Project Performance and the Locus of Influence in the R&D Matrix

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ABSTRACT

This study examines the relationship between R&D project performance and the relative influence of project and functional managers across 86 matrixed teams in nine different research and development organizations. Performance relationships are investigated for three areas of influence within the project team as well as for influence in the overall organization. Analyses show higher project performance when influence over salaries and promotions is perceived as balanced between project and functional managers. Performance reaches its highest level, however, when organizational influence is centered in the project manager and influence over technical details of the work is centered in the functional manager.
INTRODUCTION

The matrix structure was first developed in Research and Development organizations in an attempt to capture the benefits and minimize the liabilities of two earlier forms of organization. Both project and functional organizations have well known advantages and disadvantages (Marquis, 1969; Kingdon, 1973; Allen, 1977). The functional alternative, in which departments are organized around disciplines or technologies, enables engineers to stay in touch more easily with new developments in those disciplines or technologies. It has, on the other hand, the disadvantage of creating separations between technologies, making interdisciplinary projects more difficult to coordinate.

The project form of organization overcomes this problem by grouping engineers together on the basis of the problem or project on which they are working, regardless of discipline. Although it makes the coordination and integration of multidisciplinary efforts easier to achieve, the project structure removes individuals from their disciplinary departments. This detachment makes it more difficult for professionals to keep pace with the most recent developments in their underlying disciplines and results in poorer performance on longer-term technical efforts (Marquis & Straight, 1965).

Forces Inherent in the Matrix

The matrix, by creating an integrating force in a program or project office, attempts to overcome the divisions that are inherent in the basic functional structure. In the matrix, project or program managers and their staff are charged with the responsibility of integrating the efforts of engineers who draw upon a variety of different disciplines and
technical specialties in the development of new products or processes (Galbraith, 1973). The managers of functional departments, on the other hand, are responsible for making sure that the organization is aware of the most recent developments in its relevant technologies, thereby insuring the technical integrity of products and processes that the program or project office is attempting to develop.

This situation often leads to conflict between the two arms of the matrix. Project managers are often forced by market needs to assume the shorter range view of the marketing function (cf. Lawrence & Lorsch, 1967). Since they are responsible for developing a product that can be successfully produced and marketed, project managers take on a perspective that is sometimes more closely aligned to that of marketing or manufacturing than to the perspective held in the research and development organization. Functional department heads, with their closer attachment to underlying technologies, are inclined to take a longer term view and consequently, may be more concerned with the organization's capability to use the most up-to-date technologies than with meeting immediate customer needs.

Both of these issues are necessary to the survival of the organization. Someone has to be concerned with getting new products out into the market, and someone has to be concerned with maintaining the organization's long run technical capability to develop and incorporate technical advancements into future products. Research and development organizations, no matter how they are organized, always have both of these concerns. The matrix structure merely makes them explicit by vesting the two sets of concerns in separate managers.
In formalizing these two distinct lines of managerial influence, the R&D organization is generating "deliberate conflict" between two essential managerial perspectives as a means of balancing these two organizational needs (Cleland, 1968). Project managers whose prime directive is to get the product "out the door" are matched against functional managers who tend to hold back because they can always make the product "a little bit better", given more time and effort (Marquis, 1969; Allen, 1977). When these two opposing forces are properly balanced, the organization should achieve a more optimum balance both in terms of product completion and technical excellence. Unfortunately, a balanced situation is not easy to achieve. Often one or the other arm of the matrix will dominate, and then, what appears to be a matrix on paper becomes either a project or a functional organization in operation.

The net effect of matrixed forces on project performance is realized principally by their influence over the behaviors and attitudes of individual engineers. It is the engineers who perform the actual problem solving activities that result in new products or processes. It is they who ultimately determine the form of solution. How engineers view the relative power of project and functional managers over their work lives will strongly influence how they perform their jobs.

