The International Center for Research on the Management of Technology

Impacts of Supervisory Promotion and Social Location on Subordinate Promotion in an R&D Setting: An Investigation of Dual Ladders

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This research explores promotion along technical and managerial promotion paths in an R&D setting. Building on a social constructionist approach to professional socialization and careers, we investigate the impacts of supervisory promotion paths and social location on the promotion patterns of their subordinates. We also explore moderating effects of task type and subordinate on promotion patterns. Results indicate that a professional's immediate supervisor has important impacts on the subordinate's career path. Professionals reporting to supervisors promoted on the technical ladder were significantly more likely to also be promoted on that ladder. These results are accentuated for those working in research. On the other hand, those professionals reporting to either supervisors who were promoted managerially or who were gatekeepers were significantly more likely to be promoted into management. Gatekeeper status is more important than a supervisor's managerial promotion in affecting the subordinate's promotion into management. The gatekeeper effect is accentuated in development. The results underscore the important mentoring role of supervisors and provide insight into the impact of reporting relations on subsequent isolation of researchers from colleagues in development.
Organizations need to establish work environments that are both stimulating to the individual and productive for the organization (Cf., Schein, 1978). This is a particular dilemma when employees bring to the organization a set of attitudes and career aspirations that are in conflict with the organization’s work requirements and promotional opportunities. As argued by Kornhauser (1962) and Hall (1968), many R&D professionals are socialized into their technical occupations with values and definitions of success that differ significantly from those prevailing in traditional managerial settings. In the typical industrial organization, authority is expected to be discharged according to the hierarchical principle, and delegated through a series of well-ordered job positions. Technical professionals, however, value freedom to pursue one’s technical interests, responsibility for making judgements in areas of technical competence, and the ability to decide and exercise control through one’s peer group (Cf., Hill and Roselle, 1985; Dalton, Thompson and Price, 1982).

As discussed by Bailyn (1980), Delbeq and Elfner (1970), Von Glinow (1988) and Allen and Katz (1990), not all technologists are alike in their orientations toward success. Some technical professionals are motivated by a desire to contribute to their fields of knowledge and to establish distinguished reputations within their technical disciplines. These professionals have a strong academic-scientific orientation toward their work, developing strong commitments to their specialized skills and outside professional reference groups (Gouldner, 1957). Other technical professionals have a strong desire for upward mobility in the organization hierarchy. These professionals are more committed to developing their organizational careers by focusing on their firm’s commercial and product achievement. Further, Allen and Katz (1990) found that success criteria for
scientists and engineers is affected by educational background, age, and company experience. In their sample of scientists and engineers, technologists with a PhD degree were significantly more inclined toward an academic-scientific criterion of success than toward commercial-product criterion. This is true regardless of age. For those individuals without a doctorate, however, the commercial-product goals gradually increased in importance, becoming dominant at about the age of thirty.

This research builds on prior work in exploring managerial versus technical promotion patterns in an R&D setting. We investigate the impacts of supervisory promotion paths and his or her social location on promotion patterns of subordinates. We explore differences in subordinate promotion patterns by task area in R&D and by subordinate age.

THE DUAL LADDER

The dual ladder system of career advancement is an organizational arrangement that was developed to solve the dilemma of matching individual aspirations with organization requirements by providing meaningful rewards and alternative career paths for organizational professionals (Kaufman, 1975). The dual ladder approach is the formalization of promotions along two parallel hierarchies. One hierarchy provides a managerial career path while the other provides opportunity for professional advancement. A dual ladder system promises equal status and rewards to equivalent levels in the two hierarchies. Also known as the technical or individual contributor ladder, the dual ladder option was established to reward professionals (especially scientists and engineers) for outstanding scientific and technical performance without having to remove them from their professional work.
(Shepard, 1958). By providing professionally-oriented individuals with an opportunity and incentive to remain active and up-to-date in their fields, the dual ladder aims to secure for the technology dependent firm a highly motivated pool of technical talent (Allen and Katz, 1989).

While considerable research has been designed to investigate managerial careers and promotions within organizations (e.g., Schein, 1978; Bray and Howard, 1988; McCall and Lombardo, 1989), there is very little empirical research examining determinants of promotion up technical or managerial paths in dual ladder situations, especially in research, development, and engineering (RD&E) settings. We argue that divergent career paths in dual ladder settings are influenced less by individual differences, than by the subordinate's social networks. These social networks and job experiences may be shaped by their supervisor's promotion patterns and their supervisor's informal social location (Graen and Ginsburg, 1977; Katz and Tushman, 1983; Brass, 1990)

LITERATURE REVIEW AND HYPOTHESES

The dispositional approach to the study of careers and promotions argues that individuals possess certain needs, attitudes, or personality traits that predispose them to behave and respond in ways that would predictably affect their career orientations and promotional chances (McClelland, 1975; Howell and Higgins, 1990). Holland (1973) characterizes occupational choice, for example, as an expression of personality and developmental history. He sees both of these as relatively stable characteristics of individuals. Using Holland's measures of occupational themes in their comparative survey of R&D managers with technical specialists, Hill and Roselle (1985) found that R&D managers scored significantly
higher on the conventional, enterprising, and social themes while technical specialists scored significantly higher on the artistic theme. Based on these differences, Hill and Roselle (1985) argue that managers may be more responsive to authority, more interested in status and persuasion, and more comfortable in organizational hierarchies than their specialist counterparts. Other studies show similar types of differences in such self-report survey data of questionnaire items (e.g., Klimoski, 1973; Brown, Grant, and Patton, 1981; Sedge, 1985).

