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EXTERNAL COMMUNICATION AND PROJECT PERFORMANCE: AN INVESTIGATION INTO THE ROLE OF GATEKEEPERS*

MICHAEL L. TUSHMAN† AND RALPH KATZ‡

Research indicates that certain boundary spanning individuals, labelled gatekeepers, can be an important linking mechanism between organizations and their external environments. This study investigates the role of gatekeepers in the transfer of information in a single R&D setting by comparing directly the performance of project groups with and without gatekeepers. Results indicate that gatekeepers perform a linking role only for projects performing tasks that are locally oriented, while universally oriented tasks were most effectively linked to external areas by direct project member communication. Evidence also suggests that gatekeepers do more than mediate external information; they appear to facilitate the external communication of their more local project colleagues. Direct contact and contact mediated by gatekeepers, then, are two contrasting ways to link project groups with their external areas. The relative effectiveness of these linking mechanisms is contingent on the nature of the project's work.
(COMMUNICATIONS; ORGANIZATIONAL STUDIES—BEHAVIOR; RESEARCH AND DEVELOPMENT)

1. Introduction

Oral communication networks are an important medium through which information is gathered, transferred, and processed within organizations (March and Simon [36]; Boorman [13]). Communication networks are themselves characterized by a number of interrelated components, including the amount and direction of communication linkages, the degree of centralization, and the distribution of communication nodes and clusters (Tushman and Nadler [53]; MacKenzie [35]). This research focuses on the gatekeeping function within communication networks. Gatekeepers are those key individuals who are both strongly connected to internal colleagues *and* strongly linked to external domains.[1] More specifically, we investigate the relationships between the existence of gatekeepers and subunit performance for different types of tasks, as well as the role played by gatekeepers in mediating external information. These results increase our understanding of the role played by gatekeepers in the acquisition and utilization of external information.

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†Columbia University.

‡Massachusetts Institute of Technology.

[1] This research makes a basic distinction between gatekeepers and individuals who simply have substantial boundary spanning activities (BSA). To satisfy a gatekeeping function, an individual must be strongly connected both internally and externally. The assumption in many previous boundary spanning studies, including Keller et al. [28], Leifer and Huber [32], Bacharach and Aiken [8], is that those individuals reporting high BSA are also well-integrated internally, transferring and disseminating their information to others in the organization. Such an assumption, however, is often unjustified. Evidence suggests that unlike gatekeepers, individuals with high BSA are frequently isolated and are often low performing individuals (Allen [2]; Roberts and O'Reilly [41]). Or, as Von Hippel [58] has found, those individuals who serve representational roles (and are, therefore, high on BSA) are often not an effective or highly utilized source of information for other relevant organizational members.

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2. Literature Review and Hypotheses

Gatekeepers: The Phenomenon

Social systems must be able to gather and process information from external areas in order to make effective decisions (Thompson [48]; March and Simon [36]). Information processing is, however, expensive and time consuming (Arrow [6]). One way to deal with the costs of information processing is through specialization; specialized subunits evolving to deal with relatively homogenous tasks and segments of the system's work environment (Katz and Kahn [23]; Thompson [48]). Differentiation is, in turn, associated with the development of more locally defined languages and orientations; that is, a locally shared semantic and cognitive field to define, label, and generally organize a complex reality (Arrow [6]; Cherry [15]). Such localized definitions and specifications gradually unfold from interactions among the unit's task demands, the organization's overall interests and requirements, common social and task related experiences of unit members, and the unit's norms, values, and historical perspectives (Lewis [33]; Kaufman [26]). These idiosyncratic developments are a basic determinant of attitudes and behaviors in that they shape how the unit's environment is perceived and how members think about and define their various problems and associated decision parameters (Miller and Johnson-Laird [37]; Kuhn [30]).

This local orientation and coding scheme development is a double-edged sword. For those who share in this common language and awareness, communication is remarkably efficient. Not only can large amounts of information be transmitted with relatively few specialized symbols, but through systematic selection and encoding rules, misinterpretations between actors are minimized (March and Simon [36]; Allen [3]; Triandis [50]). Furthermore, actors who share coding schemes can effectively communicate both digitally (e.g. verbally or through natural languages) as well as analogically (e.g. through images or nonverbally) (Watzlawick, Beavin and Jackson [60]).

