Expected Managerial Careers Within Growing and Declining R&D Establishments

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Abstract

Numerous studies using individual-level variables have sought to explain the tendency of scientists to aspire to managerial careers within R&D establishments. The present study which concentrates on expected mobility to management examines the interplay between individual, structural and organizational determinants of the phenomenon. Logistic analyses indicate that the individual level effects were remarkably consistent with the findings reported in the literature, lending construct validity to the dependent variable used in this study. Structural level variables, which have not been examined previously, contributed to understanding expected managerial mobility within growing organizations, but had little effect in organizations experiencing a period of contraction. While the individual attributes have consequences for organizational hiring practices, the structural characteristics have implications for designing complex R&D structures.

A considerable body of literature dealing with scientific careers has repeatedly underscored the tendency of nonacademic scientists to seek a managerial position within R&D organizations. Explanations of the phenomenon have relied, thus far, on personal traits such as age, schooling, type of academic degree and professional obsolescence. Surprisingly, the organizational role in facilitating this trend and in mediating individual scientific careers has been ignored. This neglect is unfortunate since a growing number of studies have recently emphasized the significance of structural effects of the work place on career opportunities and stratification (Rosenbaum, 1979; Baron and Bielby, 1980; Baron, 1984; Spilerman, 1986).

Furthermore, past studies have concentrated on delineating the differences between research workers and R&D managers. This comparison is inappropriate for studying organizational effects since these two groups are, by definition, differentially located on the organizational hierarchy. In the absence of longitudinal mobility data, the study of expected mobility among nonmanagers is advantageous as a proxy for the phenomenon since it facilitates the identification of organizational set-ups within which these expectations are formed and shaped.

We make no claim regarding a perfect association between expected and actual mobility. Surely, perceived desirability factors are not the only predictors of mobility since they are mediated by economic and organizational conditions that shape the opportunity structure within the workplace (March and Simon, 1958). Actual mobility reflects the outcome of a complex matching mechanism between timing and internal demand and supply of job vacancies. Expected managerial mobility indicates the individual inclination to abandon the research bench given his/her personal attributes and organizational characteristics. Nevertheless, it is reasonable to assume that both expected and actual mobility are constrained or encouraged by the same opportunity structure provided by the corporation. Indeed, numerous psychological studies have revealed a strong link between desired mobility and actual behavior (Steel and Ovalle, 1984; Gerhart, forthcoming).

The main purpose of this paper is to study the interplay between individual and structural factors on perceived chances for managerial promotion among full-time research workers. As Rosenbaum summarizes: "Indeed, promotion chances may be a fundamental determinant of a wide variety of other attitudes and behaviors and are perhaps more important than individual personal traits or one's level in the organization" (Rosenbaum, 1979: 23). Thus, anticipated promotion chances may be studied both as a proxy for actual promotion and as an autonomous phenomenon.

A two-stage empirical analysis is employed in the study. Using individual level variables we first estimate the likelihood of acquiring a technical management position. Thereafter we turn to the bench researchers, those who are not in management, and estimate the determinants of their expected managerial promotion, using individual, structural and macro-organizational variables. This two-stage analysis enables us to compare expected with actual mobility and hence to validate the results.

Scientists and Managerial Careers

Studies of R&D sites have suggested that nonacademic scientists, who were trained as researchers, reach a stage in their career at which scientific work becomes less attractive and upward mobility is defined in terms of a shift into managerial and administrative posts within their organizations.

Empirical observations regarding actual and expected mobility reveal similar tendencies. First, regarding actual mobility, studies have observed an overtime shift into administration or a decrease in the amount of time devoted to scientific research. This has been documented in various national contexts: the U.S. (Engineering Manpower Commission, 1973; U.S. National Science Foundation, 1970; National Science Foundation, 1979), the U.K. (U.K. Department of Trade and Industry, 1971), Israel (Goldberg and Shenhav, 1984; Shenhav and Haberfeld, 1988), Austria, Belgium, Finland, Hungary, Poland and Sweden (Knorr, Mittermeir, Aichholzer and Walker, 1979; Knorr and Mittermeir, 1980).

Second, regarding expected mobility, scientists anticipate movement into managerial positions. An overwhelming majority (94 percent) of the researchers studied by Duncan (1972) expressed an intention to increase their administrative and managerial activities in their future careers. Results reported by Allen and Katz (1985) reveal that at least 33 percent of the researchers they sampled were heading for a managerial career. They also report that some twenty percent of students choosing engineering majors at MIT see management as their ultimate career goal (Allen and Katz, 1985). A sample consisting of nonacademic Israeli researchers (Goldberg and Shenhav, 1984) shows that some 44 percent of full-time researchers under the age of 40 expect to become R&D managers.