While these findings suggest some consistent differences between technologists and technologist-turned managers, they fail to meet conditions required of dispositional explanations (Davis-Blake and Pfeffer, 1989). This research has not shown predispositions to be either stable over time, predictive of career preferences and movements, or having similar effects on attitudes and behaviors across different organizational settings. In fact, the opposite may be more valid. In his 15-year panel study, for example, Schein (1988) concluded that individuals do not have definitive pictures of their motives, needs, aspirations, or talents. Instead, they form such perspectives through the many different work experiences they encounter within their organizations. McClelland and Boyatzis (1982) also discovered in their longitudinal study that none of their TAT measures of motivational patterns were associated with success for technical managers with engineering responsibilities. Similarly, Roberts (1991) found no consistent pattern of needs, especially achievement needs, within his long-term study of technical entrepreneurs. Finally, the results of Levinson (1978), Dalton and Thompson (1985), and Allen and Katz (1986) suggest that career orientations are not stable but change significantly over time and through different career stages.
Advocates of the human potential approach, on the other hand, assume that career progress can be explained and predicted on the basis of individual talents (Dunnette, 1971; Hinrichs, 1978). Such a research stream focuses primarily on the selection and assessment of individuals, searching for particular aptitudes and abilities. They pay little attention to management development opportunities that occur during one’s formative years in an organization. Further, this research stream fails to demonstrate direct relationships between individuals’ academic achievements and their future accomplishments, career successes, or job performances (Lee, 1986). What has become clear from a host of studies (i.e., Berlew and Hall, 1966; Bray, Campbell, and Grant, 1974; Katz, 1980) is that the degree to which individuals perceive their early career jobs as important and challenging has significant influence on their future performance and promotions. Socialization and work experiences resulting in perceptions of psychological success is a strong predictor of career progress even after the effects of individual talents have been taken into account (Wakabayashi and Graen, 1984).

These results are consistent with a more sociological approach to the study of organizational behavior in that individuals constantly need to interpret, understand, and organize their experiences (Salancik and Pfeffer, 1978). According to this social constructionist point of view, individual perceptions and outcome responses are not developed in a social vacuum but evolve as individuals enact their environments through successive encounters within their work settings (Weick, 1979; Lawrence, 1988). The reaction of technical professions to the dual ladder system, therefore, cannot be viewed in isolation from its setting. What is more important is how technical professionals build perceptions of promotional tracks through their intersections and experiences with significant others in their work
surrounding. The relative attractiveness or success of the dual ladder alternatives will be defined not so much by individual differences, formal structure, or design features, per se, but by individuals' active interpretations of promotional practices and dynamics taking place within the organization.

Underlying this social-constructionist perspective is the idea that scientists and engineers do not have well-defined notions of success and failure as they graduate and enter organizations. Instead, definitions of success emerge from the organizational context in which individuals find themselves (Cf., Lawrence, 1988; Schein, 1978). Without a firm prior definition, how technologists come to view the organization's technical and managerial ladders will be influenced more strongly by their organizational contacts and experiences than by prior academic training and socialization (Katz, 1988).

The most important set of contacts affecting one's organizational success develops through the mentoring relationship of one's immediate supervisor (Kanter, 1977; Kram, 1986). As discussed by Schein (1978) and Katz (1988), career goals and opportunities are significantly influenced by the socialization forces embedded in one's supervisory relationships. A professional's supervisor plays a critical role in helping to develop a more accurate assessment of an individual's skills and abilities, in understanding the norms and values of the local organizational culture, and most important, in defining how the individual is socialized and accepted within the setting. Accumulating research evidence indicates that supervisory-subordinate exchanges and experiences are strong predictors of career-related outcomes, including turnover, promotion, work assignments, and leadership support and attention (Graen, 1975; Katz and Tushman, 1983; Tsui and O'Reilly, 1983).
1989). Studies also suggest that working for supervisors who are themselves promoted enhances the promotional chances of their subordinates (Webber, 1976; Pelz and Andrews, 1966).

If supervisors influence career outcomes of their technical subordinates, then engineers and scientists working for supervisors promoted along different ladders might, themselves, be affected differently in their subsequent promotions. Supervisors promoted on the managerial ladder will have stronger contacts and more diverse networks in the managerial hierarchy, while those supervisors promoted on the technical ladder will have correspondingly strong networks in the technical domain. As supervisors expose their subordinates to their own idiosyncratic networks and bases of evaluation, professionals reporting to supervisors with different career tracks will have systematically different sets of networks, norms, and organizational experiences. A supervisor’s career track may act to pull subordinates along a similar path.

**H1:** Technical professionals working for supervisors promoted to the managerial ladder are more likely to be promoted managerially; whereas, those working for supervisors promoted to the technical side are more likely to be promoted on the technical ladder.

**The Influence of Gatekeeping Supervisors and Project Task Characteristics:**

Research in RD&E environments consistently shows that technological gatekeepers are extremely important in the effective transfer and utilization of external technology and information (Allen, 1984). Gatekeepers are defined as those key technical professionals who are strongly networked to both internal
sources of information. They were also more than three times as likely to remain in the organization as those technical professionals not working for gatekeeping supervisors. In development and technical service, gatekeeping supervisors not only gather, translate, and disseminate external information effectively, but they also facilitate the long-range retention, improve the external interface, and enhance the overall technical contributions of their engineering subordinates.

