ORGANIZATIONAL STRUCTURE AND INTER-LOCATION

COMMUNICATION IN AN R&D ORGANIZATION

Breffni Tomlin and Thomas J. Allen

WP 940-77   June 1977

INTRODUCTION

Geographic dispersion of organizational units has long been known to create problems of control, coordination and communication. Recent research (Allen & Fusfeld, 1976) has shed further light on just how serious this problem can become. Nevertheless, there often remains no other alternative than to locate operations at more than a single site. As a consequence often through desire to locate the research and development function close to operations, the R&D staff are also divided among locations. This can lead to serious problems of redundancy and loss of effectiveness. Internal communication is especially important in R&D (Allen, 1977; 1970; Baker, et. al., 1967; Goldhar, et. al., 1976) and is strongly related to its overall effectiveness. As a result, when physical/geographical barriers to communication appear, something must be done to counter their effects. The present paper will examine the relative importance of a number of organizational and staffing variables in overcoming the effects of geographical separation.

Setting

The organization is a moderate sized R&D organization, employing a professional staff of about 200. These 200 scientists and engineers are located in six major centers dispersed over geographic distances ranging from 10 to 200 miles. These are not very large separation distances, but all evidence (Cf. Allen & Fusfeld, 1976) would indicate that they are sufficient to produce the maximum effect. In fact, there should be little difference in the effects of 10 and 200 mile separations on communication. For this reason, all inter-site distances will be treated equally in the analysis that follows.

Data Collection

A general communication survey performed in this organization, using the methods described in Allen & Cohen (1969) and Allen (1970). In addition to

information on communication patterns, data were also gathered on the backgrounds of each individual, and on their project, group, departmental and divisional affiliations.

RESULTS

Between each pair of locations, a computation is made of the total number of possible pairs of individuals who might communicate. The proportion of those pairs who actually do communicate is taken as an index of the strength of the communication bond between the two locations.

$$\widehat{C}_{ij} = \frac{C_{ij} + C_{ji}}{N_i N_j}$$

$$0 \leq \widehat{C}_{ij} \leq 1$$

C_{ij} = the number of professionals in unit i reporting regular (weekly) communication with individuals in unit j.

N_i = the total number of professionals in unit i

N_j = the total number of professionals in unit j.

Since one means of countering a physical separation is to introduce an organizational bond between locations (Cf. Morton, 1971), a number of different arrangements of organizational bonds will be examined. The organization under study, with its six research centers, presents quite a number of such arrangements. This allows a comparison among these arrangements, in terms of their resulting communication levels. This is not to say that physical location and organizational affiliation are the only factors governing communication. They

are very important, and while other factors are not explicitly controlled in
this analysis, all evidence indicates that other factors exert a second effect
on inter-location communication. These effects will be controlled directly
in subsequent analyses, however.

Divisional Bonds

The R&D organization, under study is divided into six divisions, each of
which contains from 4 to 8 departments. In some instances, one or more
departments of one division are located separately from the rest of the division.
This splitting of divisions between centers, creates an organizational bond
between the centers, which should serve to increase the amount of communication,
or interaction between locations.

In fact, the effect is, if anything, negligible (Figure 1). First of all,
there was no communication reported between the isolated department and other
departments in its own divisions. In the sense of communication, it became
"captured" by the division, at whose center it was located. Second, the degree
of communication between the divisions, that were involved, is at best very
weak.

Nevertheless, it is interesting to see how even this weak communication
bond breaks down when analyzed on the basis of organizational hierarchy (Figure
2). The empirically derived probability of communication between bench level
professionals is zero! The most likely communication is between a first level
manager in one divisoin and a bench level scientist or engineer in the other.

Departmental Bonds

Often it is possible, or desireable for other purposes to divide the
membership of a department between two separate geographic locations. This
should certainly cause a greater increase in communication than is found when

divisions are divided across centers. In fact that is the case. In Figure 3, Departments A-4 and A-5 are located partially at two locations. The managers of both departments are located at the headquarters site for Division A, to which they belong. In the case of A-5, only one professional is moved to the remote site, while Department A-4 moves several professionals to A^1-4, at the headquarters center for Division B.

