

A FIELD EXPERIMENT TO IMPROVE COMMUNICATIONS  
IN A PRODUCT ENGINEERING DEPARTMENT:  
THE NON-TERRITORIAL OFFICE

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## ABSTRACT

A year-long investigation was undertaken to determine the impact of a radical new scheme of office layout on work-related behavior, communication and performance. The office layout under investigation is best described as "non-territorial". It is an open floor plan arrangement, but goes far beyond the traditional open space office, removing not only office walls, but most permanent stations as well. Employees (product engineers) work at large round tables, which are distributed through the office area, and may locate themselves anywhere that they wish on any given day, or at different times during a day.

The experiment was successful to the extent that employees preferred the new arrangement over the traditional one and two person offices they had previously occupied and communication within the department increased significantly. It was unsuccessful in that no measurable increase in departmental performance was registered over the period of the study.

## INTRODUCTION

The effect of architecture on human behavior is a relatively new area challenging managers, architects, and behavioral scientists. Several recent studies have shown that the impact of physical layout on various aspects of behavior can be substantial. Inter-personal communication patterns which evolve among those occupying a particular office area, laboratory, building, etc., are especially susceptible to architectural constraints. A prime determinant of communicator choice is the physical distance separating the parties in the organization. Opportunity for establishing eye-contact with potential discussion partners and the sharing of equipment or physical space are important for developing personal contacts. These contacts are the prime vehicle for transmitting ideas, concepts, and other information which is necessary for assuring effective work performance.

The more diverse the training and experience of a group's personnel, the more it can benefit from an open exchange of problems and ideas among its members. In this manner a group can achieve greater problem-solving effectiveness. Where shared information will enhance the quality of group output, isolating individuals from their colleagues must be avoided. This is not surprising once one recognizes that employees are the principal repositories and disseminators of an organization's expertise. It is primarily through personal contacts with organizational colleagues that an employee, particularly a newly-hired one, gains access to the wealth of experience that the organization possesses.

### Product Engineers

The need for information exchange is particularly acute among product engineers. The product engineer plays a very special role in the organization. He mediates between the R&D and production departments, and assumes responsibility for maintaining product quality from the initial point in the production process through its eventual use, in the field. There is no organized body of literature to which the product engineer can turn when faced with a new problem. Instead he

must rely on his own experience, or the experience of others. This is where good communication that knowledge of his problem can reach the awareness of a colleague with relevant experience. And it is only through good communication that this relevant experience can be transferred to the man with the problem. Interpersonal communication provides the essential link between a problem and the experience required to solve it. Improved communication within a product engineering department<sup>2</sup> should lead to a sharing of problems and a sharing of information and experience essential to their solution.

#### The Experimental Department

The product engineers in this study were all members of a single department. Department size varied between 13 and 19 over the course of a year's study; altogether data were gathered from a total of 24 individuals. At the beginning of the study, the department was housed in a fairly standard arrangement with either one or two persons to each of several offices that were strung along a corridor. The department also maintained laboratory facilities located directly adjacent to its office area (Figure 1a).

#### The Non-Territorial Office

The non-territorial office<sup>3</sup> was designed specifically to improve and increase the sharing of problems and experience. It is an "open-floor plan" type of office, but goes far beyond any of the open-floor plan or landscaped office. Under this concept, not only are all office walls removed, but most desks and other permanent stations are eliminated as well. There remains but one permanent station, occupied by a "Central Communicator" who handles incoming and outgoing mail, assists visitors and operates a switchboard directing calls to the phone nearest the

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<sup>2</sup> Improved communication will certainly lead to improved performance in many other activities as well. Allen (1964; 1966; 1969), Pelz and Andrews (1966), Baker et al. (1967), Shilling and Bernard (1964) and Parker, Lingwood and Paisley (1968) have all shown performance to be strongly correlated with engineers and scientists.