Individuals accrue power within organizations by controlling critical resources and by influencing critical problem solving activities and decisions (Salancik & Pfeffer, 1979). In any organization, including those with matrixed relationships, employees attend more to those managers who have more influence over technical strategies, resources, reward and promotional decisions, and the staffing of projects (Allen, 1977; Pelz and Andrews, 1976; Oldham, 1976). From the engineer's point
of view, then, managers will be seen as powerful and important to the extent that they influence the detailed technical decisions of the engineer's project work, determine his salary and promotional opportunities, and control his assignment to particular project activities. These are three critical areas in which project and functional managers contend for influence, for it is through these supervisory roles that each side of the matrix attempts to motivate and direct the engineer's efforts and performance (Kingdon, 1973). And the degree to which each side of the matrix is successful in building its power within the R&D organization will have a strong bearing on the outcomes that emerge from the many interdependent project activities (Wilemon and Gemmill, 1971).

Although a great deal has recently been written about matrix organizations (e.g., Souder, 1979; Hill and White, 1979), very little is actually known about the effectiveness of these structures (Knight, 1976). In particular, there has been no research that systematically deals with the relationships between project performance and the distribution of power and influence within the organization. Where should the locus of influence lie between project and functional managers along the more critical dimensions of supervisory influence? Will a balance in power between project and functionally oriented forces result in higher project performance? In an attempt to answer these questions, the present study examines the relationships between project performance and the relative dominance of project and functional managers for 86 matrixed project teams from nine different technology-based organizations.
HYPOTHESES

Details of Project Work

This is the arena in which matrixed project and functional interests are most likely to come into direct conflict. The project manager has ultimate responsibility for bringing the new product into being and is, therefore, intimately concerned with the technical approaches used in accomplishing that outcome. However, if the project side of the matrix is allowed to dominate development work, two quite different problems can develop. At one extreme, there is the possibility that sacrifices in technical quality and long term reliability will be made in order to meet budget, schedule, and immediate market demands (Knight, 1977). At the other extreme, product potential is often oversold beyond the organization's current technological capability. Both of these errors are more likely to occur when the project side of the matrix dominates technical decisions.

To guard against these shortcomings, functional managers can be held accountable for the overall integrity of the product's technical content. If the functional side of the matrix becomes overly dominant, however, then the danger is that the product will include not only more sophisticated but also perhaps less proven and more risky technology. This desire to be technologically aggressive — to develop and use the most attractive, most advanced technology — must be countered by forces that are more sensitive to the operational environment and more concerned with moving developmental efforts into final physical reality (Mansfield and Wagner, 1975; Utterback, 1974).
To balance the influence of both project and functional managers over technical details is often a difficult task. While an engineer may supposedly report to both managers in a formal sense, the degree to which both managers are actively influencing the direction, clarification, or the pursuit of technical details and solution strategies will vary considerably from project to project, depending on the ability and willingness of the two managers to become involved in details. Although involvement depends, at least in part, on one's understanding of the relevant technology and its application, project performance should be higher when the perspectives of both sides can be taken into account. Accordingly, the following is hypothesized:

H1: Project performance will be higher when both project and functional managers are seen to exert equal influence over the detailed technical work of matrixed engineers.

Salaries and Promotions

Advocates of matrix organizations (e.g., Kingdon, 1973; Sayles, 1976; Davis and Lawrence, 1977) have long agreed on the importance of achieving balanced influence over salary and promotion decisions. Both Knight (1976) and Goggin (1974) explicitly emphasize that matrix organizations require matching control systems to support their multidimensional structures; otherwise, they would be undermined by reward systems that are based on assumptions of unitary authority. The underlying argument is that should the engineer view either his project or functional manager as having more control over his chances for salary increase and promotion, then that manager alone is more likely to influence and direct the engineer's behaviors and priorities.

This is one of the key issues in what are often described as "paper matrix" situations: management assumes that by drawing overlapping
structures and by prescribing areas of mutual responsibility, balance will be achieved along appropriate supporting management systems. In practice, however, one of the two components of the matrix comes to dominate or appears to dominate in key areas such as determination of salaries and promotions. It is important to stress here that it is the engineer's perception that counts. Both sets of managers may be equally influential in determining the actual pay increase. If only one manager, the department head for example, calls the engineer into his office to announce the raise, the project manager's involvement will not be apparent and the engineer will come to believe that it is only the department head who counts. Engineers can acknowledge and recognize the existence of two lines of reporting, but unless they see both managers controlling their progress in terms of income and status, there will be a natural tendency for them, particularly in conflict situations, to heed the desires of one manager to the neglect of the other. The matrix then ceases to function, resulting in a structure that is more likely to resemble the pure project or functional form of organization despite any "paper" claims to the contrary.