All of this personnel movement does nothing to create any direct contact between those parts of Division A, at its headquarters center and any part of Division B. Some indirect contact is created, however. Fairly strong communication bonds naturally develop between those segments of Departments A-4 and A-5 at the two locations. Additionally, A^1-4 develops a degree of interaction with B-2 which is much higher than was found when an entire department had been located remote from its divisional headquarters (Figure 1). Apparently in their organization, moving an integral department leaves it an independent entity capable of operation with little external interaction. Splitting a department between two locations, creates a form of dependency which forces interaction not only between the split parts, but between the isolated portion and other departments at the remote location. Thus an indirect connection develops between divisions and centers, with the isolated segment of the split department acting as intermediary. This occurs only when more than one professional is moved to the remote center. Locating a single professional away from headquarters created a strong communication bond to the headquarters portion of his own department, but no interdivisional communication.
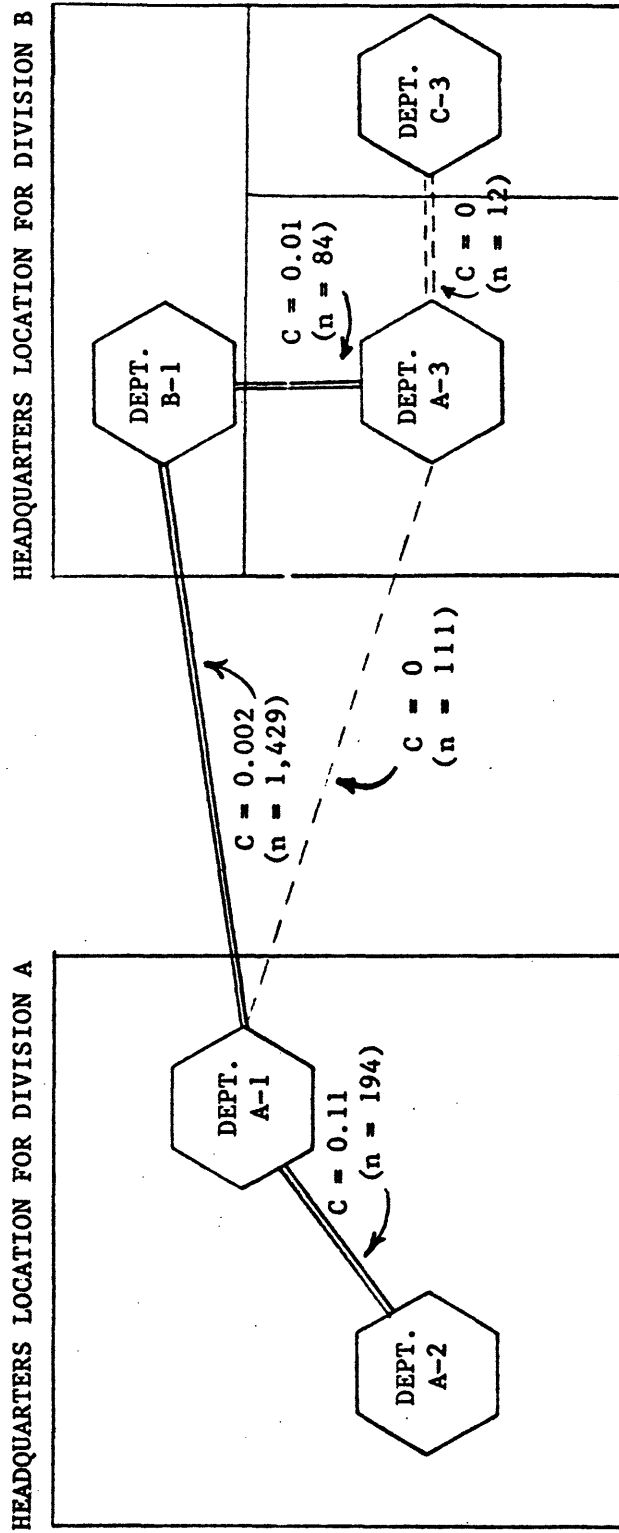
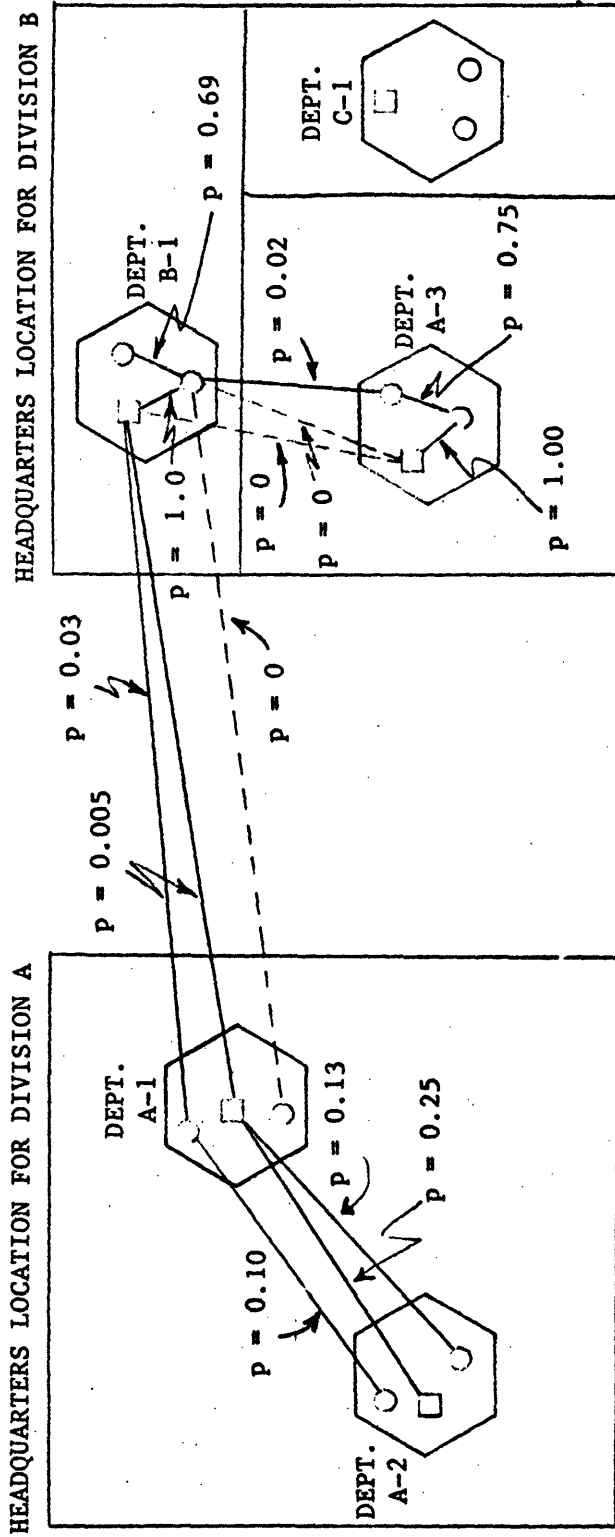Figure 1. Inter-Center Communication When Division is Split Between Centers

