly for possible links with career orientation is the high-tech firm. Gerpott et al. (1988)

contend that businesses aiming at technological leadership should attract and develop engineers with career orientations that lean toward a more scientific focus, in contrast with firms whose technological strategy is to follow the lead of other firms. Since high-tech businesses are characterized mainly by more substantial investment in research and development, it is possible that engineers who wish to work in a technical path favor these organizations as employers. Thus, we can propose the following hypothesis:

- H9: Engineers who work in high technology businesses want to orient themselves more toward a technical path (and less toward a management path).

Plateau forms. The career plateau has received an increasing amount of attention from researchers as the possibilities for promotion within organizations have become more limited (Gerpott & Domsch, 1987; Hall, 1985; Tremblay, Roger & Toulouse, 1995). The researchers first defined career plateau as being in a same position for a long time with few possibilities of being promoted to a higher position (Veiga, 1981). More recently, a survey has demonstrated however that career plateau was a multidimensional phenomenon and that the perception of plateauing (subjective dimension) had a greater influence on attitudes and behaviors than the objective dimensions of career plateau (Tremblay, Wils & Lacombe, 1996).

To our knowledge, the influence of career plateaus on career orientation among engineers has received little or no attention. However, there is evidence that engineers in the technical path are more likely to reach a plateau than those in the managerial path (Holmes & Cartwright, 1993) and suffer more from the effects of plateau (Hall, 1985). Moreover, engineers who intend to orient their careers along a managerial path tend to be less likely to reach a plateau (Steiner & Farr, 1986). Moreover, workers tend to plateau more rapidly in technical paths because of their more compressed salary structure, which may create salary dissatisfaction and prompt engineers to choose the managerial path to improve their financial situation. Hence the hypothesis:

- H10a: The more engineers feel that they are plateaued at the structural level, the more they want to orient themselves toward the management path (and less toward the technical path).
- H10b: The more engineers feel that they are plateaued at the salary level, the more they want to orient themselves

toward the management path (and less toward the technical path).

Other work-related attitudes. Work-related attitudes have been the focus of much research in the field of human resources management; they are thus useful in shedding light on career orientations. For example, the relation between organizational commitment and career orientation has been examined in studies of professionals. Organizational commitment has been linked to a form of local orientation and a desire for greater managerial responsibilities (Raelin, 1985; Stahl, McNichols & Manley, 1979; Gerpott et al., 1988). This literature suggests the following hypothesis:

H11: The stronger the engineers' commitment to the organization, the more the engineers want to opt for the management path (and are less likely to opt for the technical path).

Moreover, Aryee (1992) recently found a link between reward systems and the choice of career orientation. Engineers with a managerial career orientation value more strongly the system of rewards offered by the organization (Steiner & Farr, 1986). It is likely that perceptions of injustice in the promotion system motivate some engineers to orient their career toward paths in which criteria and processes for advancement are more objective and less political, such as the technical path. Therefore, we can propose as a final hypothesis:

H12: The more engineers perceive the promotion system as unfair, the more they want to orient themselves toward the technical path (and less toward the management path).

Methodology

Sample

This study was conducted using a questionnaire distributed among French-Canadian engineers. The data were collected in two stages. First, questionnaires were distributed to engineers in three organizations: a manufacturer of transportation equipment, an aeronautics firm and a large municipality. In all, 374 usable questionnaires were received out of 720 distributed, for a response rate of 54.2%. This high rate of response is explained by the enthusiastic participation of the organizations surveyed. Second, the questionnaire was sent to 808 randomly selected male members of the engineers' professional institute. A total of 147 completed questionnaires were returned.. In order to balance the number of male and female engineers in the data sample, the questionnaire was sent to all of the female members of the engineers' professional institute of a large Canadian province. In all, 379 usable questionnaires were received of the 1295 distributed. The response rate for men (18.2%) is smaller than that observed for women (29.3%). This difference could indicate a greater preoccupation with career-related issues among women engineers. Moreover, since questionnaires sent by mail are more anonymous, it is normal to get a lower response rate than when engineers are personally invited to complete the survey at their workplace. Overall, the response rate was 32%.