If actors do not share a common coding scheme and technical language, their work-related communication will be less efficient and more costly (Dearborn and Simon [18]; Wilensky [65]). This lack of linguistic commonality can be conceptualized as a communication impedance. The greater the mismatch in language and cognitive orientation, the greater the difficulties of communicating. This communication impedance is associated with what Bar-Hillel and Carnap [11] call semantic noise; errors in the interpretation of messages analogous to noise sources in physical systems which cause error in message reception. Communications across communication boundaries without knowledge on the part of one or both communicators of the other's coding system, may lead to misperceptions and an incomplete understanding of the message's information content (Cherry [15]).

There is, then, a paradox. The evolution of local languages and coding schemes helps the unit deal with its local information processing requirements; yet, it also hinders the unit's acquisition and interpretation of information from external areas. External information is vital, however, both in terms of feedback and for evaluating and acting on the unit's environment (Arrow [5]; Utterback [56]). How, then, can units be effectively linked to external information areas?

One way to deal with the difficulties of communicating across differentiated boundaries is through gatekeepers; individuals in the communication network who are capable of understanding and translating contrasting coding schemes. With the help of these key individuals, external information can flow into the system by means of a

two-step process. First, gatekeepers are able to gather and understand external information, and subsequently they are able to translate this information into terms that are meaningful and useful to their more locally oriented colleagues.

The two-step flow of external communication to overcome communication impedance has been described by researchers in a variety of settings. For instance, communication between subunits within organizations (Schwartz and Jacobson [44]), between R&D laboratories and external areas (Whitley and Frost [63]), between knowledge generators and knowledge users (Sundquist [47]; Crane [17]), between different components of school systems (Baldridge and Burnham [10]), and between early and late adopters of innovation (Rodgers and Shoemaker [42]; Coleman, Katz and Menzel [16]) have all been shown to occur in a two-step process.

While substantial literature supports the existence of gatekeepers, there is virtually no direct evidence to support the notion that gatekeepers can enhance subunit performance. Project SAPPHO (Achelladeles, Jervis, and Robertson [1]) and Carter and Williams [14] provide case studies, while Katz and Tushman [25] and Allen, Tushman, and Lee [4] provide only inferential support for the positive association between gatekeepers and subunit performance. The initial research question, then, investigates the association between gatekeepers and subunit performance. Is this relationship positive across task areas or are some areas more effectively linked to external areas through direct contact by subunit members? The second research question examines the role of gatekeepers in information transfer. Are gatekeepers the primary source of external information or do they also serve to facilitate the external communication of their more locally oriented colleagues?

Gatekeepers and Subunit Performance

The two-step flow of communication hinges on the existence of a communication impedance and the associated communication boundary separating the subunit from external information areas. To the extent that different technical languages and coding schemes exist between actors, communication across this boundary will be difficult, inefficient, and prone to bias and distortion (Dearborn and Simon [18]). Several studies have found an inverse relation between extra-organizational communication and both individual and subunit performance (Allen [3]; Baker, et al. [9]; Shilling and Bernard [45]).

On the other hand, if external sources do not have different languages and coding schemes from members of the subunit, then this communication impedance will not exist. Under these conditions, external areas can provide new ideas and feedback to all unit members, and there will be a positive association between extra-unit communication and overall performance. Hagstrom [21], for instance, found a strong positive association between the productivity of scientists and their level of external contact with colleagues from other universities.

The nature of a subunit's work is a basic factor affecting the development of a localized language and orientation. Work which is organizationally defined and operationalized is associated with local norms, values and languages. The interaction of bureaucratic values and demands with local tasks and coding schemes produces a communication boundary that insulates the unit from outside areas (Lawrence and Lorsch [31]; Allen [3]). For example, different firms in the same industry may face similar problems yet may define their solution approaches and parameters very differently (Katz and Tushman [25]). Locally oriented tasks, therefore, will require

gatekeepers to provide linkage to external areas; direct contact by other subunit members will be ineffective.