Figure 2. Probabilities of Weekly Communication Between Pairs of Individuals, with One Department of Division A Situated at the Headquarters Location for Division B.
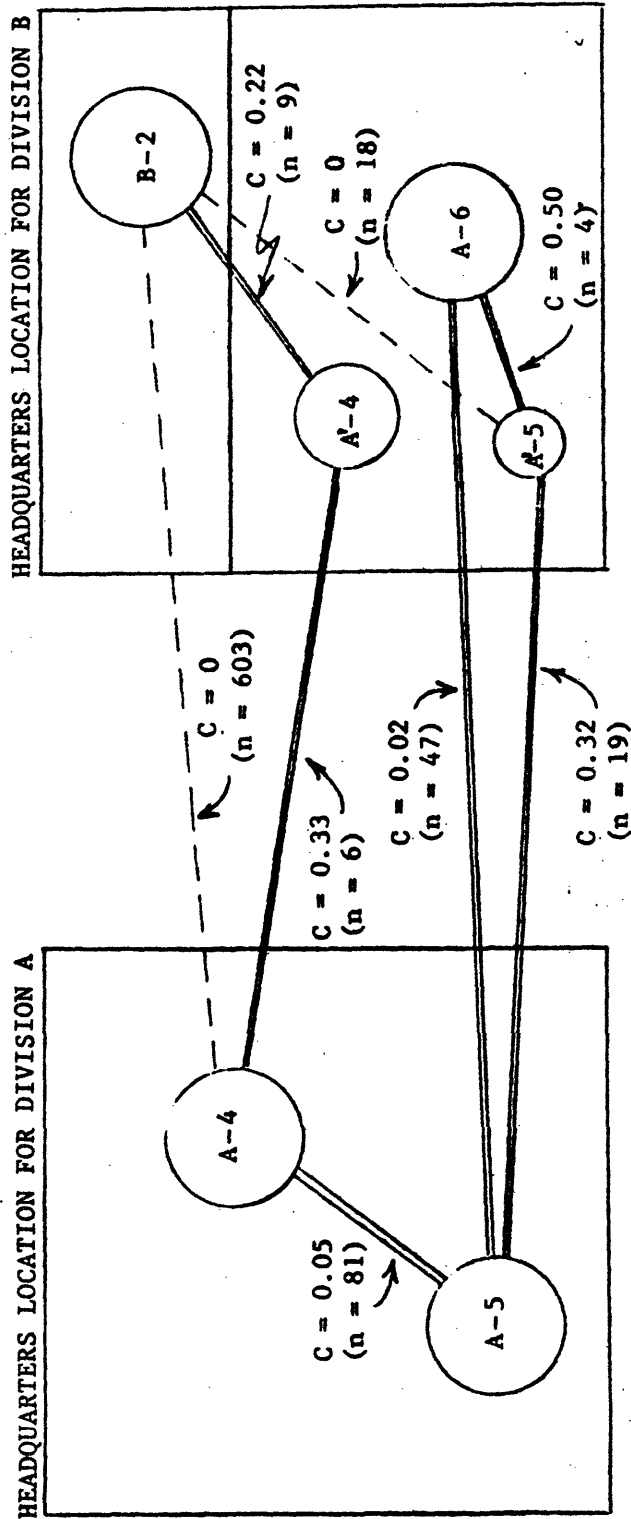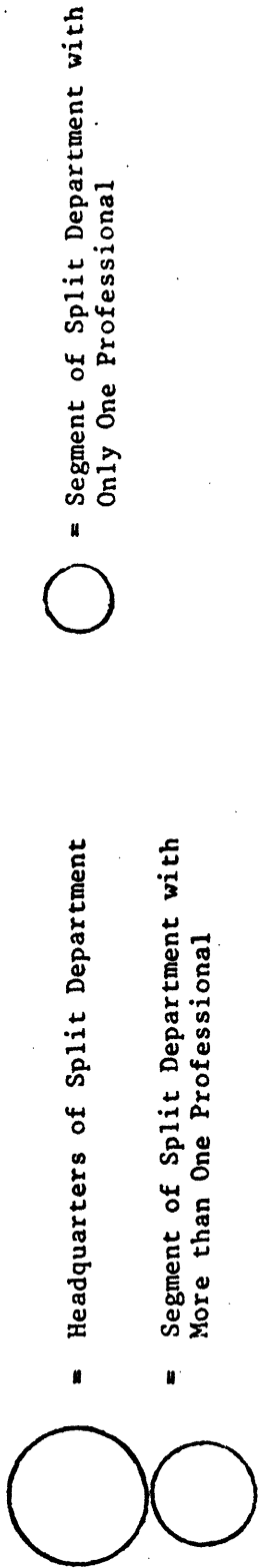
Figure 3. Inter-Center Communication When Departments Are Split Between Centers