Additional evidence regarding this phenomenon may be found in R&D employment practices. Theorists and practitioners have documented different career programs and reward structures designed by managements within organizational labor markets as strategies to minimize transition from research to administration (Hallenberg, 1970; Shepard, 1958; McMarlin, 1957; Schoner and Harrell, 1965; Emmons, 1977; Smith and Szabo, 1977; Meisel, 1977; Moore and Davis, 1977; Garcia and Stevens, 1968; Griffith, 1981; Kaufman, 1975). The existence of these programs, such as the dual ladder solution, evidently results from management concern about the massive abandonment of the research bench.

Individual Attributes: Theoretical Explanations and Empirical Findings

At the individual level, the phenomenon under discussion has been attributed mainly to age and its social and psychological consequences. It is argued that aging is associated with increased pessimism, reduction of zeal and risk taking (Kaufman, 1975), all of which are likely to retard successful research endeavor in the laboratory. Beyond this explanation we should bear in mind that age is also a proxy for overtime changes[1] such as mid-career peak in productivity (Pelz and Andrews, 1966) and knowledge obsolescence (Evan, 1963; Ferdinand, 1966; Kaufman, 1975; Margulies, Newton and Raia, 1967; Rothman and Perrucci, 1970). A decline in scientific productivity and actual, or anticipated, knowledge obsolescence accelerate scientists' inclination to leave the technical ladder. Furthermore, researchers have distinguished between scientific productivity and organizational productivity (Stahl et. al., 1979). The former refers to output oriented to standards set up by the scientific community at large (such as publishing papers in scientific journals or contributing to the discipline by participating in scientific conferences), while the latter refers to a product geared to the requirements set up by the industrial organization. Thus, successful organizational productivity, as opposed to successful scientific productivity, should strengthen the propensity to make a career shift into management.

The phenomenon has also been attributed to the differential professional socialization of scientists. Those who possess higher academic degrees (Dewhirst and Holland, 1975) and those who hold a degrees in the sciences, as opposed to engineering (Ritti, 1971), are more committed to the profession and are less likely to leave research work. In addition, professional socialization shapes career orientations of researchers (Abrahamson, 1964). The literature distinguishes between two types of scientist, based on their career orientations: locals, those who are oriented toward intraorganizational reference groups, and cosmopolitans, who are oriented toward professional external reference groups (Gouldner, 1957; Merton, 1957)[2]. Abrahamson (1964) has found that integration in the industrial laboratory is negatively affected by length of socialization and by having a cosmopolitan orientation. Locals are evidently more likely than cosmopolitans to be attracted to the internal organizational reward structure where managerial promotion is the most prominent avenue (Kornhauser, 1962). Promotion along a technical career ladder perpetuates the powerlessness of local researchers and, if it continues up to an advanced age, is perceived as a career failure (Goldner and Ritti, 1971).

Lastly, gender differences may also be expected. It has been claimed that employers see women as less competent than men to supervise other workers (Wolf and Fligstein, 1979) , and that male managers engage in "homosexual reproduction" (Kanter, 1977). Consequently organizations offer different promotion opportunities to men and women as Kanter maintains: "Women populate organizations, but they practically never run them..." (1977: 16). This phenomenon has been recently observed within an internal R&D labor market: women were consistently less likely to occupy managerial positions than were men (Shenhav and Haberfeld, 1988).

Structural Determinants of Expected Mobility

Research teams are the basic infrastructure units within which industrial R&D is conducted. While a few studies have observed their operation (Gillespie and Birmbaum, 1980; Cohen, Kruse and Anbar, 1982; Andrews, 1979; - in academia, and: Smith, 1971; Andrews, 1979; - in industry), the relationship between team characteristics and the development of scientists' careers has been overlooked. Obviously, some structural characteristics are more receptive to professional practices (Raelin, 1984).and more conducive to increasing individual opportunities than others. As Spilerman puts it: organizational rules can be viewed as "templates - molds from which individual careers are fabricated " (Spilerman, 1986). We outline, below, on an exploratory basis, structural characteristics, at the team and at the organizational level, which are likely to affect the formation of managerial expectations among R&D researchers. Four team level variables are examined: team size, type of R&D project, relationship with external clients and disciplinary composition in a team. Three others, structural centralization, the average age and the average expected mobility in a team, are used as control variables in the empirical examination of our model.

Several studies have suggested that promotion opportunities may vary considerably among different kinds of organizations and that organizations play an important part in shaping careers (Bills, 1987; Kanter, 1984; Osterman, 1984). In particular, organizational size and organizational growth should have an effect on the phenomenon in hand, as is described below.