<sup>3</sup> This idea was first conceived by Mr. Armand Beliveau of IBM. It was he who originated the concept of a non-territorial office and his management perceived the need for experimentation. (See Donofrio, 1970)

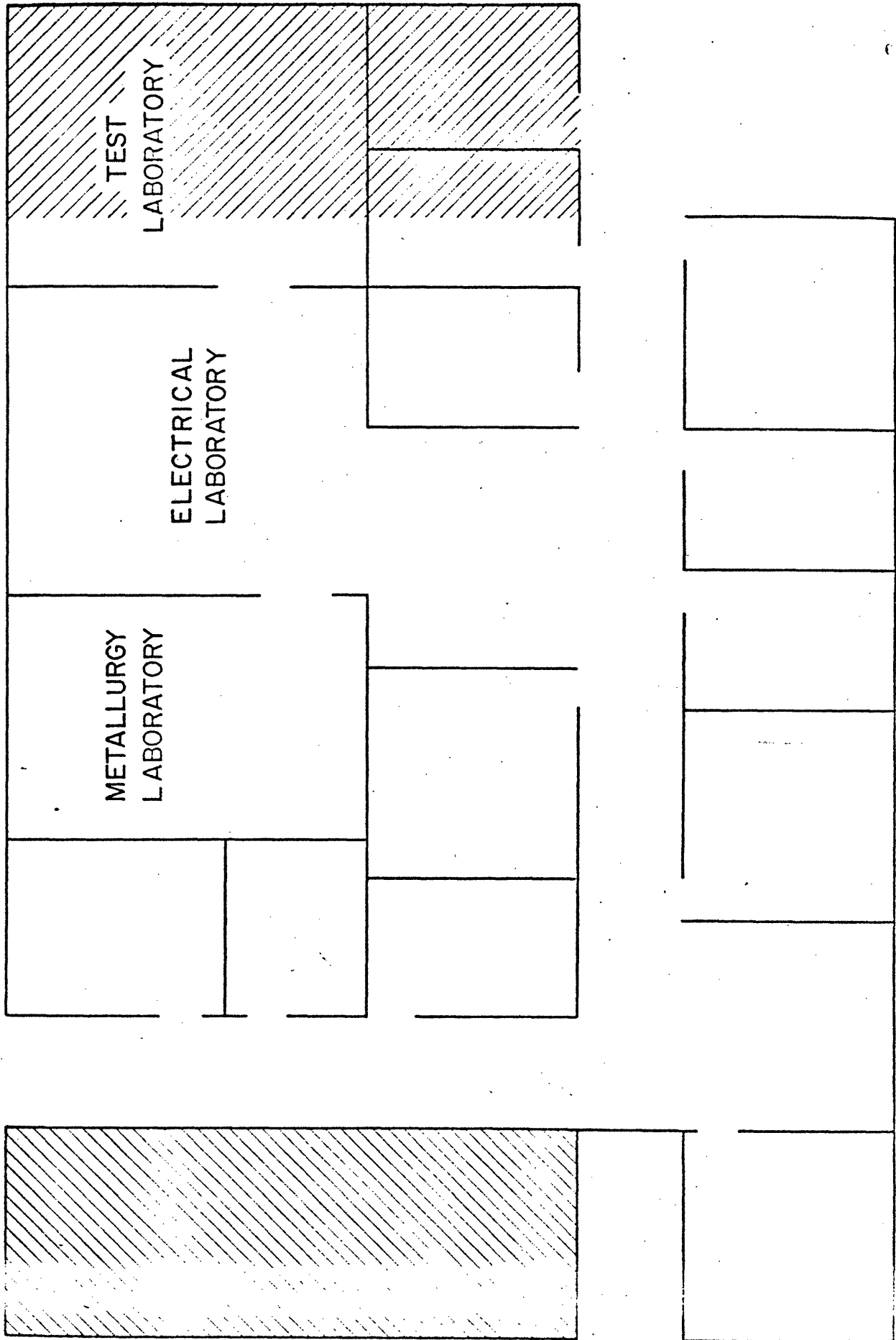


Figure 1a. Original Floor Plan of the Department

recipient of a call. All work is performed at laboratory benches and large round tables, and an individual may choose to work anywhere in the area that suits him or is convenient. In the experimental department, an electronic components laboratory, with all of its equipment, remains in its former position, adjacent to the old office area, but it is no longer enclosed. Free access can now be had between the table area and the laboratory area. In addition to the laboratory, there are three other special areas (Figure 1b). A computation area is partially screened to contain noise, and houses consoles for access to a computer. A Quiet Area is enclosed by one wall and a drapery, contains comfortable chairs and can be used for meetings, performance evaluation, or work requiring high concentration and minimum disturbance. Finally, a Total Quiet Room (formerly the department head's office) is retained, so that an individual or group can work behind a closed door, if such is desired.