In addition to these informal roles, many technological gatekeepers are also first level project supervisors. Because of their strong connectedness and positioning within the organization's communication networks, gatekeepers are likely to be perceived as high potential, powerful individuals within their laboratories (Brass, 1984). The influence of gatekeepers is, however, contingent on task characteristics. Gatekeepers accrue differential organizational influence to the extent that they mediate critical organization boundaries (Tushman and Romanelli, 1983). Gatekeepers are particularly influential in development projects as they mediate between their local colleagues and external technology. In research projects, professionals span their own research boundaries, while in technical service areas, supervisors mediate the boundary between project members and external information sources (Tushman and Romanelli, 1983; Katz and Tushman, 1979).

Given the relative importance of gatekeepers for organization boundary spanning and the differential importance of this boundary spanning for development projects, we hypothesize:

**H3:** Project work characteristics will moderate the effect that
colleagues and external sources of technical information (Allen and Cohen, 1969; Tushman, 1977). They are also high technical performers who are approachable and helpful (Allen, 1984). Gatekeepers mediate between external information sources and internal organizational requirements. As gatekeepers span organization/environment boundaries, they accrue organizational power and influence (March and Simon, 1958) Managerial promotion rates of gatekeepers are higher than those of non-gatekeeping supervisors (Taylor, 1985). The exposure and power of gatekeeping supervisors in the managerial domains may shape the managerial career opportunities of their subordinates.

**H2:** Gatekeeping supervisors will have greater impact on managerial promotions of their subordinates than non-gatekeeping supervisors.

Gatekeepers have fundamentally different performance consequences by R&D task area. Tushman and Katz (1980) and Katz and Tushman (1981) found that in universally oriented research projects, gatekeepers were inversely associated with project performance. In development projects, however, gatekeepers served an important boundary spanning function, linking their locally-oriented colleagues to external sources of information. The performance consequences of gatekeepers are contingent, then, on task characteristics.

Beyond simple boundary spanning, gatekeepers play broad roles within their work settings, becoming actively involved in the socialization, integration, and personal development of younger technologists (Katz and Tushman, 1981 & 1983). In these studies, professionals in development and technical service areas working for gatekeeping supervisors communicated more easily and effectively with outside
gatekeeping supervisors have on the managerial promotional outcomes of technical subordinates. The influence will be more significant in development projects than in research or technical service projects.

Where gatekeeping supervisors may have the greatest impact on managerial promotions in development projects, we also expect that supervisory technical promotion will have differential impacts on technical promotions contingent on task characteristics. Since technical promotion reflects research on fundamental technical (as opposed to organization) accomplishment, those supervisors promoted on the technical ladder will have enhanced networks among professionals. Supervisors promoted on the technical ladder will have greater impact on networks and socialization experiences in research as opposed to development or technical service. The effects of supervisory promotion on subsequent subordinate technical promotion will, then, be accentuated in research projects.

**H3A:** Project work characteristics will moderate the effect that supervisory technical promotion will have on the technical promotion of subordinates. The influence will be more significant in research projects than in development or technical service projects.

**The Influence of Communication:**

Hypotheses 2 and 3 argue that gatekeeping supervisors enhance the managerial careers of their subordinates. What are the underlying processes by which gatekeeping supervisors affect the managerial promotion chances of their subordinates? Empirical studies demonstrate that interpersonal communication, rather than the use of written media, is the principal means by which technical professionals collect and disseminate important ideas and information (Cf., Allen,
1984; Zenger and Lawrence, 1989). Technical professionals expend considerable
time and effort locating information, discussing problems and solutions, and
coordinating results with other individuals both inside and outside the organization
(Rosenbloom and Wolek, 1970). Research on non-routine work indicates that
communication and network patterns established by professionals are key factors
that influence an individual’s ability to perform and consequently his or her career
(Katz and Allen, 1988; Pasmore, 1988; Zenger and Lawrence, 1989). As
discussed by Dalton et al. (1982), technical professionals need to learn which
elements of work are critical, which activities require greater attention, which
individuals are credible, and how to get things done effectively using both formal
and informal channels.

In support of these arguments, studies by Graen and Ginsburgh (1977) and
Katz and Tushman (1983) show that it is not the supervisor’s hierarchical status per
se that is important in enhancing the career outcomes of subordinates. More
beneficial are the higher levels of work-related communication and vertical
integration that are fostered by certain supervisors. Katz and Tushman (1983), for
example, showed that gatekeeping supervisors facilitated internal communication
and, in turn, reduced turnover of younger engineers and scientists. When
professionals are not well integrated, socialization is more difficult, satisfaction is
lower, and turnover becomes more likely (O’Reilly et al., 1989). In a related
study, Katz and Tushman (1981) found that promotions of project supervisors were
strongly related to prior communication patterns. A higher level of internal
communication was positively associated with managerial promotions while more
isolated supervisors were promoted on the technical ladder.
These results are consistent with the notion that it is the relative levels of communication and integration within a technical setting that is critical for affecting career outcomes. Gatekeeping supervisors mediate intra-laboratory and corporate communication for their subordinates. These effects are accentuated in development activities (Tushman and Romanelli, 1983; Katz and Tushman, 1979). These more extensive organizational networks may, in turn, be associated with enhanced managerial promotion. To test directly the idea of gatekeeper-communication networks, we hypothesize:

**H4:** Engineers reporting to gatekeeping supervisors will have significantly greater communication with people within the laboratory and within the corporation than engineers reporting to supervisors, who are not gatekeepers. These patterns will be accentuated in development projects.