The profile of respondents seems quite representative of the engineers of Quebec according to data provided by the "Ordre des ingénieurs du Québec" (OIQ -- Quebec Engineers Association): average age of 38.0 years for the sample vs. 40.3 years for the population; seniority of 9.3 years for the sample vs. 9.2 years for the population; 22% of the sample having completed higher education vs. 25% for the general population. Given that the OIQ did not have statistics by gender for the 1994 population, it was impossible to assess the degree to which our female sample was representative. However, it is probable that some degree of representativeness of our female respondents was achieved since the entire population of women engineers was surveyed and the response rate was close to 30%. The women who answered the questionnaire at the second stage are on average 32.3 years old and have 5.2 years of seniority; in 30% of cases, they hold a graduate degree.

Measuring instruments

Dependent variable. This study examines only engineers who wish to change career paths: the dependent variable is therefore their *desired career path*. Moreover, studying the desired career path is pertinent since actual career path may be more a matter of circumstances which more or less reflect the true aspirations of the engineers, while the desired path should reflect what the engineers actually want. In order to measure the dependent variable, the respondents had to indicate which of the five suggestions corresponded to their career path at the time they completed the questionnaire and in which path (from the same five choices) they wanted most to adopt in the future. When the desired career path did not correspond to the current career path, this was interpreted as a desired career path change. Among engineers who wanted to change career paths, respondents who wanted to orient themselves toward the management path (coded 1) were compared with those who wanted to choose one of the four other proposed career paths: technical path, project-based path, entrepreneurial path, and hybrid path (coded 0).

Independent variables. Most of the independent variables were based on one or more statements to which each engineer responded using a five-point Likert scale to indicate agreement (1 = Strongly agree to 5 = Strongly disagree). The results were sometimes inverted so that a high score for a given factor indicated the presence, rather than the absence, of that factor. Professionalism was measured using an instrument developed by Bartol (1979) to assess three dimensions of professionalism: 1) autonomy ($\alpha=0.75$), which indicated the desire to have autonomy in one's work, 2) identification with the profession ($\alpha=0.70$), which translates into professional development behaviors such as participation in conferences and reading of professional journals, and 3) commitment to the profession ($\alpha=0.83$), which indicates identification with the profession of engineer and satisfaction with professional identity.

Career anchors were measured using an instrument adapted from and inspired by the work of DeLong (1982) and Schein (1978), which assesses six career anchors on a five-point Likert scale (1 = Unimportant to 5 = Extremely important). The management anchor was measured using eight items ($\alpha=0.86$) such as: "To be in a position in general management." The technical anchor was assessed using eight items ($\alpha=0.81$) such as: "To become highly specialized and highly competent in some specific functional or technical area." The independence anchor was measured using three items ($\alpha=0.75$) such as: "To have a job that allows me not to be constrained by the rules of an organization."

The quality-of-life anchor was evaluated using four items ($\alpha=0.73$) such as: "To have a job that permits me to reconcile work and leisure." The security anchor was measured using two items ($\alpha=0.82$) such as: "To be in an organization that will provide job security." Lastly, the service anchor was measured using two items ($\alpha=0.78$) such as: "To have a career that allows me to help others."

Four selected forms of plateau were measured, namely the structural plateau (objective and subjective dimensions) and the pay plateau (objective and subjective dimensions). The objective dimension of the structural plateau was measured using the number of years worked in the respondent's current position, making it a continuous variable. For the objective dimension of the pay plateau, respondents were asked to state whether they had reached the top of their pay scale, making it a dichotomic variable (1=yes). The subjective dimensions of plateauing were measured using an instrument developed by Tremblay, Wils & Lacombe (1996). The perception of structural plateau was assessed on the basis of five statements on a five-point Likert scale (1 = Strongly agree to 5 = Strongly disagree) ($\alpha=0.84$): "My career had always progressed but today I reached a plateau." "I think I have been at my present level for too long," "I have the feeling of having done it all at my present employment," "I have nothing new to learn at my present position" and "My career is blocked. I have the feeling of being trapped in my present position." The perception of pay plateau was evaluated by one item: "The probability of seeing my salary increase over the cost of living is low."

The perception of equity regarding the system of promotion was measured using a five-point Likert scale (1 = Strongly agree to 5 = Strongly disagree) to assess two statements developed for the purpose of this research ($\alpha=0.76$), "Decisions on promotions seemed fair" and "I think the opportunities for advancement in this company are equal for all." To assess organizational commitment, considering the length of the questionnaire (over 200 items), four items were selected from the "Organizational Commitment Questionnaire" developed by Mowday, Steers & Porter (1979) ($\alpha=0.78$). These items, measured using a five-point Likert scale (1 = Strongly agree to 5 = Strongly disagree) are: "I talk about this organization to my friends as a great organization to work for," "I find that my values and the organization's values are very similar," "I am proud to tell others that I am part of this organization" and "I am willing to put in a great deal of effort beyond that normally expected in order to help this organization be successful." The desire for promotion was measured using the statement "I would definitely like to be promoted to a higher rank", lastly work-time investment was measured using the number of hours worked per week.