The area was very attractively and tastefully decorated and a number of items such as carpeting and cloth murals, were provided to reduce noise level.

#### RESEARCH METHODS

All measurements, with the exception of the performance measures were applied to both the experimental department and a control department doing similar work at one of the company's other plants, about 200 miles away.

Since the principal effect expected is an increase in communication, communication was measured at three levels:

- a. communication within the experimental department
- b. communication between the experimental department and other departments at Essex Junction
- c. communication outside of the Essex Junction plant

All of these were measured by a single page questionnaire, administered weekly on random days for a period of three months prior to the introduction of the non-territorial office and eight months after the facility change. The questionnaire listed

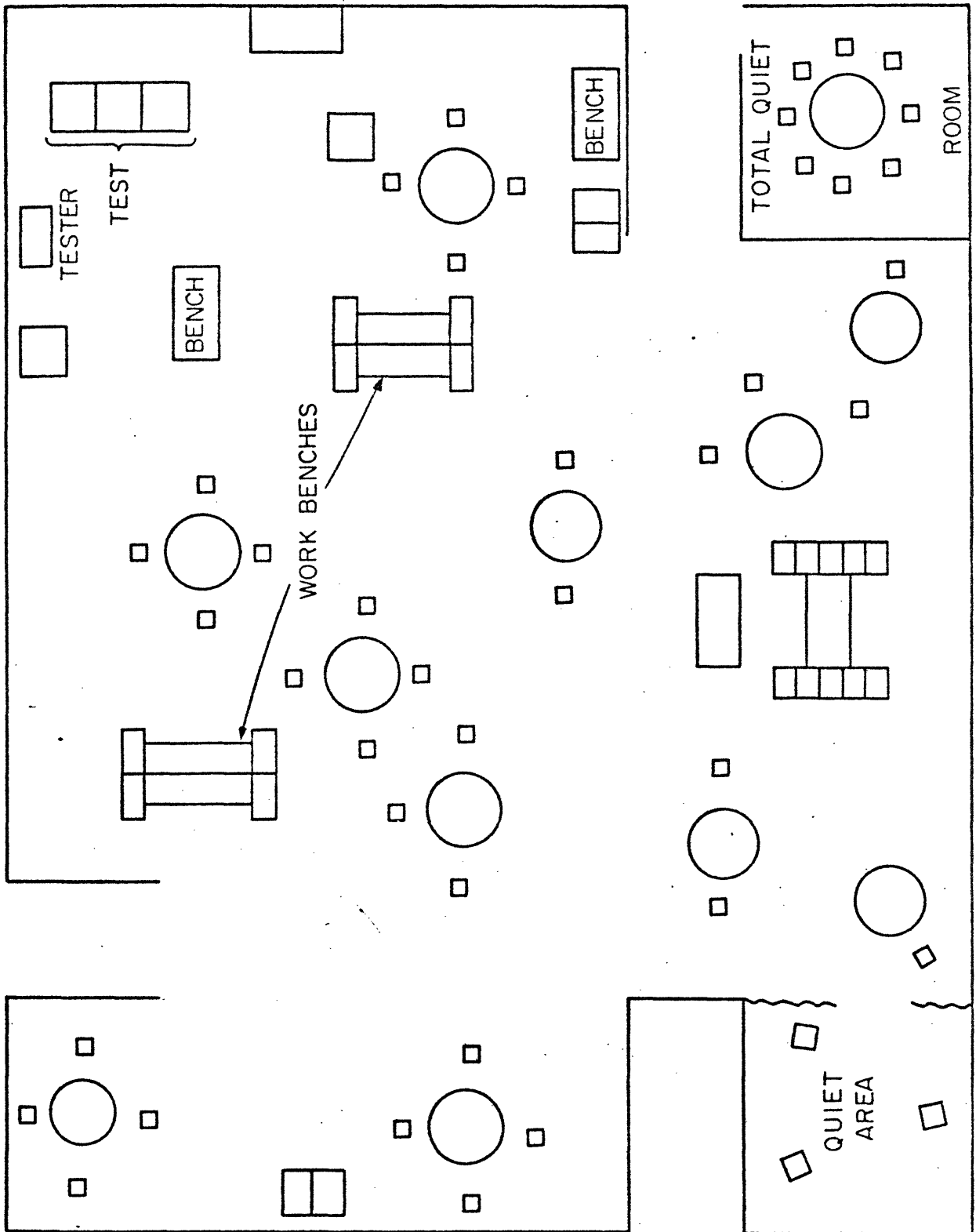


Figure 1b. Floor Plan of the Non-Territorial Office

the names of all those in the department and required only that a number be circled to report the number of communications with someone on the sampling day. Since two reports were therefore available on each communication, a very simple reliability check could be made on the basis of un-reciprocated reports. Communications outside of the department were reported in a similar way, with the single exception that names had to be entered by the respondent.