If, however, a subunit's work is universally defined (scientific work, for example), then organizational factors will be less of an impediment to external communication. Individuals outside the unit (yet in similar professions or specialties) are more likely to share similar norms, values, and language schemes, thereby, permitting effective communication across organizational boundaries. Members working on universal tasks are simply more capable of understanding the nature of the problems and corresponding solution approaches employed by their relevant external colleagues. Scientists from one organization, for example, can easily communicate with scientists from any other organization about their overlapping sets of scientific interests (e.g. Hagstrom [21]). For universally defined tasks, then, gatekeepers will not be required to link units to external information domains; instead, direct peer contact will be more advantageous.

The nature of a subunit's work, therefore, is a key contingent variable mediating the relationships between gatekeeper existence and subunit performance. Gatekeepers will be positively associated with subunit performance only under certain conditions:

Hypothesis 1: Subunits performing locally defined tasks with gatekeepers will have significantly higher performance than subunits performing locally defined tasks without gatekeepers.

Hypothesis 2: Subunits performing universally defined tasks with gatekeepers will have significantly lower performance than subunits performing universal tasks without gatekeepers.

In analysis of variance terms, these hypotheses imply that there will be no main effect between the existence of gatekeepers and subunit performance; rather there will be a significant interaction between task characteristics and the existence of gatekeepers on subunit performance.

Role of Gatekeepers

It has been hypothesized that gatekeepers facilitate the performance of those subunits working on locally defined tasks. What are the contributions of gatekeepers such that their existence in these subunits is positively associated with subunit performance? There are at least two alternatives. The more traditional explanation is that gatekeepers are a primary linking mechanism to external sources of information; information flows through these key individuals to the more local members of the network (Tushman [51]; Baldridge and Burnham [10]; Whitley and Frost [63]). From this perspective, relevant external information exists in subunits because of the boundary spanning activities of gatekeepers.

A different explanation is that gatekeepers take an active training, development, and socialization role within their work units. From this point of view, gatekeepers not only gather, translate, and encode external information, but they also facilitate the external communication of their colleagues (Blau [12]). Gatekeepers may work to reduce the communcation boundary between their subunit and external areas by directing, training and coaching the external communications of other subunit members. Under these conditions, both gatekeepers and other members of the subunit are able to effectively gather information from external areas.

If gatekeepers do permit other members to communicate effectively with external areas, then for subunits with local tasks and gatekeepers, there should be a positive association between a subunit's external communication and its performance. If

gatekeepers do not play this more active role, then there should be an inverse relation between a unit's external communication and its performance.

Given the substantial requirements for external communication in all but the most primitive of organizations, the inherent cognitive limits on information processing, and the fact that gatekeepers have their own tasks to perform, it is suggested that gatekeepers take an active role in both gathering information and facilitating the external communication of their colleagues.

Hypothesis 3: The association between external communication and overall performance for locally oriented subunits will be systematically different for units with and without gatekeepers. Subunits with gatekeepers will have a positive association while subunits without gatekeepers will have an inverse association.

Since gatekeepers perform the critical role of mediating external communication for subunits with locally oriented work, there will also be a positive association between the extra-organizational communication of gatekeepers and their unit's overall performance. To what extent, however, can supervisors substitute for gatekeepers and play this linking role to external areas?[2] Supervisors of locally oriented tasks face the same communication impedance as their subordinates when communicating externally. While supervisory communication within the organization may be positively associated with performance (e.g. Likert [34]), their communication outside the organization will be inversely related to their unit's performance.

Hypothesis 4: For units with locally oriented work, supervisors who are not gatekeepers will have an inverse relationship between extra-organizational communication and unit performance. Gatekeepers, however, will have a positive association between extra-organizational communication and unit performance.

3. Settings and Methods

This study was carried out at the R&D facility of a large American corporation. This facility is isolated from the rest of the corporation and employs 735 people. This study focussed on all professionals in the facility ($n = 345$). This laboratory was organized into seven divisional labs (or departments). These departments were organized into 61 separate projects. These projects were stable units over the course of the study; each respondent was a member of only one project.