Given that management has decided on a matrix form and that engineers recognize its existence, higher performing projects should be those in which engineers see both project and functional managers involved in the determination of their salaries and promotions. It is therefore hypothesized that:

H2: Project performance will be higher when both project and functional managers are seen to exert equal influence over the promotions and rewards of matrixed engineers.
Personnel Assignments

Personnel assignments often provide the focus for the priority battles that frequently afflict matrix organizations. With the pressure on them from both management and customers to produce, project managers often find themselves in tight competition for the resources necessary to provide results (Knight, 1977; Steiner and Ryan, 1968). One of the most critical of these resources is technical talent. Each functional department employs engineers of varying technical backgrounds, experiences, and capabilities (Allen and Cohen, 1969). Every project manager learns quickly which engineers are the top performers and naturally wants them assigned to his project. As a result, there develops an intense rivalry among project managers, each attempting to secure the most appropriate and most talented engineers for his project (Cleland and King, 1968). Functional managers, on the other hand, have a somewhat different motivation. They usually have no difficulty finding budget to support their top performers, but they have to keep all of their engineering staff employed. They therefore find themselves in the position of trying to market the services of their less talented engineers to project managers.

At this point a distinction must be made between performance at the project level and performance at the level of the entire R&D organization. Organizational performance might be higher when influence over this set of decisions is shared equally by project and functional managers. Performance of a single project will probably be higher when that project's manager had greater influence over personnel assignments, since presumably that project will then obtain the best talent. Since the performance measure used in this study is at the project level, and
realizing that high individual project performance may be sub-optimal for the organization, it will be hypothesized that:

H3: Project performance will, on the average be higher when project managers are seen to exert greater influence over personnel assignments to the projects.

Organizational Influence

In addition to the supervisory functions that go on within a project group, considerable research has shown that managers of high performing projects are also influential outside their project teams (e.g., Katz and Allen, 1982; Likert, 1967; Steiner and Ryan, 1968; Pelz, 1952). According to these studies, managers affect the behaviors and motivations of subordinates not only through leadership directed within the project group but also through their organizational influence outside the project (Katz and Tushman, 1981; Pfeffer, 1978). The critical importance of organizational influence on project outcomes has also been confirmed by many studies of technological innovation (e.g., Achilladelis, et. al., 1971; Myers and Marquis, 1969). In almost every instance, successful innovation required the strong support of organizationally powerful managers who could provide essential resources, mediate intergroup conflicts, and who were sufficiently well positioned to protect the developmental effort from sources of outside interference.

Based on these findings, if either of the two arms of the matrix is seen to have greater power in the organization at large, then the engineers' behavior should also be affected, particularly in situations of conflict. Engineers want to be on the "winning team" (Cf. Kidder, 1981). It is expected, therefore, that perceived organizational influence will be an important determinant of what actually occurs in the project, for an imbalance in organizational influence would result in
engineers paying greater attention and attributing greater importance to the more powerful side of the matrix.

This does not mean that the locus of organizational influence necessarily determines the loci of influence over work, pay, and assignments. There may be, for example, many instances in which the less organizationally powerful manager exerts greater influence over one of the other dimensions. Such incongruences place matrixed engineers in uncomfortable positions, particularly if there is strong disagreement between their two managers. As discussed by Allen (1966), discomfort over technical direction can often lead to postponement of critical technical decisions and a failure to narrow the scope of technical alternatives under consideration, resulting in lower project performance. From an exploratory standpoint, therefore, our research examines two important questions involving perceptions of organizational and project work influence. First, is there a strong association between organizational influence and the relative dominance of project and functional managers over the rewards, personnel assignments, and technical work of matrixed engineers? And secondly, to what extent do these dimensions of organizational and internal dominance interact to affect project performance? Do they independently relate to project performance or do they interact in determining performance?
Setting

The data presented in this paper derive from a study of R&D project teams in nine major U.S. organizations. Although the selection of participating organizations could not be made random, they were chosen to represent several distinct work sectors and markets. Two of the sites are government laboratories; three are not-for-profit firms receiving most of their funding from government agencies. The four remaining companies are in private industry: two from the aerospace industry, one in electronics, and one in food processing.