Removal of office walls, even without the removal of desks and permanent stations can often be very upsetting to employees, so employee acceptance of the new scheme had to be ascertained. This was done by a questionnaire which was administered two months prior to the change, three months after the change and again five months after that.

Since there was a distinct possibility that the non-territorial concept would fail because occupants might still "stake a claim" to their own territories within the open area, a measurement had to be taken of the choice of seating position. This was done with a large diagram showing the locations of all tables and work benches. On the diagram, an assistant wrote the names of people in approximately the location they were sitting or standing, at the time. This was done on the communication sampling days at 11:30 AM, 2:30 PM and 4:00 PM.

Performance was measured by means of interviews with members of departments which had often served as "customers" of the experimental department. Key personnel in the customer departments were asked to rate the experimental department in terms of four job dimensions.

Unless otherwise specified in the sections that follow, only measurements obtained from those individuals who remained in the experimental department throughout the study period will be reported. This is one of the serious limits imposed on longitudinal field research. Over the period of a year, internal turnover of personnel reduced the number of individuals participating in the study from 19 to 13. Two more engineers were later transferred out of the



department (three and five months after conversion), but they had both submitted a sufficient number of pre- and post-change communication questionnaires to be included in the comparison. One other man was transferred out shortly before the change, but returned four months before completion of the study. His communication patterns are therefore included in the comparison. Four engineers were transferred into the department after the change. Their data taken will be shown only in those instances in which it sheds additional light on some issue.

## RESULTS

### Employee Satisfaction with the Non-Territorial Office

In the minds of the investigators, this was the critical ingredient in the whole study. Could people adapt to the idea of working without a home base that was personally theirs? Much has been written in recent years about the instinctive drive to claim and defend a personal territory. While the investigators certainly do not subscribe to all the claims for a "territorial imperative" among humans, they remained skeptical when it came down to removing all the vestiges of personal space from a person's working environment. The amount and type of personal space has become one of the principal means of communicating one's status in an organization, and the opportunity to decorate a personal space has become one of the few remaining avenues for expression of individuality in large organizations. The removal of both of these, it seemed, would almost surely produce dissatisfaction. This can be clearly seen in the amount of fear that is aroused in most people when presented with the possibility of having to work in a non-territorial office.

For these reasons, it was essential that employee satisfaction with the arrangement be measured along as many dimensions as possible. Measurements were made in both the experimental and control groups two months before the change, and eight months after the change. As the result of internal personnel transfers, there are only ten people in the experimental department for whom a valid

before-after comparison of satisfaction can be made.

In general, the feelings among department members about non-territoriality have shifted in the favorable direction. Although the amount of space has not changed, they feel as though there is more (Table 1). What is even more surprising, although the shifts are not statistically significant, they feel that

TABLE 1

Mean Level of Satisfaction with Work Environment Before and After Introduction of Nonterritorial Office (five point scale) <sup>***</sup>						
	experimental department			control department		
	before	after	p <sup>*</sup>	before	after	p <sup>*</sup>
Amount of space for the job	3.33	3.78	0.05	3.60	3.92	NS
Amount of privacy	3.42	3.78	NS	3.87	3.73	NS
Amount of noise	2.69	2.50	NS	3.96	3.83	NS
Amount of distraction	2.96	3.24	NS	3.50	3.40	NS
Ease of communication	2.14	3.33	0.005	3.33	3.73	NS
Feeling about working in a non-territorial office	3.23	4.19	0.05	--	--	

<sup>\*</sup> Wilcoxon Matched-Pairs Signed Ranks Test      <sup>\*\*\*</sup> 5 = high

they have more privacy and less distraction. This must result from the shift from two person offices where privacy is low and distraction high. In the non-territorial office, it is actually easy to bury oneself in a corner and avoid distraction. There are certain places where, if someone is sitting it is obvious that he wants to be left alone. Norms seem to have developed around this which allow a person to control his privacy and the amount of distraction he confronts.