Technical Communication

To collect communication data, each professional was asked to specify those individuals with whom he or she had work related oral communications. This sociometric data was collected on a randomly chosen day each week for fifteen weeks. The sampling of days was constrained to allow for equal numbers of weekdays. Respondents were asked to report all oral work related contacts both within and outside the laboratory (including whom they talked to and how many times they talked with that person during the day). They were instructed not to report contacts that were strictly social, nor did they report written communications. During the fifteen weeks, 93 percent of the respondents submitted usable surveys. Moreover, 68

[2]Research indicates that usually between 50 and 80 percent of the gatekeepers are also first-level supervisors. These roles, then, are not independent but complementary (Allen [3]; Tushman and Scanlan [54]). This research distinguished between gatekeepers, supervisors who are also gatekeepers, and supervisors who are not gatekeepers.

percent of all the communications reported within the laboratory were mentioned by both parties (see Weiss and Jacobson [61], for comparative data). Extra-laboratory communications, however, could not be corroborated with discussion partners.

Project communication is a measure of the average absolute amount of technical communication per person per project over the fifteen weeks. As discussed in Katz and Tushman [25], six mutually exclusive communication measures were operationalized for each project as follows: (1) communication *within the Project*. (2) communication to other areas within the project's *Department*; (3) communication to other areas in the *Laboratory* (but outside of the Department); (4) communication to areas in the larger *Organization*; (5) communication to external *Professionals* outside the parent organization, including consulting firms, universities, and professional societies; and (6) communication to external *Operational* areas, including, suppliers, vendors, and customers. Extra-organizational (i.e. external) communication is the sum of the reported communication to professional and operational areas. Individual responses were pooled to obtain project communication with these various areas.

Although the literature has used a number of slightly different criteria to empirically define gatekeepers (Allen [2]; Whitley and Frost [63]), conceptually, they are defined as those internal stars (i.e. high internal communicators) who also maintain a high degree of extra-organizational communication. This study operationalized gatekeepers as those individuals who were in the top fifth of their intradepartment communication distribution and who were also in the top fifth of the extra-organizational communication distribution. Gatekeepers were identified in 21 projects; 40 projects had no gatekeepers.

Project Task Characteristics

In R&D settings, tasks can differ along several dimensions, including time span of feedback, specific vs. general problem-solving orientation, and generation of new knowledge vs. utilization of existing knowledge and experience (Rosenbloom and Wolek [43]). With these dimensions, the following tasks categories were developed with the laboratory's management to form a universal (research) to local (technical service) task dimension.

a. Basic Research: Work of a general nature intended to apply to a broad range of applications or to the development of new knowledge about an area.

b. Applied Research: Work involving basic knowledge for the solution of a particular problem. The creation and evaluation of new concepts or components but not development for operational use.

c. Development: The combination of existing feasible concepts, perhaps with new knowledge, to provide a distinctly new product or process. The application of known facts and theory to solve a particular problem through exploratory study, design, and testing of new components or systems.

d. Technical Service: Cost/performance improvement to existing products, processes or systems. Recombination, modification and testing of systems using existing knowledge. Opening new markets for existing products.

Using these definitions, respondents were asked to select the category which best characterized the objectives of their project and to indicate, on a three-point scale, how completely the project's objectives were represented by the selected category. The twelve possible answers were scored along a single scale ranging from completely basic research to completely technical service.

As in Pelz and Andrews [39], respondents were also asked to indicate what percentage of their project's work fell into each of the four categories. A weighted average of the percentages was calculated for each respondent. The scored responses to these two questions were averaged (Spearman-Brown reliability = 0.91).

Since projects are the unit of analysis, the homogeneity of project members' perception was tested to check for the appropriateness of pooling (see Tushman [51] for details). As pooling was appropriate, individual responses were combined to get project scores. The distribution of project task scores clustered into three distinct categories: (1) Research–a combination of basic and applied research categories; (2) Development, and; (3) Technical Service. Research projects carried out universally oriented scientific work (for instance, developing new knowledge in glass physics), while development and technical service work was locally oriented in that they worked on organizationally defined problems and products.