Demographic variables were measured using one question, coded as follows: sex (1=male), age (two digits), MBA (1=yes), M.Sc. and Ph. D. (1=yes). The types of organization were measured by binary variables: private sector (1=yes), high technology companies (1=yes).

The hypotheses were tested using a logistical regression analysis because the dependent variable is dichotomic. The Enter Method was chosen because the variables retained by the Stepwise Method are data-driven due to multicollinearity (Bernstein, 1988; Dillon & Goldstein, 1984). Logistical regression is also interesting since it indicates the extent to which the determinants examined correctly class individuals in one group or another. Thus it reveals the predictive power of determinants.

Results

The career profiles of respondents, detailed in Table 1, show that the career paths of engineers present a wide degree of variation. Some orientations are, however, more common. The managerial path was both the current career path of most respondents (n=300) and the most desired career path (n=269). There was also a marked interest in the current career path, such as the technical path (n=276) and the project-based path (n=157). In addition, although only 14 engineers were currently working in the entrepreneurial path, 77 would like to follow that path in the future. Table 1 also shows that roughly half of all engineers would like to change their career paths, whatever their current career path. Although a large proportion (49%) of engineers working in the technical path would like to change paths in the fairly near future, only a small minority (13%) plan to pursue their careers in the classic managerial path. This result justifies examination of *others* career paths that are available to engineers.

[Insert Table 1 here]

Table 2 presents descriptive statistics and correlations between independent variables. The zero-order correlations between variables reveal little indication of multicollinearity problems. Only three relationships exceeded the level of .50, namely: 1) age and objective structural plateau, 2) age and objective pay plateau and 3) organizational commitment and equity perception. The first two relationships are not surprising, given that other studies have shown a link between age and forms of career plateauing (Tremblay & Roger, 1993). The latter relationship was also confirmed by other studies showing that the perception of procedural justice influences strongly attitudes and behaviors at work, particularly organizational commitment (Greenberg, 1996).

[Insert Table 2 here]

Table 3 shows that the differences between the engineers who aspire to work in a managerial path vs. those who do not are significant in all comparisons studied. However, the determinants studied allow better differentiation for the hybrid path ($R^2 = .27$) followed by the technical path ($R^2 = .22$). The variables in our

model are less effective in differentiating the managerial path from the project-based path ($R^2 = .18$) and the entrepreneurial path ($R^2 = .12$).

Managerial Path vs. Technical Path: Testing hypotheses

The hypotheses H1, H5a, H5b and H6 were verified since the engineers wanting to orient themselves toward the managerial path are older ($b = .14$, $p < .10$), have a more developed managerial anchor ($b = 5.37$, $p < .001$), have a lower technical anchor ($b = -4.03$, $p < .001$) and a higher desire for promotion ($b = 0.81$, $p < .05$). In contrast, the hypothesis related to professionalism (H4) was only partially verified since only the desire for professional autonomy is significant ($b = -1.98$, $p < .01$). No significant results were found for the other dimensions of professionalism. The other hypotheses could not be verified. Although we have not postulated a hypothesis regarding the security anchor, it is interesting to note that the engineers who prefer the technical path have a significantly stronger security anchor than those who prefer the managerial path ($b = -.84$, $p < .05$).

Managerial Path vs. Non-Traditional Career Paths

Managerial Path vs. Project-Based Path: When engineers who prefer the managerial path are compared with those who want the project-based path, it appears that the engineers aspiring to the managerial path have a more developed management anchor ($b = 2.18$, $p < .001$), work more hours ($b = .66$, $p < .01$), have a higher desire for promotion ($b = .47$, $p < .05$) and perceive the system of promotions in the company as being more fair ($b = .82$, $p < .01$). In terms of career anchors, those who prefer the project-based path are characterized by a stronger technical anchor ($b = -1.11$, $p < .05$), security anchor ($b = -.54$, $p < .05$) and service anchor ($b = -.47$, $p < .10$) and a weaker quality-of-life anchor ($b = .83$, $p < .05$) than those who prefer the managerial path. Moreover, those who prefer the project-based path more often work in high technology companies ($b = -.78$, $p < .10$) and have stronger feelings of plateauing with regard to pay ($b = -.39$, $p < .10$).