When this set of communication bonds is further analyzed in terms of the hierarchical positions of the individuals involved (Figure 4), the most interesting revelation is that nearly all inter-location communication is due to supervision/subordinate relations. When a single professional is assigned to a separate location there is at least a low probability of regular weekly communication (p=0.17). Strangely, this disappears when two or more individuals are relocated. Then the only regular weekly communication occurs between supervisor and subordinate. In two out of three cases (p=0.67) there was regular weekly contact between supervisor and subordinate, but in no instance was such regular contact found between two individuals at the bench level. This compares with probabilities of 0.42 for weekly contact between bench level professionals within the headquarters component of the split department and 1.0 within the remote component. Splitting a department, thus reduces the probability of colleague contact by a substantial amount. Fortunately it has virtually no effect on supervision/subordinate relations. It does increase the degree of contact between working level professionals in the remote component and the division with which it is co-located. The probability of such contact increases from 0.02 to 0.33.

The contact between Division Bond the main portion of Division then occurs through mutual contacts with departmental component A'-4. The results of inter-divisional colleague contact at Center B can be communicated to Center A, by means of contact between the manager of Department A-4 and his subordinate in A'-4.
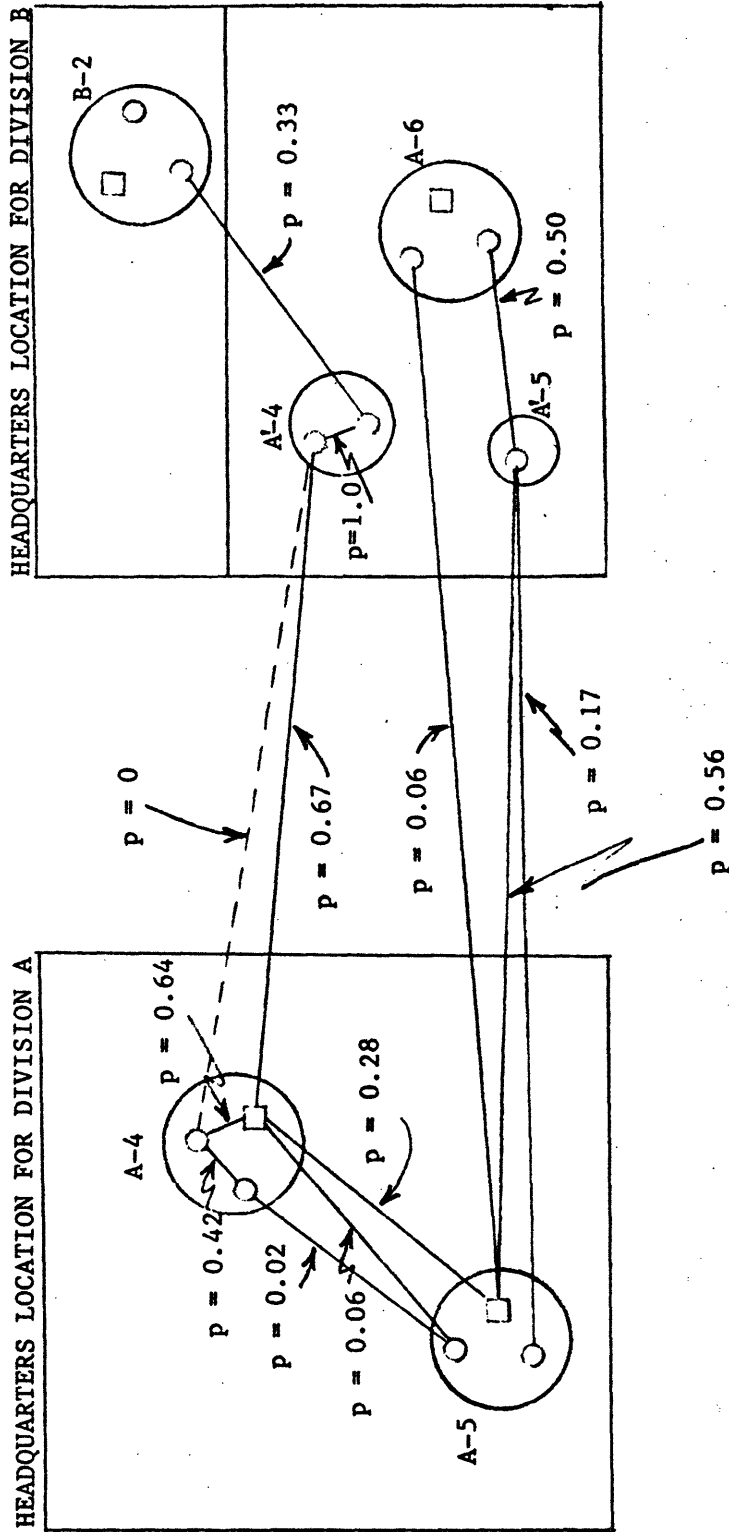
Figure 4. Probabilities of Weekly Communication Between Individuals When Departments Are Split Between Centers.

Divisional and Departmental Bonds in Combination

When both divisions and departments are divided across locations (i.e. some departments are removed entirely from divisional headquarters, and others are divided between headquarters and remote locations), the analysis becomes more complex but with reasonably predicted results (Figure 5). Inter-center communication becomes very high, but there is negligible effect on communication crossing both divisional and locational separations. Nearly all of the inter-center location is within a single division, while nearly all of the inter-divisional communication is within a single center.

The sum of all of the inter-center communication bonds is 0.68. The sum of all of the inter-divisional bonds is 0.42. The strength of that bond which is both inter-center and inter-divisional is only 0.002.