**RESEARCH METHOD**

This study was conducted among the 345 technical staff members of a large RD&E organization, which was divided into seven separate functional departments. A total of 61 projects, organized around different disciplines and product-based problems were identified across these departments. Data were gathered in two waves over a five year period. Only professionals assigned to these projects at the beginning of our data collection participated in the study. Each technologist was a member of only one project and worked for a single project supervisor.

**Communications and Gatekeeping Supervisors:** As described by Katz and Tushman (1979), each professional reported (on specially provided lists) those individuals with whom they had work-related communications on a randomly
chosen day each week for 15 weeks. Using this method, we could accurately obtain for each technical professional six mutually-exclusive measures of communication as follows:

1. **Departmental communication**: The amount of communication with technical peers within the individual's functional department (including project).

2. **Laboratory communication**: The amount of communication with technical colleagues in the other six functional departments.

3. **Supervisory communication**: The amount of communication with the individual's immediate project supervisor.

4. **Managerial Communication**: The amount of communication with the departmental manager.

5. **Corporate communication**: The amount of communication with individuals outside the RD&E facility but within other corporate divisions, primarily marketing, manufacturing, and finance.

6. **External communication**: The amount of communication with outside RD&E professionals.

Since gatekeepers are defined as having high internal and external networks, this study defines gatekeepers empirically as those project members for whom both departmental and external communications are in the top fifth of their respective distributions. This definition is consistent with prior studies, including, Allen (1984), Whitley and Frost (1973) and Tushman and Katz (1980). Based on these methods, 15 (25 percent) of the project supervisors are also functioning as technical gatekeepers while 46 (75 percent) of the project supervisors are not.
Project Task Characteristics: Using definitions described in Katz and Tushman (1979), respondents indicated how well the objectives of their work fell into the categories of research, development, and technical service. As in Pelz and Andrews (1966), project members also indicated the percentage of their project activities that fell into each of these three possible project categories. A weighted average of these two answers is used to calculate a score for each project member (Spearman-Brown reliability = 0.91). To categorize projects, these individual scores are averaged within projects to yield a classification of 14 research, 24 development, and 23 technical service projects. As discussed by Tushman (1979), the homogeneity of members' perceptions of project characteristics was checked to ensure the appropriateness of aggregating across individual scores.

Individual Promotion and Performance: Five years after collecting the communication data and reporting relationships, the authors returned to the organization to collect promotional data for all original participants, i.e., all technical project members and project supervisors. In this organization, all technical and managerial ladder positions and titles start above the project supervisory level. Because our study had not involved anonymity, we could determine, from the organization's personnel list, whether or not the participants were promoted over the five years. For each technical professional and project supervisor, we could determine whether they were: (1) promoted on the technical ladder, (2) promoted on the managerial ladder, (3) not promoted above the project level, or (4) had left the organization. All promotional outcome analyses reported here are based only on those who remained within the organization over the five years.
RESULTS

The first hypothesis focuses on the influence of supervisors' careers on the promotional outcomes of their technical subordinates. Examining the promotional outcomes for the entire sample of 213 technical professionals, one finds almost identical percentages of engineers promoted on the technical and managerial sides of the dual ladder - approximately 10 percent in each case\(^1\) (Table I). The breakdown of these outcomes by their supervisors' careers, however, shows that the distributions of technical and managerial promotions are not equivalent. In partial support of our initial hypothesis, results indicate that supervisory careers are significantly related to technical promotions but not to managerial promotions. As hypothesized, a large percentage (32.3 percent) of those professionals working for supervisors promoted on the technical ladder were themselves promoted on that ladder. This proportion is more than four to five times the rates found for the other three categories, each of which is below eight percent.

![Table I](http://example.com/table.png)

<table>
<thead>
<tr>
<th>Supervisor's Promotion Record</th>
<th>Proportion Promoted to:</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Technical Positions</td>
</tr>
<tr>
<td>All Engineers (N = 213)</td>
<td>9.9%</td>
</tr>
<tr>
<td>Supervisor Promoted Managerially (N = 96)</td>
<td>7.3</td>
</tr>
<tr>
<td>Supervisor Promoted Technically (N = 31)</td>
<td>32.3</td>
</tr>
<tr>
<td>Supervisor Not Promoted (N = 19)</td>
<td>5.3</td>
</tr>
<tr>
<td>Supervisor Left (N = 49)</td>
<td>6.1</td>
</tr>
<tr>
<td>Significance Level</td>
<td>0.05</td>
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<td></td>
<td>N.S.</td>
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15
Results pertaining to managerial promotions, on the other hand, do not support hypothesis 1. Only 11.5 percent of the engineers reporting to supervisors promoted managerially received a similar promotion. This proportion is comparable to the rates of engineers reporting to supervisors promoted technically or not promoted. It is slightly less than the rate for those whose supervisors had left. Supervisory careers have a stronger influence on the technical side of dual ladder progressions than on the managerial side.

**Gatekeeper Influence**

Hypothesis 2 argues that, since gatekeeping supervisors have substantial organizational networks and exposure, they have greater effect on managerial promotions of their subordinates than non-gatekeeping supervisors. Results in Table II support hypothesis 2. Those engineers assigned to supervisors who were also gatekeepers have significantly higher managerial promotion rates than these engineers reporting to non-gatekeeping supervisors. The career impact of gatekeeping supervisors is focused on the managerial ladder. Indeed, those engineers reporting to gatekeeping supervisors have significantly fewer technical ladder promotions than those who reported to non-gatekeeping supervisors (Table II). Of the 21 professionals promoted technically, only one had been working for a gatekeeping supervisor. These results indicate that gatekeeping supervisors have an important, yet focused, effect on managerial career tracks of their subordinates. These results and those in Table I indicate that a supervisor’s prior gatekeeper status is a relatively more important determinant of their subordinate’s subsequent managerial promotion than is the supervisor’s managerial promotion.