Managerial Path vs. Entrepreneurial Path: When the engineers looking to the managerial path are compared with those aspiring to pursue an entrepreneurial path, it is interesting to note that those who want to orient themselves toward the managerial path have a stronger security anchor ($b = .72$, $p < .01$) associated with a weaker independence anchor ($b = -1.10$, $p < .01$) and a weaker technical anchor ($b = -1.07$, $p < .05$) than those who prefer the entrepreneurial path.

Engineers who plan to orient themselves toward the entrepreneurial path have a desire for promotion that is less pronounced ($b = .56, p. < .05$), perceive the system of promotion as being less fair ($b = .70, p. < .05$), are more likely to work in the private sector ($b = -1.33, p. < .05$) and have more often reached an objective pay plateau ($b = -1.20, p. < .10$) than engineers who are considering the managerial path.

Managerial Path vs. Hybrid Path: Compared with the engineers wanting to orient themselves toward the managerial path, engineers choosing the hybrid path more often work in high technology companies ($b = -1.79, p. < .01$), have a less developed desire for promotion ($b = 1.13, p. < .001$), a lower management anchor ($b = 1.88, p. < .01$), and perceive the system of promotions as less fair ($b = 1.40, p. < .001$) than engineers wanting to orient themselves toward the managerial path. Moreover, those who prefer the hybrid path more often have earned a higher education degree in science ($b = -1.91, p. < .01$) while those who choose the managerial path more often hold a MBA degree ($b = 2.76, p. < .10$). However, those who prefer the managerial path more often work in the private sector ($b = 1.67, p. < .05$) and are more plateaued at the structural level ($b = .41, p. < .01$) than engineers opting for the hybrid path. Finally, engineers who want to orient themselves toward the hybrid path have a stronger organizational commitment ($b = -1.20, p. < .05$) even if they perceive themselves as being more plateaued at the pay level ($b = -.57, p. < .10$) than engineers in the management path.

Although several of the determinants studied did not distinguish the engineers opting for the managerial path from those wanting the technical path, many of the factors nonetheless appear useful in distinguishing engineers who aspire toward the managerial path from those who are considering non-traditional career paths. Moreover, respondents who prefer the managerial path invariably have a more developed management anchor and a stronger desire to be promoted than those who select other career paths in the survey. Nonetheless, certain potential determinants do not appear very useful in identifying the career path in which engineers wish to orient themselves. These variables include sex, professional identification and professional commitment.

[Insert Table 3 here]

Discussion

The main objective of this research, conducted on a sample of French-Canadian engineers, was to identify the determinants of aspiration towards a managerial

career path in comparison with preference of the technical path, and to explore the determinants of a managerial career path in comparison with a project-based path, an entrepreneurial path or a hybrid path. Our results show that half of the engineers wish to change career paths – and contrary to a number of studies, engineers examined in this research place a high value on options other than the management path. Moreover, this study suggests that individual determinants are more powerful predictors of career path aspirations than are factors related to the work context.

More specifically, our results show that career anchors are especially relevant variables in distinguishing engineers who wish to work in managerial path from those who desire to work in each of the other paths. These results support the work of Schein (1978; 1985) who has demonstrated the role of the management anchor and the technical anchor in the predisposition to holding management and technical positions.

Moreover, it appears that other career anchors may be worth taking into consideration to better understand engineers' career aspirations. For example, the independence anchor is useful in identifying the desire to choose an entrepreneurial path. The security anchor is ranked higher by engineers who opt for technical paths or project paths, compared with those who chose managerial careers. The latter group are nonetheless seeking greater security than those who prefer the entrepreneurial path. It is also worth noting that engineers who are interested in management, while working more hours, place greater value on the quality of life than do engineers who choose the project path. This finding suggests that, at least for engineers who opt for the management path, quality of life is not necessarily incompatible with work activities. However, engineers who prefer the project path may be more willing to sacrifice their quality of life (e.g. relocation overseas) to work on a more interesting project.

A second individual determinant that clearly distinguishes engineers who favor the management path from the other groups is the desire for promotion. This finding supports Bailyn & Schein (1980) and Steiner & Farr (1986) who found that engineers who wanted to advance in management rated promotion considerably higher than those who opted for the technical path. Moreover, in our study the management-oriented engineers valued promotion more highly than those who chose other paths. Perhaps engineers who choose management place more emphasis on managerial rewards, which are often expressed in terms of salary increase, fringe benefits, perks and decision making, and that engineers who opt for paths other than management tend to value and seek other types of recognition (e.g. recognition of technical expertise). For example, Steiner and

Farr (1986) found that people who are management oriented perceive management careers to be highly rewarding than people who are technically oriented. Moreover, their data reveal that those engineers who were less interested in promotion rated the management rewards system lower than did managerially oriented respondents.