Project Performance

As performance measures are particularly difficult to develop for R&D settings (Whitley and Frost [62]), a subjective measure similar to that used by Lawrence and Lorsch [31] was employed. Each department manager ($n = 7$) and laboratory director ($n = 2$) was interviewed separately. They were asked to evaluate the overall technical performance of all projects with which they were technically familiar.

Each manager interviewed was asked to make their informed judgements based on their knowledge of and experience with the various projects. If they could not make an informed judgment for a particular project, they were asked not to rate the project. Criteria the managers considered (but were not limited to) included: schedule, budget, and cost performance; innovativeness; adaptability; and the ability to cooperate with other areas of the organization. Each project was independently rated by an average of 4.7 managers on a seven-point scale (from very low to very high). As the performance ratings of the nine judges were intercorrelated (Spearman-Brown reliability = 0.81), individual ratings were averaged to yield overall project performance scores (range from 3.0 to 6.4; median of 4.6).

Demographic Data

During the course of the study, demographic data was also collected from the laboratory's professionals, including their age, educational degrees, years in the laboratory, and years in their current project.

4. Results

Gatekeepers and Project Performance

As previously discussed, there should be no overall main effect between the presence of gatekeepers and project performance. Instead, there should be significantly different relationships depending upon the projects' task characteristics. Hypothesis 1 predicted that locally oriented tasks (i.e. development and technical service projects) would show a positive association between gatekeeper existence and project performance. Hypothesis 2, on the other hand, predicted that universal tasks (i.e. research) would show an inverse relation between gatekeeper existence and project performance.

The means reported in Table 1 indicate that, in general, the performance of projects

TABLE 1

Project Performance As A Function of Gatekeeper Presence

	Mean Project Performance	Standard Deviation
Projects *With* Gatekeepers ($N = 21$)	4.70	0.702
Projects *Without* Gatekeepers ($N = 40$)	4.53	0.729
Mean Difference =	0.17[+]	

[+]Not significantly different at the $p < 0.10$ level.

with gatekeepers are not significantly different from the performance of projects without gatekeepers. To investigate the specific hypotheses, a two-way ANOVA was employed to test for the interaction effect between task characteristics and gatekeeper existence on project performance. As hypothesized, there are no main effects on project performance for either the existence of gatekeepers or for task characteristics. There is, however, a strong disordinal interaction effect ($F = 4.73$; $p < 0.01$; $D.F. = 2, 54$).

More specifically, the breakdown of performance means, as shown in Table 2, strongly supports the second hypothesis. Research projects with gatekeepers are significantly lower performing than those research projects without gatekeepers. In fact, the correlation between the existence of gatekeepers and project performance is significantly negative ($r = -0.47$; $p < 0.05$). Research projects appear more effectively linked to external areas through direct member contact (see Katz and Tushman [25]).

There is also partial support for hypothesis 1 in that development projects with gatekeepers are significantly more effective than those development projects without gatekeepers. In sharp contrast with research projects, the correlation between the existence of gatekeepers and the performance of development projects is strongly positive ($r = 0.51$; $p < 0.01$). Unlike research projects, development projects are effectively linked to external areas through gatekeepers. Technical service projects, on the other hand, exhibit no significant differences between those units with and without gatekeepers. The mechanisms used by technical service projects to import external information remain unclear. The performance scores displayed in Figure 1 highlight the differential impact of gatekeepers on research vs. development projects.

TABLE 2

Project Performance As A Function of Project Type and Gatekeeper Presence

Project Type	Mean Performance for Projects		*T*-Value
	With Gatekeepers	Without Gatekeepers	For mean Differences
Research	4.22 ($N = 5$)	4.92 ($N = 9$)	− 1.88**
Development	4.91 ($N = 8$)	4.15 ($N = 15$)	3.10***
Technical Service	4.80 ($N = 7$)	4.67 ($N = 16$)	0.38