In each organization, initial meetings were held with higher level research and development managers in order to understand how the R&D organization was structured, to identify the project assignments of all R&D professionals, and to learn the multiple reporting relationships and managerial and technical titles of all project members. Short meetings were then scheduled with the professionals assigned to the projects to explain the broad purposes of our study, to solicit their voluntary cooperation, and to distribute questionnaires to each professional individually.\(^1\) To insure the accuracy of data on project assignments, respondents were told to answer all questions in terms of the project assignment identified on the questionnaire’s front page. If this was incorrect or not up-to-date, they replaced it with their correct project assignment. Questionnaires were also tailored to the particular reporting structure with language appropriate to each project group.

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\(^1\) This personalized distribution was necessary to insure that each engineer received the correct questionnaire form. It probably had the additional side benefit of increasing the response rate.
Project managers, functional managers, and staff engineers and scientists received slightly different questionnaires reflecting their different positions. Project managers, for example, were not given questions about themselves or about the functional managers of any of their matrixed staff.

Individuals were asked to complete the questionnaires as soon as reasonably possible. Stamped, return envelopes were provided so that completed forms could be mailed to the investigators directly. These procedures not only insure voluntary participation, but they also enhance data quality since respondents must commit their own time and effort. Response rates across organizations were extremely high, ranging from 82 percent to a high of 96 percent.

Although these procedures yielded over 2,000 respondents from 201 project teams, over half of the projects were not organized in a matrix. Furthermore, few of the projects were totally matrixed in the sense that all engineers and scientists had dual reporting relationships to both project and functional managers. Only those projects in which 20 percent or more engineers in a pure matrix arrangement will be used in this analysis. This gives a total of 86 projects.\(^2\) Respondents are considered to be part of a matrix structure when they report formally to separate project and functional managers, and when these two managers have no direct reporting relationship between them. There were 486 matrixed engineers working on these 86 projects, an average of almost six matrixed engineers per project.

\(^2\) On any particular question, the number of project teams from which complete data were obtained ranged from 63 to 86.
Matrixed Relationships

Respondents were asked to indicate (on seven-point, Likert-type scales) the degree to which their project and functional managers influenced: 1) the technical details of their project work; 2) their salary increases and promotions; 3) their selection to work on the project; and 4) the overall conduct of the organization. For each of these dimensions influence, scale responses ranged from a "1" for "my project manager dominates" to a "7" for "my functional manager dominates"; the middle point, "4", indicating that influence was balanced between the two. For each question, individual member responses were averaged to calculate overall project scores for the four influence areas and only the responses of matrixed project members were used. As described by Katz and Tushman (1979), analysis of variance methods were used on all aggregated measures to insure the validity of combining individual perceptions to derive project scores. For each dimension of influence, lower scores will be taken to indicate project manager dominance and higher scores to indicate functional manager dominance.

Project Performance

Since comparable measures of objective performance have yet to be developed across different technologies, a subjective measure was used similar to that of Lawrence and Lorsch (1967) and Katz and Tushman (1981). In each organization, project performance was measured by interviewing higher level management and asking each manager (at least one hierarchical level above the project and functional managers) to indicate on a five-point, Likert-type scale whether a project team was performing above, below, or at the level expected of them. Each manager
was asked to evaluate only those projects with which he was personally familiar and knowledgeable. Evaluations were made by individual managers independently and submitted confidentially to the investigators. On the average, each project was evaluated by between four and five managers. More importantly, the evaluations show a very strong internal consensus within each organization (Spearman-Brown reliabilities range from a low of 0.74 a high of 0.93). It was therefore deemed safe to average ratings of individual managers to yield reliable project performance scores. To clarify the distinction between higher and lower project performance, scores were normalized to a mean of zero from the original sample mean of 3.32.