In Morton's (1971) terms, when both a physical and organizational barrier coincide (inter-divisional and inter-center) there is virtually no communication. Only when one of these barriers is replaced by a bond does communication follow. The combination of a physical barrier and an organizational bond seems to produce slightly more effect in this instance. The inter-center communication produced by the departmental and divisional bonds is about 60 percent greater than the inter-divisional communication produced by the common location bond. Unfortunately the amount of direct communication which is both inter-center and inter-divisional remains at a negligible level. The only hope for information passing to Division B from those segments of Division A located at its headquarters center, lies in the operation of intermediaries or relay points in departments A-3, A'-4, and A'-5.

In Figure 6, we see, as we did earlier, that nearly all of the inter-center communication is hierarchical. The most probable links all involve at least one department head. The highest probability connections are between bench-level

11

Figure 5. Inter-Center Communication When Both Integral and Split Departments
are Located Away From Their Headquarters

= Integral Department

= Headquarters of Split Department

= Segment of Split Department with
More Than One Professional

= Segment of Split Department with
Only One Professional

HEADQUARTERS LOCATION FOR DIVISION A

HEADQUARTERS LOCATION FOR DIVISION B

A-2

A-5

A-4

A-1

C = 0.11
(n = 194)

C = 0.05
(n = 81)

C = 0.05
(n = 81)

C = 0.002
(n = 1,429)

C = 0
(n = 36,490)

C = 0
(n = 2,085)

C = 0
(n = 74)

C = 0.01
(n = 144)

C = 0
(n = 603)

C = 0.33
(n = 6)

C = 0.32
(n = 19)

C = 0.02
(n = 47)

C = 0.03
(n = 33)

B-1

A'-4

A-3

B-2

C = 0.01
(n = 84)

C = 0.15
(n = 74)

A'-5

A-6

C = 0.33
(n = 9)

C = 0
(n = 18)

C = 0.50
(n = 4)

C = 0
(n = 12)

C = 0
(n = 29)

C = 0.22
(n = 9)

C = 0.01
(n = 81)

professionals in A^1-4 and $A^1$5 and the managers of A-1, A-4 and A-5. Communication with the manager of A-1 is the only exception to the rule of direct hierarchical communication. It is an important exception, however. The probability of communication between a professional in split department A-4 and the manager of an integral department at a different center is just as high as the probability of communication with that professional's own department head.

The professional in the split department comes to occupy a very special role. He has a high probability of communication with managers back at his home center, and a moderate probability of interaction with professionals in the division with which he is co-located. He provides the principal avenue for the flow of technical information between divisions.