**$p < 0.05$; ***$p < 0.01$

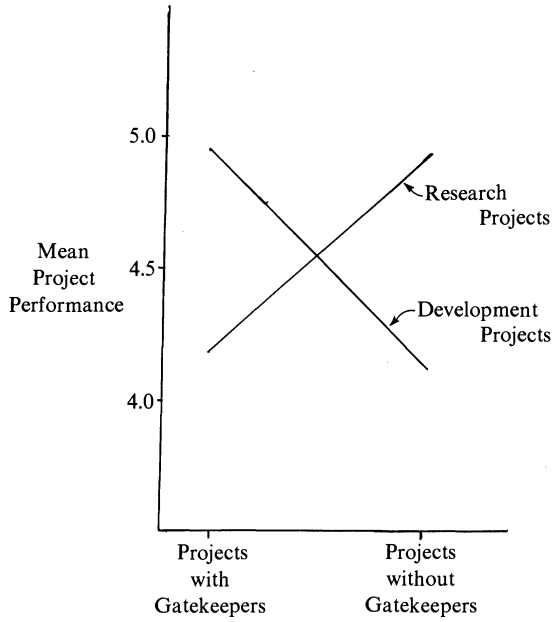

FIGURE 1: Mean Performance of Development and Research Projects By Gatekeeper Presence

Role of Gatekeepers

Hypothesis 3 argued that for locally oriented tasks, gatekeepers do much more than simply channel information from external areas into the subunit. Gatekeepers may act to reduce the communication impedance between local and external areas by training, directing, and socializing their fellow colleagues. If gatekeepers serve this dual role then both gatekeepers and their peers will be able to communicate effectively with external areas. Those locally oriented projects without gatekeepers will have no effective link to external areas.

Results reported in Table 3 support these ideas. For development and technical service projects without gatekeepers there is a consistent inverse association between members' extra-organizational communication and project performance. For those locally oriented projects wth gatekeepers, however, a significantly different pattern emerges—extra-organizational communication is positively associated with project performance. These positive correlations remain strong even after the direct communication effects of gatekeepers are removed. Finally, the differences in the correlations between those development and technical service projects with and without gatekeepers are statistically significant. It appears that gatekeepers have a strong impact on project members' ability to communicate directly with external areas.

Consistent with earlier results (see Table 2), members of research projects do not seem to face a communication impedance when communicating externally. Their extra-organizational communication is positively associated with project performance independent of the existence of gatekeepers. If anything, results in Table 3 suggest that gatekeepers might hinder the external communication of research project members. Gatekeepers, then, do not play an important information transfer role in the more

TABLE 3

Spearman Rank-Order

Correlations Between Project Performance and External Communications By Project Type and Gatekeeper Presence[b]

Project Type	Measures of External Communications	Correlations with Performance for Projects: With Gatekeepers	Without Gatekeepers
Research	a) All project members	0.33	0.52*
	b) All project members excluding the project's gatekeeper (in the first column) or the project's supervisor (in the second column)[a]	0.40 ($N = 5$)	0.43* ($N = 9$)
Development	a) All project members	0.27	− 0.39**
	b) All project members excluding the project's gatekeeper (in the first column) or the project's supervisor (in the second column)	0.54* ($N = 8$)	− 0.18 ($N = 15$)
Technical Service	a) All project members	0.39	− 0.18
	b) All project members excluding the project's gatekeeper (in the first column) or the project's supervisor (in the second column)	0.51* ($N = 7$)	− 0.11 ($N = 16$)

* $p < 0.10$; **$p < 0.05$;

[a]80%, 75%, and 71% of the gatekeepers in the research, development, and technical service project groups, respectively, were also project supervisors.

Note 1: Underlined pairwise correlations are significantly different at the $p < 0.10$-level.

[b]Nonparametric correlations are reported because of the small sample sizes within each category.

universally oriented research projects, while they seem to play a vital role in the more locally defined development and technical service projects.

To what extent can supervisors of development and technical service projects substitute for gatekeepers in linking their units to external areas? As supervisors face the same external communication impedance as their subordinates, hypothesis 4 reasoned that for supervisors who were not gatekeepers, the greater their external communication, the lower the performance of their project. However, gatekeepers (whether they be supervisors or not) should have a positive association between their extra-organizational communication and project performance.