The data also reveal a difference, in this organization, between the ages of
those promoted on the technical and managerial tracks. While there was a fairly uniform age distribution of engineers promoted to the technical side, ranging from the mid 20's to the mid 50's, this was not true of the managerial ladder. Almost 70 percent of those professionals

promoted managerially were in the 27 to 34 age group at the start of our study. Given these age effects on managerial promotion, Tables I and II were reanalyzed for this more homogeneous cohort.

<table>
<thead>
<tr>
<th>Promotion Track of Engineers as a Function of Their Supervisor's Gatekeeping Role</th>
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<tbody>
<tr>
<td>Supervisor’s Prior Role</td>
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<td></td>
</tr>
<tr>
<td>All Engineers (N = 213)</td>
</tr>
<tr>
<td>Engineers Whose Supervisor Was a Gatekeeper (N = 37)</td>
</tr>
<tr>
<td>Engineers Whose Supervisor Was Not a Gatekeeper (N = 176)</td>
</tr>
<tr>
<td>Significance Level</td>
</tr>
</tbody>
</table>

More than twice as many engineers within the 27 to 34 age range were promoted to the management side than to the technical side, 21.9 percent versus 9.4 percent (Table III). More importantly, there is an association between gatekeeping supervision and promotional outcomes for this cohort (Table III-A).
While only 14.9 percent of those not assigned to a gatekeeper were promoted managerially, almost three times as many professionals (41.2 percent) working for a gatekeeping supervisor received a managerial promotion. Almost half of the engineers receiving

| Promotion Track of Engineers as a Function of Their Supervisor's Gatekeeping Role and Promotion Record |
|-------------------------------------------------|-------------------------------------------------|
| All Engineers (N = 213)               | Proportion Promoted to:       |
|                                    | Technical | Managerial |
|                                    | Positions | Positions |
| 9.4%                                | 21.9%     |
| III-A Supervisor's Prior Gatekeeping Role |
| Engineers Whose Supervisor Was a Gatekeeper (N = 17) | 0 | 41.2 |
| Engineers Whose Supervisor Was Not a Gatekeeper (N = 47) | 10.6 | 14.9 |
| Significance Level | 0.10 | 0.05 |
| III-B Supervisor's Promotion Record |
| Supervisor Promoted Managerially (N = 30) | 6.7 | 30.0 |
| Supervisor Promoted Technically (N = 12) | 8.3 | 8.3 |
| Supervisor Not Promoted (N = 9) | 11.1 | 11.1 |
| Supervisor Left (N = 13) | 7.7 | 23.1 |
| Significance Level | N.S. | 0.10 |

Cohort Analysis based on engineers in the 27 to 34 age range in which 70 percent of the managerial promotions took place.

managerial promotions in the five year period had reported to a gatekeeping
supervisor. In sharp contrast, none of the engineers reporting to gatekeeping supervisors pursued (or were asked to pursue) the technical promotional alternative. Consistent with the data in Table II, for this younger cohort, gatekeeping supervisors have a strong impact on managerial careers, but they are inversely associated with technical promotion. Evidently, gatekeeping supervisors' networks are more focused on managerial/organizational as opposed to technical issues.

For this younger cohort, the results in Table III-B support hypothesis 1. Subordinates reporting to managers who were promoted managerially are promoted managerially significantly more frequently than those engineers who reported to supervisors not promoted managerially. Are these managerial promotion patterns driven by supervisory gatekeeper status or managerial promotion? Results in Table III indicate that, for this younger cohort, having a supervisor who is a gatekeeper is more likely to result in a managerial promotion than is the supervisor's own promotion experience. Only 30 percent of the engineers reporting to supervisors promoted managerially received a similar promotion. This reduced rate stems from the fact that only 15 percent of those professionals working for non-gatekeeping supervisors, who were promoted managerially, were themselves promoted to managerial positions. Gatekeeping supervision is by far the most instrumental factor for high rates of managerial promotion, fostering almost 80 percent of the managerial promotions received by individuals reporting to supervisors promoted managerially.
Project Task Characteristics

Hypothesis 3 argues that the effect of having a gatekeeping supervisor on managerial promotion would be accentuated in development projects. Hypothesis 3A argues that the impact of having one’s supervisor promoted on the technical ladder would have its greatest impact on the subordinate’s technical promotion in research projects. Tables IV and V replicate Tables I and III-A, but are analyzed by project area. Although sample sizes are small, in support of hypothesis 3A, the highest rate of technical promotion occurs for those individuals who worked on applied research projects for supervisors promoted on the technical ladder (Table IV). Almost 60 percent of these professionals received technical promotions over the five year period, a rate substantially higher than for engineers in the other 11 cells. In this organization, technical professionals promoted as individual contributors were working for supervisors who not only were not gatekeepers, but most were working for supervisors who were on the technical promotion track, especially in applied research settings. There are no effects of supervisory promotion patterns on technical promotion of subordinates in either development or technical service areas. As predicted, promotion on the technical ladder is only affected by the supervisor’s technical promotion in research areas.
Table IV