Of the other individual determinants studied, certain factors appear more relevant in distinguishing engineers who choose management from those who adopt one of the other career paths under study. As earlier researchers noted (Biddle & Roberts, 1993; Kerr et al., 1977; Ritti, 1968), age is apparently a relevant factor in distinguishing those who choose a technical path from those who opt for management. It is plausibly more demanding for an engineer to pursue a technical path at an advanced age, owing to the rapid pace of technological evolution. Consequently, these engineers must consider management as they get older. It is also possible that remaining in a technical field regardless of age is perceived as a sign of career failure in certain organizations (Lawrence, 1984). In this context, the optimal strategy for achieving recognition as a “successful” engineer, both inside and outside the organization, is to abandon the technical path for a management position, as early as possible.

Work-time investment is also useful in distinguishing engineers who choose management paths from those who prefer project paths, but not engineers who opt for a technical path. This trend has been observed in earlier studies (Aryee, 1992). The positive relation observed between the desire for promotion and the work-time investment ($r = .20, p < .01$) suggests that to access the managerial path, it is important for engineers not only to manifest their desire to be promoted, but also to invest in their careers. It is also possible that, in certain organizations, the project career route is perceived as a less demanding, visible or risky career orientation than the management path. This may explain why engineers who invest less time in their work and who have a strong security anchor tend to prefer the project path.

Furthermore, the choice of higher education type may distinguish engineers who prefer management careers (MBA training) from those who choose hybrid careers (scientific training). It is important to note that this is the only case in which higher education has proven to be a significant determinant. Moreover, contrary to earlier studies (Hall et al., 1992; Rynes, 1987; Steiner & Farr, 1986, Allen & Katz, 1992), this research did not detect a difference in terms of training between individuals who preferred management over those who favored a technical path. Surprisingly, engineers with MBAs do not prefer the management

path significantly over the technical, project or entrepreneurial path. This finding may be attributable to the limited number of engineers in our sample who hold MBAs (n = 21). The relation between scientific training and the hybrid path may be explained by the fact that individuals who complete a master's or doctoral science degree develop higher expectations of varied work challenges and a stronger desire to work in a context that does not constrain them to a definitive career path. Furthermore, as Bailyn (1991) pointed out, multiple work assignments may be a strategy to avoid over-specialization. The hybrid path can be viewed as that which best reconciles these expectations.

Lastly, this study demonstrated that professionalism-related attitudes do not distinguish the engineers who aspire to management from those who prefer technical paths. Similar to the findings of Gerpott et al. (1988), our study revealed that engineers who opt for technical career paths exhibited a more pronounced desire for professional autonomy.

Of the variables related to the work situation, the perception of equity in the promotion system emerged as the strongest discriminating factor. This variable distinguishes engineers who opt for management from those who choose project, hybrid or entrepreneurial paths. However, it did not differentiate engineers who chose management from those who turned to technical paths. One can argue that certain engineers prefer to adopt one of the alternative paths to management because they perceived that the promotion system in their organization was unfair, or because they had been treated unfairly in their attempts to rise to management positions. This explanation corroborates earlier studies that showed that non-mobile individuals, or individuals who were unable to access desired positions, were more inclined to perceive the reward system as unfair (Tremblay et al., 1995).

Of the other variables related to the work situation, only the private/public work sector played a determining role, in two cases. First, individuals who chose the entrepreneurial path were found more frequently in the private sector than the public sector, compared with those who chose management orientations. Perhaps engineers who work in the private sector perceived better opportunities in terms of founding companies, given that they had greater contact with the market and the competition. Moreover, when engineers who wanted to embark on the management path were compared with those who chose a hybrid path, the former group was found to be more prevalent in the private sector. The stronger desire of public sector engineers to opt for hybrid careers may be partly explained by the fact that in large bureaucratic organizations, such as the public sector, there are a great variety of formal career structures, and the pursuit of a

hybrid career is more accepted and an easier career route in the public sector than private sector .