Organizational Size and Team Size - Promotion opportunities have been found to increase in large organizations (Stolzenberg, 1978; Baron, 1984; Bielby and Baron, 1983). Furthermore, big organizations tend to be structurally more complex (Scott, 1981), with larger administrative components (Blau, 1970). These findings lead us to believe that managerial expectations might be

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higher in larger organizations but not necessarily higher in larger teams since empirical evidence regarding the effect of unit size on managerial promotion is unavailable. Our expectations regarding the effects of size are even less clear in the light of a recent meta-analytical review of the relationship between size and performance. Gooding and Wagner (1985) have suggested that there is no guarantee that evidence drawn from research about organizational size is applicable at the subunit level, since each may involve different organizational properties. Nevertheless, given the importance of size in the organizational literature, and given the different structural attributes for which it may be a proxy (Kimberly, 1976), we expect that both unit size and organizational size would affect expected mobility to management. However, the direction of this effect is yet to be explored.

Type of R&D project: basic research versus development - It has been suggested that technology affects mobility patterns (Thompson, 1967; Vardi and Hammer, 1977). In the context of research laboratories we distinguish between basic research projects and development projects (Kornhauser, 1962). We argue that involvement in development, as opposed to basic research, increases managerial expectations for two main reasons. First, development projects generate technical interdependence among researchers and require more coordination and administrative work, which in turn are associated with managerial roles and increased managerial expectations. Second, basic research projects create environments receptive to professional norms and enable the researcher to work on problems that he or she and his/her colleagues value as important for the profession. Indeed, Kornhauser (1962) has found that researchers engaged in basic research projects were more likely to value professional rewards while their counterparts in development projects were more likely to be authority oriented.

Relationships with external clients - The source of project funding may also affect expected mobility into management. Although this proposition has not examined systematically, it has been argued that complex funding structures, and relationships with external clients in particular, might increase researchers' administrative responsibilities (Shenhav, 1988). A similar argument regarding external funding and administrative complexity has recently been proposed in the context of school organizations (Meyer, Scott and Strang, 1987).

Multiple Disciplines - The scientific discipline is an important hallmark of modern science, and scientists have been trained to practice scientific research within disciplinary boundaries. Yet, the discipline has a diminished role as an independent entity in the context of organizational research since its cognitive aspects are often far removed from the practice of marketable Research and Development. Interdisciplinary teams, are frequently formed for the purpose of conducting organizational R&D. They require greater interaction and coordination than monodisciplinary teams and conseqviently call for managerial skills. We therefore expect to find a higher level of managerial expectations in multiple-discipline teams.

Control variables - Three structural variables have been controlled for in the proposed model. Two variables represent the organizational opportunity structure and are hypothesized to affect the formation of expectations (Hall, 1968); these are the average age in the team and the average managerial expectations among team members[4]. The third control variable addresses the team's social structure. In particular, we control for highly centralized versus decentralized structures (which may affect the degree to which autonomous research is possible) as presented in the specification of the variables below.

Organizational Growth and Organizational Decline

Rosenbaum (1979) reports that organizational growth increases promotion rates since opportunities created by growth "spill over" to groups which may not otherwise be promoted. Likewise, Bielby and Baron (1983) found that growth increases chances for promotion when controlling for size. Freeman and Hannan (1975) and Ford (1980) have found that organizational administrative components tend to expand during growth but do not necessarily contract during decline. McKinley (1987) has stated that the relationship between structural or technical complexity and administrative intensity is moderated by organizational decline (or growth)[5]. We thus expect that different factors and criteria affect promotion chances in these two types of organizations and therefore estimate our model separately in growing and in declining organizations.

Methods

Data

The data for the study were collected during 1985-1986 as part of an NSF nation-wide research project on the social structure of R&D teams conducted at Stanford University. The teams included in the study were selected according to pre-specified guidelines. A team was defined as a group of people working on a common scientific or technical task and formally recognized as a unit within the company. This data set is unique in several respects: first, data from all team members have been collected in a study of a large number of teams. Second, this sort of data allows us to combine and compare individual and structural determinants of the phenomenon in hand. Third, the response rate was extremely high: 91% of the members of the teams studied returned completed questionnaires.