The correlations reported in Table 4 support these ideas. For development and technical service projects, the greater the extra-organizational communication of supervisors who were not gatekeepers, the lower their project's performance. Supervisors are not an inherently effective linking mechanism to external domains. However, the association between external communication and project performance is very different for those supervisors who are also gatekeepers. The greater the external communication of these individuals, the greater their project's performance. The differences in the correlations between those supervisors who are gatekeepers and those who are not are statistically significant, indicating that supervisory status alone cannot deal with the requirements for effective linkage to external areas.[3]

[3]As most gatekeepers were also supervisors, there were not enough cases to investigate the association between the external communication of non-supervisory gatekeepers and project performance.

TABLE 4

Spearman Rank Order Correlations Between Project Performance and the External Communications of Project Supervisors by Project Type and Gatekeeper Presence

Project Type	Correlations Between Project Performance and External Communications For:	
	Project Supervisors who are also Gatekeepers	Project Supervisors who are not Gatekeepers
Development	0.31	− 0.45**
	($N = 6$)	($N = 15$)
Technical Service	0.42*	− 0.33*
	($N = 5$)	($N = 16$)

*$p < 0.10$; **$p < 0.05$;

Note: The underlined correlations are significantly different at the $p < 0.10$ level.

Alternative Explanations

Given the nature of the preceding results, alternative explanations must be examined. It is conceivable, for example, that restricted variances in either the performance or communication measures could explain the changing pattern of correlations across different categories. Accordingly, for all pairwise correlational comparisons, means and standard deviations were checked to ensure that none were significantly different.

Furthermore, it is important to make sure that the composition of projects with and without gatekeepers do not differ in some other meaningful way. It has been suggested that project behaviors such as communication and innovation might be influenced by demographic characteristics including age, education, and project tenure (Pelz and Andrews [39] and Katz [24]). To rule out such rival possibilities, we compared the different project groupings along these several demographic variables. As there were no statistically significant differences, rival hypotheses based on demographic differences are less plausible.

5. Discussion

The acquisition of information from external areas is vital for organizations. It was hypothesized that there are at least two distinct methods by which subunits can acquire external information: direct contact by members of the subunit and contact mediated by gatekeepers. This research has investigated two basic questions with respect to these methods: 1) under what conditions will gatekeepers be a more effective linking mechanism than direct contact; and 2) what role do gatekeepers play in mediating the flow of external information.

The results reported here suggest that the external linkage mechanism is contingent on the existence of a communication impedance separating a focal unit from external information areas. The interaction of bureaucratic structures and constraints along with tasks which are locally defined is associated with the evolution of local values, norms, and languages. The greater the language/cognitive differences between areas, the greater the communication impedance. Communication across these boundaries will be inefficient and prone to bias and distortion.

It is not that relevant information does not exist with outside sources, rather it is simply more difficult and expensive to effectively communicate across these communication boundaries. Therefore, for locally oriented tasks, an inverse relation between extra-organizational communication and subunit performance was hypothesized; gatekeepers would be an effective linking medium for these tasks. However, it was hypothesized that members of universally defined subunits would be less constrained by local norms, values, or languages. As the communication impedance between research areas and external information areas will be low, it was hypothesized that direct peer communication would be more effective than communication mediated by gatekeepers.

These hypotheses were strongly supported for research and development projects. Locally defined development projects with gatekeepers were significantly more effective than those development projects without gatekeepers. For the more universally oriented research projects, though, there was a significant inverse relation between the existence of gatekeepers and project performance. The more effective research projects relied on direct contact with external sources of information.

Contrary to expectations, the performance of technical service projects was independent of the existence of gatekeepers. If members of technical service projects cannot effectively communicate with external areas (e.g. Rosenbloom and Wolek {43], Katz and Tushman [25]), and if there is no association between the existence of gatekeepers and the performance of those projects, then how are technical service projects linked to external areas? Furthermore, if development and technical service tasks are both locally defined, why should the results for these areas be so different?

These contrasting results may be due to differences in the nature of the work in development and technical service areas. Development projects involve a dynamic technology, new knowledge and/or new products. Uncertainty is relatively high in these projects and the locus of relevant task expertise will be with the project members. Technical service projects, on the other hand, work with mature technologies, existing knowledge and existing products. Task uncertainty is relatively low and the locus of task expertise will be at more senior levels of the hierarchy (Rosenbloom and Wolek [43]).