RESULTS

As previously explained, matrixed engineers' responses were averaged to classify projects on the degree to which project or functional managers exerted influence over each of four activity areas. To examine the way in which influence was distributed, project scores from 1 to 3 were coded as signifying dominant influence by the project manager while scores from 5 to 7 were taken to indicate functional manager dominance. Intermediate values from 3 to 5 were considered as balanced.

The locus of influence, as shown in Table I, varies considerably both among projects and across dimensions of influence. The influence over technical details of work and personnel assignments are balanced in the majority of cases. In sharp contrast, over half of the functional managers are seen to have greater influence over salaries and promotions. Functional managers are viewed as controlling these rewards
in almost 60 percent of the projects; project managers in only 7 percent. One must remember once again that it is the matrixed engineers' perceptions of the situation that is being measured, for it is perceived reality, not the reality itself, that influences engineers' behavior.

Table I

Distribution of Managerial Influence By Area As Perceived By Project Members

<table>
<thead>
<tr>
<th>Area of Influence</th>
<th>Locus of Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Functional manager</td>
</tr>
<tr>
<td>1) Internal Areas of Influence</td>
<td></td>
</tr>
<tr>
<td>a) Technical content of project work</td>
<td>13.1%</td>
</tr>
<tr>
<td>b) Salaries and promotions</td>
<td>58.3</td>
</tr>
<tr>
<td>c) Personnel assignments</td>
<td>29.5</td>
</tr>
<tr>
<td>2) External Organizational Influence</td>
<td>30.8</td>
</tr>
</tbody>
</table>

Note: N varies by area of influence because some questions were not included in early versions of the questionnaire.

Project managers may in fact have equal influence over salaries and promotions, but unless this is clearly apparent to the engineer, it will not affect his behavior.

Organizational influence, in contrast, was almost equally distributed across the three influence categories; 31 percent of the projects having a more dominant functional side, 31 percent having a more dominant project side, and 38 percent having a reasonably balanced situation.
Because the projects under investigation come from government, non-profit, and industrial organizations, it is also important to see if there are major differences across these sectors. Generally speaking, there are no significant differences in the distributions of managerial influence for the dimensions of project work details and personnel assignments. In each sector, the distributions are consistent with the percentages reported in Table I. The other two loci of influence, on the other hand, vary to some degree with the type of organization. Influence over salaries and promotions is more likely to be balanced in industrial organizations (almost 50 percent of the projects) while project managers have more influence over rewards in almost 43 percent of the projects in government settings. Functional managers, in sharp contrast, dominate rewards in over 80 percent of the projects in the not-for-profit organizational sector.

With respect to organizational influence, matrixed engineers see their project managers as stronger in over half of the projects in both industrial and government organizations. Once again, however, functional managers have greater power in the not-for-profit sector, for almost half of the functional managers are seen as having considerably more influence within their organizations than their project management counterparts.

None of these organizational variations is terribly surprising. The not-for-profits with their somewhat more academic, research orientation place greater emphasis on the disciplines and functional managers are therefore accorded more power within these settings. In industry and government, there is a stronger orientation toward project management, since in both instances there is a clear-cut product or system that must be brought into being. Project managers, therefore, tend to be given
greater organizational influence and this allows them to have a stronger voice in salary and promotion policies, as well.

Project Performance

Based on the above distributions, it is very clear that the degree to which project or functional managers exert influence differs considerably across projects. Locus of influence also differs for each dimension of influence. The next step, therefore, is to test our hypotheses by seeing how project performance varies with locus of influence on each dimension. To examine the proposed relationships, an analysis of covariance is performed on each dimension of internal project influence. In each case, project performance is the dependent variable while the categories of managerial dominance and balance (i.e., the locus of influence) represent independent levels of variation. Since the number of engineers reporting in a matrix format differs substantially across the projects, the number of matrixed engineers within each project is used as a covariate.