The 2285 scientists and engineers in the sample work in 224 different research teams, drawn from 29 American companies representing eight different lines of business (Cohen et. al. 1986). The 224 teams range in size from 3 to 34 members with an average of 10.2 members (standard deviation = 4.9). The data utilized in this study are based on responses to two types of questionnaire (out of four different types employed in the study). The major instrument (UM) was distributed to every team member including the team leader. The team leader also filled out a short supplementary questionnaire (UL). Several structural measures of the team were calculated on the basis of data collected from the UL questionnaire (unit size, type of client), while other measures are based on central statistical values (such as the mode or the mean) which were calculated across unit members within their original teams (from UM questionnaires). Each structural characteristic was then attributed to every individual working on the team before the final analyses, using the overall sample of individuals, was conducted. The analyses were restricted to researchers who hold a regular research position with no formal managerial responsibilities.

Data on organizational level variables are drawn from the Business Week Magazine (R&D Scoreboard, 1982). Organizational size refers to the 1981 figures and organizational growth history is measured as the average annual percentage change over the period 1977-1981.

Measures

The dependent variable estimating expectation to hold a managerial position is based on a question asking the researcher whether he expects to hold a managerial position in the same organization "ten years from now." The individual-level independent variables employed in the study were: age, age squared (for a possible curvilinear effect as was implicitly suggested by Rosenbaum, 1979 and by Raelin, 1985), academic degree (MA/Ph.D), gender, type of discipline (engineering and business administration versus all other disciplines), obsolescence level, local and cosmopolitan orientations (these two are not mutually exclusive as is suggested below) and productivity. Productivity was divided into two parts: scientific productivity was indicated by articles published in professional journals, and organizational productivity was measured by intra-organizational technical reports (see: Stahl, McNichols and Manley, 1979). Definitions of variables and descriptive statistics are presented in Table 1.

Descriptions, definitions and statistics for the structural level variables are presented in table 3. Those are: team size (SIZE), team social structure (TYPE A), development (DEV) and basic (BASIC) research (the reference category was "applied research"), number of different disciplines represented in a team (POLYDIS), average age in the unit (AVAGE), average managerial expectation within the unit (AVEXPECT), and project initiation by a client (CLIENT). Two variables, social structure (TYPE A) and type of project (DEV, BASIC), require further clarification.

The classification of team social structure is based on the work done by Cohen et. al. (1982) who suggested a four way typology: Type A: a highly centralized structure. This type is similar to the professor-students model. Type B: collective activity involving mutual agreement and sharing of responsibility among team members. This type is similar to the academic ideal of collegial interaction. Type C: a highly decentralized structure with minimal exercise of internal control; "The team project is largely an umbrella over distinct and disparate sub-projects..." (Cohen et. al. 1982: 211). Type D: team members share intellectual responsibility for the work through a collective planning process. However, the execution of the work is centralized. Type A was introduced into the analysis as a dummy variable.

Teams were also classified according to the type of project being conducted. The definition of work type is based on the modal response for the area of R&D and consists of three categories: basic research, applied research and development. Two dummy coded variables were generated: basic research (coded as "1") versus all the others (coded as "0") and development ("1") versus all the others ("0").

Organizational size is represented throughout the analysis in units of 100,000 employees. Data on organizational size were available for 18 of the 29 companies. The average size was 118,399 employees with a minimum of 5089 and a maximum of 741,000 (the standard deviation is 183,095). Growth (or decline) history was measured by annual percentage change in organizational size for the years 1977-1981. Data were available for 19 companies. The variable ranges from -11.7 percent to 20.2 percent with an average of 1.58 (standard deviation was 7.6).

We began with 1852 individuals, for whom we had complete information on all the individual and structural level variables. Since data on organizational size and on growth (or decline) were not available for all the companies, the inclusion of these variables reduced the number of individuals to 1152 complete cases.

In order to estimate the probability of expecting a managerial position we used a logit regression model which has better statistical properties for a dichotomous dependent variable than Ordinary Least Squares estimation (see appendix).

Results

Table 1 presents descriptive statistics for the individual level variables, separated for team leaders and bench researchers. Leaders, on the average, are older, hold higher academic degrees and report higher obsolescence levels. They are also more likely than nonmanagers to be males and to possess engineering and business-administration degrees. The figures regarding productivity and professional orientations are of considerable interest. Leaders, on the average, scored higher on both productivity measures -- scientific and organizational -- than nonmanagers. Owing to their advantageous position (better access to information and to material resources, and collaboration with subordinate colleagues), managers are able to produce higher rates of written material (Knorr, Mittermeir, Aichholzer and Walker, 1979; Goldberg and Shenhav, 1984). Similarly, leaders were found to be both more local and more cosmopolitan than their non-leaders counterparts. These findings are in accord with the contention that the two orientations (localism and cosmopolitanism) do not necessarily form one continuum. Rather, technical managers maintain both orientations simultaneously (Goldberg, Baker and Rubinstein, 1965; Goldberg, 1976). The findings also support the argument that the vocational and cultural orientations of technical managers fall somewhere in between those of pure managers and pure researchers (Hill and Collins-Eaglin, 1985).