Lastly, it is surprising to note that the other variables related to the work situation are significant only in cases where the engineers who opted for management paths are compared with those who aspired to hybrid paths. The greater desire for hybrid orientation among engineers who work in high-tech firms can be explained by the larger fluidity or flexibility of career structures in this type of organization (Bailyn, 1991). In comparison with public-sector engineers, the interest shown in the hybrid path by high-tech sector engineers can be better explained by the flexibility and ambiguity of the career structures than by the size and diversity of the formal structures. These results suggest the importance of paying close attention to the characteristics of organizational and career structures, along with individual's perceptions of these structures.

Our results also showed that the desire for hybrid career orientation is associated with a lower objective structural plateau. Therefore, one can argue that individuals who opt for this career path tend to enjoy changing positions and types of responsibilities fairly frequently. These engineers can be characterized as "transitory" under the career change typology proposed by Driver (1979). It is more difficult to explain why engineers who report strong commitment are most often inclined to choose hybrid rather than managerial paths; two tentative explanations may be advanced. Strong organizational commitment may lead engineers to seek diversified responsibilities, which translates into a desire to adopt a hybrid orientation. Complementary analyses have shown that private-sector engineers were more strongly committed than their public-sector counterparts. Perhaps in the private sector, organizational commitment is a necessary condition for being able to pursue a career that offers flexibility in terms of career movement. This same versatility may also be perceived as a prerequisite to attaining the most desirable positions in the organization (e.g. job rotation within the organization). Moreover, in the public sector the hybrid career possibilities may depend less on organizational commitment of engineers, and more on inclusion in political networks and the ability to succeed in the selection process (eg: pass the examination).

Conclusion

This study underlines the fact that engineers' decisions to move towards a particular path are based on a form of logic specific to each career path. Engineers, as a professional group, are not as homogeneous one would imagine,

given their broad range of career interests. The managerial path is not viewed as the sole alternative, and the two traditional career paths (managerial and technical) apparently do not meet the needs of all engineers.

Practical implications

These results point to a number of practical implications. The attraction felt by engineers for multiple career orientations should encourage the organizations that hire them to examine the opportunities available within their career system. In order to retain and motivate this professional group, businesses must offer multiple career paths, or hire only engineers with a profile corresponding to the opportunities and paths they offer. The findings related to determinants of career orientation provide some indication of the relevant factors that should be considered when hiring an engineer. If the firm is growing, and intends to be led by senior managers who are also trained engineers, it must ensure that it hires enough engineers wishing to work in a managerial field. If the organization offers few promotion opportunities, the best strategy would be to hire engineers with a technical or project-based orientation, depending on the type of work to be done. Therefore, our research clearly demonstrates the importance of career anchors in understanding the aspirations of engineers. An assessment of career anchors may therefore be a highly relevant career planning tool in determining mobility. A better understanding of the career anchors may prove to be useful to both individuals who plan to make changes in their careers and organizations who have put in place tools to improve the match between career supply and demand.

Almost half of the engineers in our study would like to see a change in their career in coming years. They are motivated not by dissatisfaction with their current career but rather by a need to see their career progress. Businesses should therefore examine the opportunities for career development that they offer to engineers. Besides the engineers working in a technical career path who would like to move towards the managerial path, some engineers in the managerial path would like to return to the technical path or try a project-based path, among other possibilities. The entrepreneurial orientation should be closely examined by businesses since it corresponds to a genuine need, although few engineers are currently working in this career path. Almost 10% of the engineers in our sample hoped to launch their own business, and thus constitute either potential competitors or potential allies. The development of entrepreneurship within organizations calls for a fundamental reconsideration of career management practices and reward systems. In addition, since not all engineers seek increased managerial responsibilities, organizations must develop diversified and equitable

reward systems to meet the range of needs expressed. Multiple career paths could conceivably introduced as a lever for a reward strategy based on professional and career development. Human resources managers must also examine the transitions that are possible and accepted within their organizations. A transfer from a managerial path to a technical path may be perceived as an acceptable solution, or as an admission of failure. If some transitions are encouraged and others discouraged, an engineer who would like to move in a direction that is viewed unfavorably in the organization will have no other choice but to change employers. Researchers have suggested that the firms which encourage multiple transitions are better positioned to develop the skills of their employees and improve their adaptability (Badawy, 1988; Hall, 1985).