Technical Details of Project Work. To test the extent to which project performance varies with locus of influence over the technical of project work, the performance means are broken down by each of the Likert scale intervals (Table II). Performance does not vary significantly with the locus of influence over technical content. Although there is a slight tendency toward higher performance with moderately high influence by the project manager or with strong influence by the functional manager, neither of these tendencies is significant and the latter result stems from only two, relatively small, development projects. In any event, balanced involvement on the part of both arms of the matrix is not related to higher project performance. Hypothesis one is not supported by the present data.
Salaries and Promotions. In the area of salaries and promotions, the ANOVA results of Table III show that project performance varies significantly across the locus of managerial influence. The mean performance levels in Table III indicate that project performance is highest when influence is either balanced or when project managers are viewed as controlling organizational rewards, albeit there are only four project cases in this latter category. Nevertheless, mean performance is significantly lower when functional managers are seen by matrixed project members as having a more influential say over their salaries and promotion opportunities.
Table III

Project Performance as a Function of the Locus of Influence Over Salaries and Promotions

<table>
<thead>
<tr>
<th>Scale Values</th>
<th>Locus of Influence</th>
<th>Number of Projects</th>
<th>Mean Project Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 2</td>
<td>Project manager</td>
<td>4</td>
<td>0.78</td>
</tr>
<tr>
<td>2 - 3</td>
<td></td>
<td>2</td>
<td>-0.37</td>
</tr>
<tr>
<td>3 - 4</td>
<td>Balanced</td>
<td>9</td>
<td>-0.08</td>
</tr>
<tr>
<td>4 - 5</td>
<td>Balanced</td>
<td>20</td>
<td>0.57</td>
</tr>
<tr>
<td>5 - 6</td>
<td>Functional manager</td>
<td>12</td>
<td>-0.39</td>
</tr>
<tr>
<td>6 - 7</td>
<td></td>
<td>37</td>
<td>-0.23</td>
</tr>
</tbody>
</table>

ANOVA:

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>df</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influence over salaries</td>
<td>5</td>
<td>2.79</td>
<td>0.02</td>
</tr>
<tr>
<td>Size of project</td>
<td>1</td>
<td>2.65</td>
<td>N.S.</td>
</tr>
<tr>
<td>Interaction</td>
<td>5</td>
<td>2.00</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Because the distribution of projects along the influence continuum is so highly skewed towards functional control, Tukey's (1977) smoothing procedures were also used to obtain a more meaningful picture of the association between project performance and the locus of managerial influence over salaries and promotions. An examination of the resulting plot of smoothed performances (Figure 1) reveals a fairly regular pattern of decreasing performance with increasing functional control over monetary and career rewards. In support of hypothesis 2, therefore, one can conclude from both Table III and Figure 1 that project performance is a direct function of the degree to which project managers are seen co-influencing the salaries and promotions of their matrixed subordinates.
LOCUS OF INFLUENCE OVER SALARIES AND PROMOTIONS

FIGURE I. SMOOTHED PROJECT PERFORMANCE AS A FUNCTION OF LOCUS OF INFLUENCE OVER SALARIES AND PROMOTIONS SMOOTHED BY 3RSSH METHOD USED TWICE (TUKEY, 1977)
Personnel Assignments. Project performance does not vary significantly with the locus of influence over personnel assignments (Table IV). Although we hypothesized that project performance would be higher when these decisions are balanced between matrixed engineers' project and functional managers, this does not turn out to be the case—at least not to the extent that its effects can be seen across all project groupings. It is interesting to note, however, that the lowest performing set of projects are those in which the functional managers are seen as controlling the allocation of project personnel.

Table IV

<table>
<thead>
<tr>
<th>Scale Value</th>
<th>Locus of Influence</th>
<th>Number of Projects</th>
<th>Mean Project Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 2</td>
<td>Project manager</td>
<td>5</td>
<td>0.02</td>
</tr>
<tr>
<td>2 - 3</td>
<td></td>
<td>5</td>
<td>0.06</td>
</tr>
<tr>
<td>3 - 4</td>
<td>Balanced</td>
<td>17</td>
<td>0.01</td>
</tr>
<tr>
<td>4 - 5</td>
<td>Balanced</td>
<td>16</td>
<td>0.17</td>
</tr>
<tr>
<td>5 - 6</td>
<td>Functional manager</td>
<td>15</td>
<td>-0.59</td>
</tr>
<tr>
<td>6 - 7</td>
<td></td>
<td>3</td>
<td>0.45</td>
</tr>
</tbody>
</table>

ANOVA:

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Df</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influence over personnel</td>
<td>5</td>
<td>1.03</td>
<td>N.S.</td>
</tr>
<tr>
<td>assignments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size of project</td>
<td>1</td>
<td>1.90</td>
<td>N.S.</td>
</tr>
<tr>
<td>Interaction</td>
<td>5</td>
<td>0.87</td>
<td>N.S.</td>
</tr>
</tbody>
</table>
Organizational Influence. To what extent is organizational influence associated with the three measures of internal influence within the project? The correlations in Table V show that the locus of organizational influence is very closely related to the locus of influence over salaries and promotions and to the locus of influence over personnel assignments. The way in which matrixed engineers view the relative power of project and functional managers within the organization is not independent of how they view their managers' relative power over organizational rewards and staffing decisions. The locus of organizational influence is, however, independent of how matrixed members see their project and functional managers influencing the technical content of their work details. The correlation between these two areas of influence is very close to zero.

Table V

<table>
<thead>
<tr>
<th>Correlation of Organizational Influence with Influence Over:</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical content of work</td>
<td>-0.02</td>
</tr>
<tr>
<td>Salaries and promotions</td>
<td>0.65**</td>
</tr>
<tr>
<td>Personnel assignments</td>
<td>0.49**</td>
</tr>
</tbody>
</table>

*p = 0.05; **p 0.001
Since there is not a strong connection between organizational influence and influence over technical content of the work, the final question is whether the loci of influence in these two areas operate separately on performance or whether they interact to affect project performance. A two-way analysis of variance (Table VI) reveals once again that influence over the technical details of project work is not related, at least as a main effect, to project performance. The locus of organizational influence, on the other hand, is significantly associated with project performance in that projects with relatively more powerful project managers are somewhat higher performing than are other projects.

More important, however, the ANOVA results also reveal a very strong interaction effect on project performance between these two modes of influence. As shown by the 2x2 table of performance means at the top of Table VI, project performance is substantially higher when project managers have relatively more influence within the organization and functional managers have relatively more influence over the technical content of what goes into the project. Performance is lowest when functional managers are dominant in both of these areas. Additional analyses did not uncover any interference with these findings by project size or organization sector; nor did they uncover any other significant interaction effects on project performance among the other influence combinations.
Table VI

Project Performance as a Function of the Loci of Influence Over Technical Details of Project Work and Influence in the Organization

<table>
<thead>
<tr>
<th>Locus of Influence Within the Organization</th>
<th>Locus of Influence Over Project Work Details</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Project manager</td>
</tr>
<tr>
<td>Project manager</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>N=30</td>
</tr>
<tr>
<td>Functional manager</td>
<td>-0.05</td>
</tr>
<tr>
<td></td>
<td>N=30</td>
</tr>
</tbody>
</table>

ANOVA:

<table>
<thead>
<tr>
<th>Sources of Variation</th>
<th>df</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influence over technical content</td>
<td>1</td>
<td>0.36</td>
<td>N.S.</td>
</tr>
<tr>
<td>Influence in organization</td>
<td>1</td>
<td>4.88</td>
<td>0.03</td>
</tr>
<tr>
<td>Interaction between work influence and organization influence</td>
<td>1</td>
<td>6.45</td>
<td>0.01</td>
</tr>
</tbody>
</table>
DISCUSSION

The thrust of our findings suggests an ideal separation of roles between the managers of matrixed R&D professionals. The project manager should be concerned with external relations and activities. He or she should have sufficient access and power within the organization to gain the backing and continued support of higher management, to obtain critical resources, and to coordinate and couple project efforts to marketing and manufacturing (Cf. Achilladeles et al., 1971). The concern of functional managers, on the other hand, should be more inwardly-directed, focussing chiefly on the technology that goes into the project. They should be more closely associated with the necessary technologies, and consequently, should be better able than project managers to make informed decisions concerning technical content.

Now these roles can never be completely separate since, for example, relations with marketing and manufacturing have critical implications for technical content and vice-versa. A strong working relationship must therefore exist between project and functional managers. However, rather than sharing responsibilities and involvement in order to achieve more effective project performance, the results suggest that performance is highest when project managers focus principally on external relations and the output side of the project's work, leaving the technological input side to be managed primarily by the functional side of the matrix.