Proportion of Engineers Promoted on Technical Ladder as a Function of Their Supervisor's Promotion Record and Previous Type of Work

<table>
<thead>
<tr>
<th>Supervisor’s Promotion Record</th>
<th>Previous Type of Work:</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>All Engineers</td>
<td>25.0% (N=40)</td>
<td>5.7% (N=105)</td>
</tr>
<tr>
<td>Supervisor Promoted Managerially</td>
<td>11.1 (N=18)</td>
<td>4.6 (N=65)</td>
</tr>
<tr>
<td>Supervisor Promoted Technically</td>
<td>57.1 (N=14)</td>
<td>8.3 (N=12)</td>
</tr>
<tr>
<td>Supervisor Not Promoted</td>
<td>--- (N=0)</td>
<td>0 (N=7)</td>
</tr>
<tr>
<td>Supervisor Left</td>
<td>0 (N=8)</td>
<td>9.5 (N=21)</td>
</tr>
<tr>
<td>Significance Level</td>
<td>0.01</td>
<td>N.S.</td>
</tr>
</tbody>
</table>

Contrastingly but in support of hypothesis 3 with respect to managerial promotions, those professionals who had worked on development projects for gatekeeping supervisors received the highest rate of managerial promotion. Two-thirds of them were promoted to management positions (Table V). Although sample sizes are small, this promotion rate is significantly higher than the managerial promotion rates.
Table V

Proportion of Engineers Promoted on Managerial Ladder as a Function of Their Supervisor’s Gatekeeping Role, Promotion Record and Previous Type of Work

<table>
<thead>
<tr>
<th>Supervisor’s Promotion Record</th>
<th>Previous Type of Work:</th>
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<tbody>
<tr>
<td>V-A Supervisor’s Prior Gatekeeping Role</td>
<td></td>
</tr>
<tr>
<td>Engineers Whose Supervisor Was a Gatekeeper (N = 17)</td>
<td>33.3% (N=6)</td>
</tr>
<tr>
<td>Engineers Whose Supervisor Was Not a Gatekeeper (N = 47)</td>
<td>20.0% (N=10)</td>
</tr>
<tr>
<td>Significance Level</td>
<td>N.S.</td>
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V-B Supervisor’s Promotion Record

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</tr>
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<tbody>
<tr>
<td>Supervisor Promoted Technically</td>
<td>20.0% (N=5)</td>
<td>0 (N=7)</td>
<td>--- (N=0)</td>
</tr>
<tr>
<td>Supervisor Not Promoted</td>
<td>--- (N=0)</td>
<td>0 (N=4)</td>
<td>20.0% (N=5)</td>
</tr>
<tr>
<td>Supervisor Left</td>
<td>--- (N=0)</td>
<td>18.2% (N=11)</td>
<td>0 (N=2)</td>
</tr>
<tr>
<td>Significance Level</td>
<td>N.S.</td>
<td>0.10</td>
<td>N.S.</td>
</tr>
</tbody>
</table>

Cohort Analysis based on engineers in the 27 to 34 age range in which 70 percent of the managerial promotions took place.

for any other project or supervisory category (The rate in development, with a non-gatekeeping supervisor, for example was only 14.8 percent). As predicted, gatekeeping supervisors have no significant impact on managerial promotion patterns in either research or technical service areas. Table V-B indicates that the impact of supervisory promotion on managerial promotion rates of subordinates is
also limited to development areas. Evidently, the impact of a manager’s social and formal location on subordinate managerial promotion is sharply limited to development areas.

How does the influence of gatekeeping supervisors compare with the effects of non-gatekeeping supervisors promoted managerially in development? While two-thirds of those individuals reporting to gatekeeping supervisors were promoted to management, less than 20 percent of those reporting to non-gatekeeping supervisors promoted managerially were similarly promoted. This is a difference of almost 50 percent. Gatekeeping supervisors have considerable impact on managerial promotion rates of their technical subordinates, especially in development.

Communications

These findings demonstrate the influence of supervisors’ careers on subordinate promotional outcomes within particular project areas. What are the underlying processes by which supervisors affect their subordinate’s promotion patterns? Hypothesis 4 argues that gatekeeping supervisors affect laboratory and corporate communication networks of their subordinates which, in turn, increase managerial career opportunities. These effects are hypothesized to be accentuated in development projects.

The data show the strong influence of supervisory gatekeepers on the communication networks of their subordinates in development and technical service projects (Table VI). For these types of project, engineers reporting to gatekeepers have significantly more contact with their departmental colleagues and their
gatekeeping supervisors than engineers working for non-gatekeeping supervisors. They also have two to four times as much contact with their departmental managers. Of perhaps greater importance, however, is the finding that in development projects, technical professionals assigned to gatekeeping supervisors had considerably more interaction with other functional areas of the corporation than engineers assigned to non-gatekeeping supervisors. Such cross-functional activity has been shown by numerous researchers (e.g., Souder, 1985; Cooper, 1987) to be crucial in the new product development process. Gatekeeping supervisors have no impact on the communication networks of subordinates in research projects.