Study limitations

Our research admittedly has certain limitations. First, although most of the logistic regressions produced significant results, explained variance levels remain low. This tends to suggest that other variables not taken into consideration in the research may influence career orientation. The characteristics of the position currently held, the level of growth within the organization and organizational size are obviously likely to influence the desired career orientation. Second, a further limitation is the use of certain variables measured by means of a single indicator. This may have affected reliability. Third, the generalization of results is limited by the fact that our sample was taken from the population of a single province in which the Anglo-Saxon culture does not predominate. Moreover, the representativeness of our sample is undoubtedly biased owing to the voluntary overrepresentation of female engineers. Fourth, the methods used to gather and analyze the data should be considered. The research design was cross-sectional, and it is thus impossible to infer causal relationships. A further limitation is that all variables, both independent and dependent, derive from the same questionnaire. This raises concerns about shared variance due to a common measurement method. Lastly, the operationalization of the dependent variable, i.e. the desire for a different career path, is not necessarily an indication that one currently has a desire to change. A more precise measurement tool might have been multiple indicators and a preference intensity scale for each of the paths.

Future research avenues

Despite these limitations, our study suggests a number of avenues for future

research. The importance of career anchors in career orientation underscores the need to delineate the career anchors associated with hybrid career paths (e.g. flexibility) and to develop an instrument to measure new anchors. Longitudinal studies are also needed to verify: 1) whether engineers eventually work in their desired career path; 2) whether their interest in a given career path changes or remains constant; and 3) whether the engineers who are in a career path corresponding to their wishes are more satisfied and more productive than those working in a career path that does not correspond to their wishes. Another profitable area of future research is to verify whether the determinants of career change and career orientation are the same for private-sector vs. public-sector organizations, services vs. manufacturing companies, and entrepreneurial vs bureaucratic firms. An additional line of research would be to study other professions, such as scientists, computer experts, or lawyers to verify whether their desire to change career paths and the related determinants are similar to those reported by engineers. Lastly, this study has shed light on the role of organizational fairness in the choice of a career path. It would certainly be worthwhile to study which form of fairness (distributive, procedural or interactional) has the greatest influence on the desire to change career paths, and which career paths most affect the perception of fairness.

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Table 1
Frequency of desired career path among engineers, by current career path

Actual career path \ Desired career path	Managerial path	Technical path	Project-based path	Entrepreneurial path	Hybrid path	New career	Lack of response	TOTAL
Managerial path	165 (55,0)*	29 (9,7)	46 (15,3)	23 (7,7)	21 (7,7)	14 (7,0)	2 (0,7)	300 (100,0)
Technical path	36 (13,3)	142 (51,4)	43 (15,6)	20 (7,2)	22 (8,0)	7 (2,5)	6 (2,2)	276 (100,0)
Project-based path	37 (23,6)	10 (6,4)	82 (52,2)	6 (3,2)	17 (10,8)	5 (3,2)	--	157 (100,0)
Entrepreneurial path	1 (7,1)	2 (14,3)	--	10 (71,4)	--	1 (7,1)	--	14 (100,0)
Hybrid path	29 (21,8)	16 (12,0)	28 (21,1)	14 (10,5)	38 (28,6)	6 (4,5)	2 (1,5)	133 (100,0)
TOTAL	269	202	199	77	98	38	10	880

* The figures in brackets indicate the percentage of individuals in a given current career path who would like to pursue the desired career path shown.