Despite this finding, most of the projects in our sample do not have this role separation pattern, at least as judged by matrixed project members. In more than half of our project groups, for example, matrixed
members report their project managers having substantially more influence over the technical details of their project work than their functional counterparts. Perhaps this should not be too surprising since it is the project manager who manages the output and who is ultimately responsible for the project's success. It is, moreover, his reputation and career that are most intimately tied to project outcomes. Nevertheless, according to our study, performance would be higher if project managers accepted greater influence from functional managers who have engineering personnel assigned to their projects and who should have better knowledge of the technologies.

The enhanced role of the functional manager should also provide some additional benefit in mitigating one of the characteristic problems long inherent in matrix organizations. Functional managers have often felt threatened by the introduction of the matrix. Where they formerly had power and visibility in their functional structures, they see, under the matrix, a drift of all of this "glamour" to the project side of the organization. As a result, the matrix has often been defeated by recalcitrant or rebellious department heads, who saw the technical content of their responsibilities diminishing and their careers sinking into an abyss of personnel decisions and human relations concerns. With a clear delineation of technical responsibilities and an explicitly defined contributive role for functional managers in the technical content of projects, this problem may well be alleviated.

Over the years, there has been considerable discussion concerning the need to maintain a balance of power in matrix organizations. Very little has been done, however, to investigate the elements or components of power and influence that should be balanced. Using project
performance as our criterion, the present study looked into the effect of balance or imbalance along four dimensions of influence. The results, surprisingly enough, provide very little support for the theories of balanced responsibility. Except for joint influence over the area of salary and promotion, higher project performance is not associated with a balanced state of influence along any of the other three dimensions of supervisory activity.

Where does this leave all of the theories and propositions regarding matrix balance? The final set of results in Table VI leads to a better understanding of how balance of power should be achieved to make the matrix effective. It is not through mutual balance or joint responsibilities along single dimensions of influence; rather it is through role differentiation between dimensions of influence that the matrix must be made to work. The project manager's role is distinctly different from that of a functional manager. The two should have very different concerns and should relate to both the project and the larger organization in distinctly different ways. It makes sense, therefore, that the influence which they exert over the behavior of matrixed project members should be along different dimensions.

The project manager is concerned with gaining resources and recognition for the project and with linking it to other parts of the business to ensure that project direction fits the overall business plan of the organization. His is an outward orientation, and therefore, project performance should be greater when the project manager has greater outward organizational influence.

The functional manager should be concerned with technical excellence and integrity, managing the project's input in terms of state-of-the-art
technology. The functional manager's orientation, therefore, is an inward one, focusing on the technical content of the project. The detailed technical decisions must be made by those who are closest to the technology. This localization of technical decision-making in functional departments necessarily implies an important integrating role for the project manager. It is his responsibility to make sure that the technical decisions overseen by several different functional managers all fit together and to avoid sub-optimization. Clearly, the greater the project manager's organizational influence, the easier it will be for him to integrate and negotiate among functional managers whose technical goals may sometimes conflict.

CONCLUSIONS

This study provides a clearer understanding of what balance of power in a matrix organization means. When two lines of reporting exist in an organization, some locus of influence must exist between them. If, however, one or the other side of the matrix dominates completely, then the matrix essentially disappears and lower project performance will probably result. What is also clear from our findings is that balanced authority need not exist along each dimension of influence. Instead, the distribution of influence is better accomplished through differentiation in the input and output oriented roles of functional and project managers, respectively—although joint involvement by both managers in the area of organizational rewards is significantly related to higher project performance.
Finally, it should be reemphasized that the loci of influence in most of our sampled projects do not match our normative findings. This may be one reason why so many studies have reported vast levels of role conflict and ambiguity among matrixed professionals (e.g., Hill and White, 1979). Perhaps it has been the lack of a clear understanding of how to differentiate and complement the different areas of internal and external influences that has led to so much stress and frustration in implementing and maintaining matrix-type designs. Clearly, more research is needed to understand how to staff and manage individuals in these more complicated structures, and hopefully, the findings presented here will encourage additional research in that direction.
REFERENCES