If the locus of expertise and decision making is relatively high in technical service projects, it may be that they are linked to external areas not by gatekeepers within the project, but by more senior levels of the hierarchy. More generally, this logic suggests that the locus of task expertise and the nature of a subunit's task are key contingent variables in predicting the mechanism by which the unit is externally linked. For locally oriented subunits where task expertise is located within the subunit, gatekeepers within the unit must be the linkage to external areas. Where, however, the task is locally oriented and expertise lies higher in the hierarchy, then the unit can rely on the formal hierarchy as an external linking mechanism (Walsh and Baker [59]; Whitley and Frost [62]; Keller et al. [28]).

What role do gatekeepers perform in linking local projects to external areas? The data indicate that gatekeepers not only bring in information from external areas, but perhaps more importantly, they facilitate the extra-organizational communication of their more locally oriented colleagues. In locally oriented subunits, gatekeepers may actually increase the information processing capabilities of their units by reducing the communication impedance separating their unit from external areas. Locally oriented subunits with gatekeepers may be able to take better advantage of external information since the number of members capable of communicating across the unit's

boundary increases with correspondingly less dependence on gatekeepers for gathering and disseminating external information. In universally oriented tasks, on the other hand, gatekeepers are not a critical source of external information, nor do they serve any communication facilitating function. Research project members cannot rely on others for their external information; in a sense they must be their own gatekeepers.

Project supervisors cannot substitute for gatekeepers in linking locally oriented units to external areas. The extra-organizational communication of supervisors who were not gatekeepers was inversely associated with project performance. While supervisors may have well developed and useful internal linkages, they face the same extra-organizational communication impedance as their subordinates. Unlike their peers, the external communication of supervisory gatekeepers was positively associated with project performance. Gatekeepers, therefore, play a key role in communication networks; a role that is different yet complementary to the supervisory role. These data suggest distinguishing between two types of project supervisors: those supervisors who have a local orientation and those who are more cosmopolitan (that is, supervisors who are also gatekeepers). Locally oriented supervisors may be most influential in administrative or budgetary kinds of activities, while gatekeeping supervisors may be more influential in technical activity and decision making.

6. Conclusion

Organizations in general and R&D laboratories in particular are dependent on timely and accurate information from a variety of external areas. This research suggests that direct peer contact, contact mediated by gatekeepers and contact mediated by the hierarchy are alternative mechanisms by which subunits can be linked to external information areas. Each mode of information transfer seems to be appropriate under certain conditions; the choice of linkage mechanism being contingent on the nature of the unit's work and the locus of task expertise within the subunit.

Gatekeepers are most important in development projects; units whose task is locally defined yet where the technology employed is changing. For these kinds of units, a few key individuals provide the most effective linkage to external areas. This two-step process operates informally; individuals approach those who they see as technically competent and current. While this gatekeeping role cannot be legislated, it can be facilitated. Managers can select technically respected individuals and systematically facilitate their internal and external linkages (e.g. through transfers, training, travel budgets, etc.). Further, management can formally and informally reward individuals who perform this boundary spanning function in development projects (see also Tushman and Scanlan [54]).

The importance of gatekeepers is, however, tempered by the existence of alternative media for extra-organizational information. As research projects are unencumbered by external communication boundaries, direct peer contact seems to be the most effective way to access external professional information. While gatekeepers exist in research projects (e.g. Tushman [51]), they function here as a complement to direct external communication. In constrast to development projects, those research projects who rely on gatekeepers for their external information are lower performing units. On the other hand, for technical service projects, units whose task is locally defined and where the rate of change of the core technology is low, senior levels of the hierarchy may be the most effective link to external information sources.

In summary, gatekeepers are but one vehicle to link organizations to external

information areas. As external information is important, managers must choose, develop and facilitate appropriate linkage mechanisms to meet the information demands of their unit's work. As tasks, technologies, and external information requirements evolve over time, different processes should also evolve to handle the units' changing information processing requirements. Future research must investigate these alternative modes of acquiring external information and explicitly address the evolution of communication networks over time.[4]

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