**TABLE 2 - Intercorrelation of independent variables
All engineers (N=362)**

	Mean	Stand. dev.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1. Age	35.27	8.91	--																						
2. Sex (male)	0.57	0.50	.24	--																					
3. Mgt training (MBA)	0.05	0.22	.14	-.07	--																				
4. Scientific training (M. Sc. & Ph. D.)	0.19	0.39	.13	.01	-.06	--																			
5. Deisre for promotion	3.55	1.12	-.11	.01	-.06	-.04	--																		
6. Work-time invest.	3.02	1.22	-.28	-.06	-.00	-.15	.25	--																	
7. Autonomy	2.79	0.50	.15	.11	-.01	.01	-.08	-.17	--																
8. Identification	2.43	0.83	.13	.07	-.02	.14	.05	.00	.08	--															
9. Commitment	3.80	0.57	.03	.02	-.00	.03	.02	.05	.03	.26	--														
10. Managerial anchor	3.45	0.65	-.04	.08	.07	-.02	.50	.12	.03	.07	.10	--													
11. Technical anchor	3.70	0.56	.03	.27	.09	.07	.15	-.02	.08	.18	.23	.31	--												
12. Independ. anchor	3.61	0.75	.01	.14	.04	-.09	-.06	.09	.11	.00	.08	.21	.32	--											
13. Quality of life anchor	3.61	0.77	-.16	-.04	-.03	-.01	.01	-.09	.04	-.13	-.18	.24	.16	.29	--										
14. Security anchor	3.56	0.93	.03	.12	-.09	.00	.05	-.13	.06	-.04	.05	.22	.23	.08	.38	--									
15. Service anchor	3.23	0.87	-.03	.12	-.04	-.01	.14	.05	.02	.19	.18	.24	.27	.21	.13	.13	--								
16. Priv./publ. (private)	0.60	0.49	-.42	-.04	-.04	-.12	.06	.52	-.11	-.19	-.08	.08	-.05	.07	.09	-.02	-.06	--							
17. Org. type (High-tech)	0.43	0.50	-.23	.14	.00	-.14	.09	.29	-.11	-.18	-.03	.10	.08	.05	.10	.11	.09	.35	--						
18. Obj. struc. plateau	4.08	4.69	.62	-.26	-.01	.09	-.01	-.33	.17	.18	.04	.03	.11	.02	-.05	.13	-.00	-.35	-.20	--					
19. Obj. pay plateau	0.27	0.45	.59	.13	-.02	.08	-.03	-.36	.13	.16	.04	.03	-.08	-.07	-.03	.05	-.00	-.49	-.28	.49	--				
20. Sub. struc. plateau	2.76	0.95	.40	.17	.02	.04	.15	-.24	.13	.08	-.20	.07	.04	-.01	.03	.03	-.01	-.18	-.19	.39	.33	--			
21. Sub. pay plateau	3.36	1.14	.34	.19	.02	.04	.14	-.16	.10	.05	-.16	.07	.06	-.01	.03	.03	.08	-.24	-.14	.27	.36	.50	--		
22. Equity perception	2.77	0.94	-.14	-.14	-.03	.02	-.12	.22	-.07	-.00	.21	-.07	-.10	-.07	-.08	-.10	-.06	.15	.11	-.16	-.22	-.36	-.26	--	
23. Org. commitment	3.35	0.85	-.20	-.02	-.04	.03	.12	.32	-.11	.06	.34	.11	.02	-.06	-.08	.04	.04	.28	.23	-.19	-.25	-.43	-.31	.49	--

. If $.10 < r < .13$, correlations are significant to .05.

. If $r > .13$, correlations are significant to .01.

Table 3
Regression analysis results
Dependent variable: career path aspiration among engineers
wishing to change career path

	Managerial /technical N=148	Managerial /project- based N=195	Managerial /entrepre- neurial N=156	Managerial /hybrid N=153
INDIV.-RELATED VARIABLES				
Age	.14*	.04	.06	.03
Sex (male)	.20	.29	-.60	.20
Management training (MBA)	1.66	.46	-.48	2.76 [†]
Scientific training (M.Sc. & Ph.D.)	-.03	.69	-.29	-1.91***
Desire for promotion	.81**	.47**	.56**	1.13****
Work-time investment	-.19	.66***	.11	.45
Professionalism				
Autonomy	-1.98***	-.60	.28	.98 [†]
Identification	-.47	.10	.25	.38
Commitment	1.26	.24	.47	-.42
Career anchor				
Managerial anchor	5.37****	2.18****	1.06**	1.88***
Technical anchor	-4.03****	-1.11**	-1.07**	-.36
Independence anchor	.20	-.15	-1.10***	.09
Quality of life anchor	-.98	.83**	.41	.26
Security anchor	-.84**	-.54**	.72***	-.41
Service anchor	-.53	-.47 [†]	-.25	-.59
WORK-RELATED VARIABLES				
Private/Public sector (priv.)	.29	.17	-1.33**	1.67**
Type of organization (High-tech)	1.42	-.78 [†]	.00	-1.79***
Forms of career plateau				
Objective structural plateau	-.06	-.04	.00	.41***
Objective pay plateau	.19	.32	-1.20 [†]	.55
Subjective structural plateau	-.55	.30	.04	-.54
Subjective pay plateau	-.39	-.39 [†]	.03	-.57 [†]
Equity perceptions	-.31	.82***	.70**	1.40****
Organizational commitment	-.34	-.45	-.14	-1.20**
Constant	3.83	-7.60	-6.03	-8.95
% Correct	87.16 %	77.44 %	75.80 %	85.62 %
R² SUM	.22	.18	.12	.27

* p<.10 ** p<.05 *** p<.01 **** p<.001

- For each dichotomic variable, the group in brackets was coded « 1 ».
- Each column presents the results of a logistic regression analysis (non-standardized beta coefficients).

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