In development and technical service projects, gatekeeping supervisors strongly promote the hierarchical and cross-functional integration of their technical staffs. Thus, it may not be the assignment of technical professionals to gatekeepers, per se, that enhances managerial promotion. What may drive the managerial promotion pattern in development is the strong communications (i.e., departmental, hierarchical, and crossfunctional networks) that are established with critical information areas as a consequence of working with gatekeeping supervisors.
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<tr>
<td>Departmental Colleagues</td>
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<tr>
<td>Engineers Whose Supervisor Was a Gatekeeper</td>
<td>84.8</td>
<td>158.6**</td>
<td>112.4**</td>
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<tr>
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<td>82.6</td>
<td>97.2**</td>
<td>79.2**</td>
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<td>31.8</td>
<td>27.6</td>
<td>16.1</td>
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<td>24.2</td>
<td>22.8</td>
<td>13.9</td>
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<td>Immediate Supervisor</td>
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<tr>
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<td>25.3</td>
<td>29.6*</td>
<td>28.6**</td>
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<tr>
<td>Engineers Whose Supervisor Was Not a Gatekeeper</td>
<td>26.1</td>
<td>23.2*</td>
<td>19.6**</td>
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<td>Departmental Manager</td>
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<tr>
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<td>5.6</td>
<td>9.8**</td>
<td>12.6***</td>
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<td>Engineers Whose Supervisor Was Not a Gatekeeper</td>
<td>4.3</td>
<td>4.7**</td>
<td>3.0***</td>
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<tr>
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<td>36.2***</td>
<td>17.4</td>
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<td>6.4</td>
<td>14.1***</td>
<td>19.8</td>
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<td>1.8</td>
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<td>2.6</td>
<td>1.6</td>
<td>0.9</td>
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The statistical significance of differences between mean levels is noted as follows:

* p < 0.10; ** p < 0.05; *** p < 0.01
The data in Tables I to VI show the effects of supervisory promotion and supervisory gatekeeper status on subordinate managerial and technical promotion patterns by task area. To further assess the relative strengths of supervisory promotion, gatekeeper status, and task area on managerial and technical promotion discriminant analysis was employed. Consistent with results reported above, this analysis indicates that supervisory technical promotion is significantly associated with subordinate promotion on the technical ladder and that this effect is accentuated in research projects (Table VII). On the other hand, managerial promotions are driven by gatekeeping supervisors. These managerial promotion effects are accentuated in development projects. Since gatekeeping supervisors were almost always promoted on the managerial ladder in this laboratory, we are unable to empirically untangle managerial promotion from gatekeeper effects.
<table>
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<tr>
<th><strong>Table VII</strong></th>
<th><strong>Discriminant Analyses</strong></th>
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<td><strong>Dependent Variable</strong></td>
<td><strong>Independent Variables</strong></td>
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<tr>
<td>Engineer Promoted to Technical Ladder</td>
<td>0.28***</td>
</tr>
<tr>
<td><strong>Chi Squared</strong> = 33.8; df = 3; p &lt; 0.001. Proportion correctly classified = 89.5%</td>
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<tr>
<td>Engineer Promoted to Gatekeeper Development</td>
<td>0.53***</td>
</tr>
<tr>
<td><strong>Chi Squared</strong> = 10.9; df = 3; p &lt; 0.05. Proportion correctly classified = 79.6%</td>
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</table>

All variables are (0,1) Dummy Coded with Yes = 1 and No = 0. Standardized Canonical Discriminant Function Coefficients are shown in each cell with the following significance levels indicated: *p < 0.10; **p < 0.05; ***p < 0.01

**DISCUSSION**

The research findings indicate that relationships and contacts taking place within a given organizational context have important effects on the dynamics of a dual ladder system. Professionals may not have well-defined preconceived notions of success upon graduation; instead, their careers and perceptions develop from their organizational experiences. In particular, our results suggest that supervisors play a strong role in shaping the professional’s outlook toward the dual ladder system.
There were very different patterns of influence on the promotion of individuals to the technical and managerial ladders. Those supervisors who were promoted on the technical ladder strongly affected their subordinates who tended to follow that path, especially if they were working in applied research. Very few managerial promotions took place for professionals reporting to supervisors promoted technically. In fact, only three such promotions occurred within this facility over the five years.

Past research also shows that supervisors promoted technically are less well integrated into the communication networks of their organizations than their managerially promoted counterparts (Cf., Allen and Katz, 1989; Gouldner, 1957). If these supervisors are also strongly instrumental in the socialization of those professionals who follow them to the technical side, then it is likely that such isolation will become self-sustaining. Perhaps this is a reason why so many companies feel that those on the technical ladder are disconnected from what is going on in the larger organization. If the technical ladder involves greater freedom over what one does, and if those on the ladder have less interaction with others in the organization, the tendency may be to choose work that is even less interdependent, thereby accentuating the separation between technological and organizational domains.

Engineers who had gatekeeping supervisors were more likely to assume management positions than those whose supervisors were not gatekeepers. This is especially true for younger engineers and for engineers working in product and process development where the managerial promotion rate for professionals assigned to gatekeepers was more than four times the promotion rate of those not
assigned to a gatekeeping supervisor. While supervisory promotion on the managerial ladder is also associated with subordinate managerial promotion, gatekeeper status is relatively more important than supervisory managerial promotion in facilitating a subordinate’s managerial career.

Why are gatekeepers so strongly related to high levels of managerial promotion for their technical subordinates? Is it the effect of their technical talents, their interpersonal skills, or their relatively strong connections to outside RD&E professionals? While these are important characteristics of gatekeepers, our communication network results suggest that gatekeeping supervisors are related to higher rates of managerial promotion because they greatly enhance the communications and connections of their technical subordinates, particularly their hierarchical and cross-functional networks. It is these high levels of activity that discriminates between engineers reporting to gatekeeping supervisors and those not reporting to gatekeeping supervisors. These high levels of work-related contact and involvement with key information areas and relevant managers help guide and sponsor the work of engineers who report to gatekeeping supervisors.