Only 28 percent of the researchers in our sample expected a managerial position within the next 10 years. It should be noted that this figure is lower than previously reported in the literature (e.g., Duncan, 1972; Goldberg and Shenhav, 1984).[9]

<TABLE 1 ABOUT HERE>

In the following, we first estimate the effect of several individual level variables on the likelihood of being a team-leader, using a logit analysis (Table 2). Although technical leaders are not pure managers they have already made the first step towards a managerial career. This analysis should not be confused with our main objective of estimating the probability of expecting a managerial position (Table 4). As will become apparent below, the results with regard to likelihood of being a leader and the results regarding the likelihood of expecting a managerial position (among non leaders) are remarkably similar, providing further validity to the link between actual and expected mobility.

Several individual level variables described in Table 1 (the productivity measures, professional orientation and obsolescence level) were excluded from the analysis as they are 'position-dependent' and can be seen as after-the-fact consequences rather than independent variables. Age was found to have a curvilinear effect on the likelihood of being a team leader[6]. Up to a certain age[7] the likelihood of being a leader increases with age. Given that a person has not acquired a managerial position, his/her chances of being a manager decrease gradually thereafter. It was also found that entrance into management is more prevalent among holders of higher academic degrees and among researchers with engineering and/or with business-administration degrees. Surprisingly, and contrary to previous findings regarding organizational promotion (Kanter, 1977; Baron, 1987), no significant gender differences between leaders and non-leaders were found. This may be attributed to the scientific occupation, where hierarchical progression is only one among several career options for scientists, which in turn reduces competition between males and females. Indeed, Bailyn (1987) has shown that men and women hold similar career orientations towards managerial advancement.

<TABLE 2 ABOUT HERE>

Table 3 presents descriptive statistics for the structural level variables which were used to estimate expected mobility to managerial positions.

<TABLE 3 ABOUT HERE>

The effects of individual and structural factors on expected managerial mobility, among rank and file researchers, are presented in Table 4 using three logit models. The first includes a group of individual level variables, the second examines structural level variables and the third equation combines the two sets.

<TABLE 4 ABOUT HERE>

[8]

Apart from gender and type of discipline, all individual variables have a significant effect, in the hypothesized direction, on expected managerial mobility (table 4, first column). Higher academic degree, higher obsolescence, local orientation and organizational productivity (technical reports) are associated with increased likelihood of expected managerial mobility. Scientific productivity (journal articles) and a cosmopolitan orientation, on the other hand, reduce expectations of entering into management. Age was found to have a peak, after which expectations declined. These findings provide further evidence of a link between expected and actual mobility. The relationships between individual level variables and expected mobility are very similar to those found in previous studies which addressed the effects of individual variables on holding a managerial position.

However, whereas the individual level variables can be compared with previous findings, the lack of knowledge regarding structural effects on managerial expectations is apparent. The structural effects are presented in the second column of table 4. Expected mobility was found to be positively affected by an interdisciplinary structure, by involvement in development projects and by the average expectations level. Negative effects were found for team size and for the average age. No effect was found for team social structure or for existing relationships with clients. Before possible interpretations of these effects are made, the full model should be considered.

The full model, which examines the effects of individual and structural variables, including macro organizational size, on expected managerial mobility is presented in Table 4 in two forms. First, the logit coefficients are presented (column 3). Since the logit coefficients are difficult to interpret, they have been transformed (see appendix for method of transformation). The transformed coefficient (B_i^t, presented in table 4, column 4) indicates the proportional probability changes resulting from a one unit change in each independent variable evaluated at the sample mean[9].

Apart from publishing articles all the significant individual level variables have remained unchanged. Two structural level variables; averages of expectations level and team age[10] were no longer significant.

Note that the effect of team size in equation (2) is negative. Previous research dealing with size has produced conflicting findings. Several researchers have suggested that promotion opportunities rise with increased size (Stolzenberg, 1978; Rosenbaum, 1979; Baron, 1984). Others maintain that the proportion of managers declines with increased size (Rushing, 1966; Scott, 1981). The inconsistent results regarding the effect of size, however, may be the outcome of confusing levels of analysis (Kasarda, 1974). Organizational size and subunit size may have different effects on organizational phenomena as Gooding and Wagner (1985) have noted. Equation (3) includes both team size and organizational size. We find that unit size is still negatively related to the formation of expectations, whereas organizational size has no significant effect. It is possible that, ceteris paribus, increased team size generates higher perceived competition among team members and therefore lower expectation levels.