SUMMARY

The foregoing analysis is the first real empirical test of the ideas formulated by Morton (1971) in his description of the Bell Telephone Laboratories interface with Western Electric. It shows that Morton was, as usual, correct in his assessment. Locating a portion of one organization at the site of another does indeed create a link between the two, albeit an indirect one. This analysis furthermore provides new information on the relative strengths and impacts of physical and organizational barriers and bonds. It shows that a physical barrier coupled with an organizational bond will produce a higher level of contact between professionals then will a combination physical bond and organizational barrier. In other words, at least in this one instnace, organizational separation has a more serious impact on communication then does physical separation.
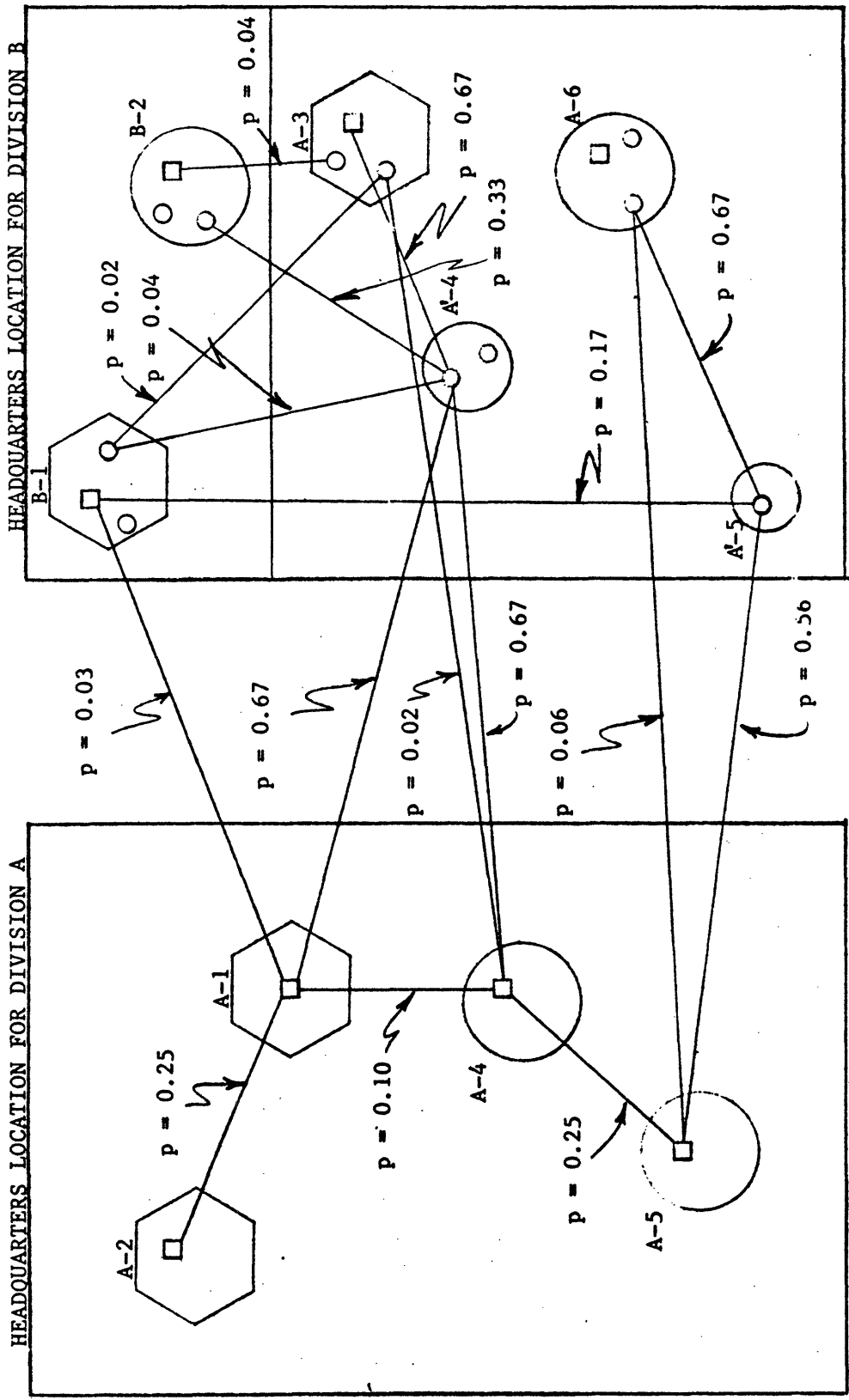
Figure 6. Probabilities of Weekly Communication Between Individuals When Both Integral and Split Departments are Located Away From Their Headquarters.

Of course all of the present analysis needs to be supplemented by data from other organizations and by further analysis. Additional analyses of these data are presently being pursued. Data were collected in the same organization, following a major re-organization. These data are being analyzed to further determine the impact of organizational variables on communication between centers.

REFERENCES

Allen, T.J. (1977) <u>Managing the Flow of Technology: Technology Transfer and the Dissemination of Technological Information within the R & D Organization</u>, Cambridge, Mass.: M.I.T. Press.

Allen, T.J. and A.J. Fusfeld (1976) Research laboratory architecture and the structure of communications, <u>R & D Management</u>, <u>6</u>.

Baker, N.R., J. Siegmann and A.H. Rubenstein (1967) The effects of perceived needs and means on the generation of ideas for industrial research and development projects, <u>I.E.E.E. Transactions on Engineering Management</u>, 14.

Allen, T.J. (1970) Communication networks in R & D laboratories, <u>R & D Management</u>, <u>1</u>.

Goldhar, J.D., L.K. Bragaw and J.J. Schwarz (1976) Information flows, management styles, and technological innovation, <u>I.E.E.E. Transactions on Engineering Management</u>, 23, 51-62.

Allen, T.J. and S.I. Cohen (1969) Information flow in two R & D organizations, <u>Administrative Science Quarterly</u>, <u>14</u>, 12-19.

Morton, J.A. (1971) <u>Organizing for Innovation</u>, New York: McGraw-Hill.