In product and process development work especially, gatekeepers are highly influential individuals who significantly enhance project performance by effectively connecting engineers to more useful ideas and information outside the project. Technical professionals working for such individuals, therefore, are likely not only to have better access to critical information, but also better opportunities for more significant work and visibility in the organization. Because they are well-connected professionally and organizationally, gatekeepers in development projects are also likely to provide technical professionals with a more balanced and accurate
understanding of the organization's expectations and commercial focus. Such higher-quality exchanges help engineers penetrate the organization's political and technical cultures, making it easier for them to access resources, operations, and local experience necessary to carry out their work. It is these kinds of advantages which may, in turn, lead to higher rates of managerial promotion.

Why are these communication networks so critical in RD&E? As discussed by Allen (1984), much of the effort in RD&E involves dealing with the organization's localized technologies. To do this effectively, technical professionals need more than academic or universal information. In development settings, professionals must rely heavily on more experienced people within the organization for knowledge, information, and guidance to solve the firm's particular technical problems.

In R&D, engineers discover that their problems are often ambiguous and ill-defined. Often, information they need is unknown or diffused throughout the organization, and problems are rarely totally solvable (Cf., Allen, 1984; Rosenbloom and Wolek, 1970). In these kinds of non-routine and uncertain environments, professionals have to establish credibility and build information networks to execute and complete their task. Although engineers are expected to seek advice from their more senior and experienced colleagues, they are particularly hesitant to acknowledge their weaknesses or approach colleagues they do not know for help and assistance (Gerstberger, 1974). According to Allen (1984), engineers will not necessarily use optimal sources of information; instead, they will function to minimize the psychological cost of their interactions by not taking personal risk or calling into question their knowledge and abilities. Because
they are interpersonally and technically competent and are able to communicate so effectively across organizational boundaries, gatekeepers may be particularly important in helping professionals establish contacts and networks to information areas that are critical but difficult to approach. These processes facilitate more effective work contacts for technical professionals reporting to gatekeeping supervisors which, in turn, may lead to higher performance and better chances of managerial promotion.

IMPLICATIONS AND CONCLUSIONS

The data indicate that supervisors have an important effect on career outcomes of their subordinates. The data also illustrate concerns which can emerge in a dual ladder system if these influence patterns become restrictive. Technical professionals in this organization, for example, who value a managerial career but who find themselves working for supervisors moving up the technical ladder may feel frustrated as they see less support for their career choice. Similar dissatisfaction could emerge for those professionals wishing to remain individual contributors but who find themselves working for supervisors who favor the managerial hierarchy. In a dual ladder system, mismatches between career needs of supervisors and subordinates need to be remedied if the laboratory is to utilize fully the talents of their technical workforce across the full spectrum of RD and E activity.

These contrasting effects of supervisory promotion and gatekeeper status on subordinate promotion patterns help us to understand some of the barriers between research and development areas (Allen, 1984; Allen and Katz, 1989). If technical
managers pull their subordinates up the technical ladder and if gatekeeping supervisors are promoted managerially and, in turn, pull their subordinates up the managerial ladder, then the underlying dynamics of dual ladders might work to isolate the different ladders from each other. These informal processes may work to meet professional needs of supervisors and subordinates but at a cost to the linkage and integration so important to effective product/process development (e.g. Imai et al., 1985).

Much of the controversy surrounding dual ladders revolves around the issue of power: those on the management side have it; those on the technical side do not (Allen and Katz, 1989). The promotional patterns revealed in this study highlight part of this problem. Given the important organizational and technical roles that gatekeepers play, they represent a strong source of both formal and informal power. It makes sense, therefore, that the ladders these individuals choose to follow will greatly affect the allocation of power. In this organization, all but one of the technical gatekeepers were promoted to the management track. Such a one-sided situation is probably not conducive to an equitable distribution of power across the two ladders. How gatekeepers are promoted and distributed between the two ladders may be very critical to the balance of power between the two ladders and in turn, to the organization's performance.

Finally, while this study reports important differences in career outcomes driven by supervisory promotion patterns and gatekeeper status, the study has several limitations. In a longitudinal field study of this sort, random assignment of engineers to supervisors is not possible. Although the arguments presented here emphasize the direct roles that supervisors play in influencing professionals'
careers, it is also possible that supervisors either attracted or were assigned engineers who were more likely to follow particular promotional paths. In addition, data were not collected on how long individuals worked for their respective supervisors or on other supervisory, project, or career-related experiences. Readers must also be cautioned that all of the analyses presented in this paper may be idiosyncratic to this organization. Nevertheless, it is through studies of the present sort that we will learn more about the impacts of supervisory and gatekeeper status on subordinate promotion along alternative paths of dual ladders. Such research will both increase our understanding of socialization processes in professional settings and improve management of dual ladders.

FOOTNOTES

1. Although there is much literature to suggest that scientists and engineers are different (Allen, 1988), we will use "engineer" in the remainder of this paper to refer to all technical professionals.

2. Although this gatekeeping supervisor is now on the technical side in fact, he was originally promoted to the management side but was later shifted to the technical ladder. As discussed by Allen and Katz (1988), this is a common problem in dual ladder systems when it leads to perceptions that the technical side is a "dumping ground" for unsuccessful managers. Such perceptions would aggravate the power differences between the sides of the dual ladder.
REFERENCES