Table 5 presents the same equations separated for individuals employed in organizations which experienced a period of growth and for those who experienced organizational contraction.

<Table 5 About Here>

The separate analyses of these two types of organization are clearly beneficial. All the significant relations found in table 4 have remained unchanged in analyzing growing organizations. Two additional variables (equation 5), basic research projects (BASIC) and initiation of an external client, also indicate significant effects on the dependent variable. In declining organizations, however, most significant effects disappear. In particular, most structural level variables were no more relevant in predicting expected mobility than individual level variables.

Summary

This paper attempted to determine the factors associated with scientists' formation of aspirations to leave the research bench and to enter a managerial career ladder. Since we were interested in the comparison between individual and structural effects, studying expected mobility seemed to be an advantage in the absence of overtime data.

Apart from gender, all the effects of individual level variables on "expected mobility" are consistent with previous R&D studies. In addition, the effects of these variables on actual mobility to technical leadership (table 2) are similar to those regarding "managerial expectations" (table 4). These consistencies with the literature regarding the individual level variables, and the similar results regarding actual and expected mobility, lend a degree of construct validity to the dependent variable used in the present study (EXPECT). Several structural level factors were found to have a significant effect on the studied phenomenon in organizations that experienced growth. These were: type of R&D project (development and basic research), team size, disciplinary composition (multiple disciplines), and project initiation (CLIENT). It is also apparent that it is easier to trace the logic of expected managerial mobility in growing organizations than in declining ones. This finding is consistent with the view that organizational decline moderates the relationship between intra-organizational characteristics and administrative intensity (McKinley, 1987). The next obvious step in this line of research is to collect individual and structural level data for more than one point in time. This design will enable the estimation of the effect of structural variables in time 1 on individual location (career position) in time 2.

The main theme of this paper was that managerial expectations are not solely the result of individual differences among scientists, but are also determined by the organizational context within which they are employed. While the effects concerning individual characteristics have consequences for hiring practices, the results concerning organizational characteristics have implications for designing complex R&D structures. Management which seeks to establish a technical ladder (within the dual career ladder framework) in a particular establishment should consider the individual variables which encourage technical work and apply selection criteria accordingly. At the same time, those structural requirements conducive to technical work should be created.

Notes

1. In fact, Knorr and her colleagues (1980) maintain that scientists' age can be used as a proxy for the level of one's administrative position.

2. The two orientations (localism and cosmopolitanism), however, do not necessarily form one continuum and it is possible to identify individuals on both scales simultaneously (Goldberg, Baker and Rubinstein, 1965; Goldberg, 1976).

3. Organizational literature regarding the effect of size on administration, however, reveals somewhat conflicting results. Rushing (1966) in particular has argued that administration is not a unitary structural element but rather a "heterogeneous category" with management only one of its various components. Considering management alone, Scott (1981) puts forward an alternative proposition: the proportion of managers tends to decline as organizations increase in size (Scott, 1981: 236).

4. Aggregate level variables such as education level, company tenure and hierarchical level, have been previously used in the context of R&D to reflect organizational climate (see: Gerpott, Domsch and Pearson, 1986).

5. Organizational decline is defined as a downturn in organizational size (McKinley, 1987).

6. Indeed, Rosenbaum (1979) has found that young, college-educated employees attain promotion in a very short period of time or else they are not promoted.

7. This was claimed to be around the age of 38-40 (see: Goldberg and Shenhav, 1984).

8. Male and female scientists have identical means (.28) and identical standard deviations (.45) for the EXPECT variable. However, women are less likely then men to hold a business administration degree (.22 vs. .41 respectively), to posses lower academic degrees (.42 vs. .60 respectively) and to publish scientific papers (.25 vs. .36).

9. The transformed coefficients should be interpreted as follows: on the average, the effect of 10 years change in scientists' age on the probability of expecting a managerial position is .0026, or: having an advanced academic degree increases the probability of expecting a managerial position by $.11 \times 10^{-3}$.

10. The possibility that this finding is affected by the individual's age is ruled out since the correlation coefficient between age and average age is low (r=-.00015).

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Table 1
Descriptive Statistics for Individual Level Variables: Definitions, Means and Standard Deviations for Leaders and for Non-Leaders (bench researchers)

Variable	Definition	(N=196) Leaders Mean (S.D.)	(N=2027) Non-Leaders Mean (S.D.)
EXPECT	A dummy coded as 1=Expect to hold a managerial position within the next 10 years 0=Does not expect to hold a managerial position within the next 10 years		.28 (.45)
AGE	Age on a five category scale 1 = under 30 2 = 30-39 3 = 40-49 4 = 50-59 5 = over 60	2.83 (.88)	2.58 (1.08)
AGE9Q	Age squared	8.79 (5.12)	7.83 (6.02)
MA/Ph.D	A dummy coded as 1 = An M.A. or a Ph.D degree 0 = Otherwise	.83 (.38)	.57 (.50)
GENDER	A dummy coded as 1 = male; 0 = female	.92 (.30)	.87 (.35)
DISCIPLINE	A dummy coded as 1 = Engineering/Bus .Administration 0 = Otherwise	.45 (.50)	.39 (.49)
OBSOLESCE	Professional obsolescence (dummy coded) 0 = able to keep up with new developments 1 = Not able to keep up with new developments	.40 (.49)	.35 (.48)
REPORTS	A dummy coded as 1 = Produced technical reports within the last 3 years 0 = Did not produce technical reports	.79 (.32)	.72 (.37)

Table 1 contd.

Variable	Definition	(N=196) Leaders	(N=2027) Non-Leaders
		Mean (S.D.)	Mean (S.D.)
ARTICLES	A dummy coded as 1 = produced articles within the last 3 years 0 = Did not produce articles within the last 3 years	.34 (.50)	.34 (.47)
LOCALS	Local orientaion on a 4 category scale 4 = Receiving recognition from inside the organization is critically important 1 = Receiving recognition from inside the organization is not important at all.	3.1 (-71)	2.9 (-77)
COSMO	Cosmopolitan orientation on a 4 category scale 4 = Receiving recognition from professional colleagues outside the organization is critically important 1 = Receiving recognition from outside is not important at all	2.4 (.93)	2.1 (.89)

Table 2

Personal variables associated with "Being a Leader" as a Dependent Variable - Logit Regression

	Dependent Variable: Leader/Non-Leader
AGE	.95**
	(.22)
AGESQ	-.14**
	(.04)
M.A./Ph.D	.63**
	(.09)
DISCIPLINE	.22**
	(.08)
GENDER	.04
	(-04)
INTERCEPT	1.91
	2007
	2027

Standard errors in parentheses

** Significant at .01 level (two-tailed test)

Table 3

Descriptive statistics for structural level variables: Definitions, means and standard deviations

Variable	Definition	Mean (S.D.) for teams N = 224
TEAM SIZE	Size of the research unit	10.2 (4.9)
TYPE A	A dummy coded as 1 = Type A Structure (hierarchical) 0 = Orherwise	.16 (.37)
DEV	A dummy coded as 1 = development 0 = Basic research or applied research	.46 (.50)
BASIC	A dummy coded 1 = basic research 0 = Otherwise	.20 (.40)
POLYDIS	Number of different disciplines represented in the research unit	2.3 (1.35)
AVAGE	Average AGE in the research unit On a five category scale as described in Table 1	2.61 (.58)
AVEXPECT	Average EXPECT in the research unit	.39 (1.46)
CLIENT	A dummy coded as 1 = the research project was initiated by a client outside the company 0 = the research project with no participation of external clients	.14 (.34)

Table 4
Individual and Structural factors Predicting
Expected Mobility (EXPECT) to a Managerial Position among bench researchers
- Logit Regression

<u>Dependent Variable; EXPECT</u>

	Equation (1)	Equation (2)	Equation (3)	
	ft	ft		(j^** *
AGE	.62(.14)**		.54(.17)**	.26
AGESQ	0.15(.03)**		-.13(.03)**	-.06
MA/PhD	.22(.06)**		.22(.08)**	.11
GENDER	.09(.09)		.18(.12)	.09
DISCIPLINE	-.02(.06)		.11(.08)	.05
OBSOLESCE	.20(.05)**		.20(.06)**	.10
REPORTS	.18(.04)**		.37(.10)**	.18
ARTICLES	18(.06)**		-.07(.08)	-.03
LOCALS	.12(.04)**		.13(.05)**	.06
COSMO	11(.04)**		10(.04)**	-.07
TEAM SIZE		-.009(.005)*	-.01(.006)**	-.005
TYPEA		-.06(.08)	.0i(.09)	.005
DEV		.15(.06)**	.18(.08)**	.09
BASIC		-.14(.09)	-.15(.11)	-.07
POLYDIS		.15(.02)**	.13(.03)**	.06
AVAGE		-.17(.05)**	.08(.07)	.04
AVEXPECT		.04(.02)**	.02(.02)	.01
CLIENT		.08(.08)	.15(.12)	.07
ORGANIZ. SIZE			-.03(.02)	-.01
INTERCEPT	3.9	4.59	3.8	
x^2	1635	1814	1164	
N	1852	1852	1220	

-Standard errors in parentheses
-Organizational size is divided by 100,000

* Significant at .05 level (two-tailed test)
** Significant at .01 level (two-tailed test)

*** fi^{fc} is the probability change associated with one-unit change around the mean of the independent variable i. All ft^{fc}'s are multiplied by

Table 5

Individual and Structural factors Predicting
Expected Mobility (EXPKT) to a Managerial Position among berch researchers
In Qxwing and Declining Organizations- logit Regression
<u>Dependent Variable: EXPECT</u>

	Growth	Decline	Growth	Decline	Growth		Decline	
	(1)	(2)	(3)	(4)	(5)		(6)	
								B*-***
AGE	.39(.21) *	.98(.27)**	-	-	•45(.23) *	.34	•76(.34) **	.47
ACES)	-.10(.04) **	-.22(.05) **	-	-	~.11(.04) **	-.08	-.18(.07) **	-.n
J^/PH)	.35(.10)**	. 13(.11)	-	-	.4K.11)**	.31	.28(.15) *	.17
GENBER	.13 (.14)	. 11(.17)	-	-	•05(.15)	.04	-.03 (.24)	-.02
DISCIPLINE	-.14(.10)	.10(.10)	-		-.13(.12)	-.10	• 16(.15)	.10
CB90IES2E	. 13(.08) *	.16(.08) **	-	-	• 14(.08) *	.10	.22(.11) *	.13
FEFCKIS	.55(.14)**	.27(.14) *	-	-	.46(.15) **	.35	. 31(. 19)	.19
AKTICUS	-.07(.10)	-.23(.11) **	-	-	.08(.11)	.06	-.11(.15)	-.07
LOCALS	.09(.06)	.17(.07)**	-	-	.13(.07) *	.10	• 14(.09)	.09
OOSM3	-. 13 (.0 6) **	-.11(.06) *	-	-	-.13(.06) **	-.10	-.05(.08)	-.03
TEAM SIZE	-	-	-.00 5(.007)	.008(.01)	-.02(.009) *	-.01	.02 (.01)	.01
TYPEA	-	-	-.11 (.12)	.20 (.17)	-.07(.13)	-.05	.17 (.20)	.10
DEV	-	-	.28 (.11)**	-.008(.15)	• 31(.12) **	.23	-,11(.18)	-.07
BASIC	-	-	-.14 (.16)	.16 (.16)	~.32(.17) *	-.24	•05(.IB)	.03
pocrois	-	-	.12 (.04)**	.06 (.05)	.13(.05) **	.10	-08(.08)	.05
AVAJE	-	-	-.20 (.08)**	.01 (.13)	-.io(.m	-.08	.28 (.17)	.17
AVEXPECT	-	-	-.007(.02)	2.92 (.31)**	-.01(.02)	-.008	3.16(.41)**	1.9
CLIENT	-	-	.51 (.2)**	.19 (.16)	.45(^2) **	.34	.15 (.20)	.09
OFGANIZ. SIZE	-	-	-	-	-.006(.09)	-.05	-.03(.03)	-.02
INTER: EPT	3.83	3.26	4.70	3.11	3.79		1.41	
x^2	667	580	730	590	616		416	
N	694	606	723	640	675		477	

-Standard errors in parentheses
-Organizational size is divided by 100,000

* Significant at .05 level (two tailed test)
** Significant at .01 level (two tailed test)

*** **B^{fc} is the probability change associated with one-unit change around the mean of the independent variable i. All** *(\$-'s* **are multiplied by**

Appendix

The procedure for obtaining the transformed coefficients is as follows. According to the logit formulation the probability (P) of Y = 1 (expected managerial mobility) is a non linear function of the Covariates vector:

$$P = \frac{\qquad}{1 + e^{-V}} \qquad (1)$$

where e is the natural logarithm, and the vector v is a linear function of the independent variables in the equation:

$$v = B_0 + \beta_1 X_1 + {}_2 X_2 + \ldots \beta_n X_n \qquad (2)$$

where B is the logit coefficient and X^ is the sample mean of the respective independent variable.

The derivative of P with respect to X^ is used in order to obtain the transformed coefficient:

$$B_i^t = \frac{dp}{\;} \; " \; B_i \, f(v) \qquad (3)$$

where P (1—P) is substitute for the f(v) function:

$$B^{fc}_1 = \frac{dp}{dx_i} = B_1 \cdot P\ (1-P) \qquad (4)$$

where:

$$P = \frac{1}{1 + e^{-}} \qquad (1)$$

The transformed coefficient (B^) provides the proportional probability change resulting from a one unit change evaluated at the sample mean. Its interpretation is similar to an OIS interpretation.