Perceived noise level has increased but not significantly. This is one of the inherent difficulties in open floor plan offices, and must be carefully watched.

Ease of communication and overall feelings about the non-territorial office both increased significantly. It appears that the longer a person works in this sort of office, the more favorably disposed he becomes toward it. There was a fairly even range of responses in the "before" measurement, with five out of ten indicating a negative, or at best an indifferent attitude toward it. After eight months, one man remained indifferent; all the rest showed positive responses. Direct exposure to the non-territorial office reduces the fear that seems inherent in the idea. The longer that people work in this type of environment, the more they come to like it. In addition to the questionnaire data, several of the engineers volunteered their opinions to one of the investigators, with such comments as, "Don't ever fence me in again!" or "I was skeptical before, but I'd hate to go back to closed offices now". It certainly would seem at this point that our apprehensions over employee acceptance should be laid to rest. Of course, we might have nothing here but a "Hawthorne Effect", but it seems doubtful that such a condition would persist for over eight months with relatively sophisticated workers. Furthermore, if positive responses could be prompted simply as a result of the special treatment accorded the department, there would not have been so many negative responses in June. The "special treatment" had actually begun some time prior to June at the time when the department was selected for the experiment and first told about it. All members of the department had viewed scale models of the new facility arrangement for several months before the June survey, and had seen or talked with the architects and designers, who almost constantly visited the area during the Spring of 1970. If being specially selected elicits positive feelings, then those feelings should have been evident at the time of the June survey. The control group, which was told that they had been specially selected for a study on which future facilities planning would be based, did not shift significantly on any of the dimensions of satisfaction (Table 1).

### Communication Patterns

Intra-departmental. Among the members of the experimental department, communication has increased significantly<sup>4</sup> both in terms of the number of communications per man ( $p < 0.02$ ) and in the number of individuals ( $p < 0.01$ ) with whom the average engineer communicates (Figure 2). In the original office arrangement, the pattern of communications was very strongly influenced by the positioning of offices. An individual communicated quite a lot with his office partner and perhaps with a next-door neighbor but there was little tendency to go much further. As expected, this has disappeared. Communication is now more evenly spread through the department. It is also far heavier. Prior to the facility change, the average engineer communicated with a departmental colleague 8.04 times per day, or about once per hour. These communications were held with 3.56 different individuals for an average of 2.26 communications per person. Following the change, the number of daily communications increased to 11.82 and were held with an average of 6.30 individuals. This results in a rate of 1.88 communications per individual. In other words, while the number of daily communications increases under the new scheme, the number of people, with whom an individual communicates, increases at an even greater rate. The average engineer, therefore, has daily contact with a higher proportion of the members of his department under the new scheme.

It is important to note that the number of people with whom an engineer communicates actually increased over a period in which the pool of available communication partners was shrinking. At the outset of the study, there were 19 people in the department. Over the course of the study this number gradually shrank to a low of 12, and it was only in the closing months that new members were introduced, and one former member returned, bringing department size back up to 16. When new

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<sup>4</sup>Analysis of Variance with Nested Classifications.



members are taken into account (dashed line in Figure 2), the average number of people with whom communication is held increases to 7.68. This is more than double the initial level.

### The Territorial Imperative Revisited

Basic to the concept of the non-territorial office is the implicit assumption that people will not remain at the same work station, but will position themselves wherever they can work most effectively at a given time. If people "stake out" their own territories and remain within them, the facility becomes no different from any other open-plan office. With no previous direct experience upon which to draw, the question of the occupants' reaction remained an important one up until the time of the experiment. There was no way to determine a priori whether individuals would decide upon favored positions and then spend most of their time at those stations or vary their location from day to day and, hopefully, even within each day. The limited evidence available up to the time of the experiment tended to favor a tendency to establish personal territory. Studies in old age homes and mental hospitals (Sommers, 1969) indicate that the occupants of such institutions frequently establish personal territories, whether a particular seat at the dinner table, a favored chair in a lounge or even a specific tree to sit under during a summer afternoon. Furthermore, they can become very upset when someone preempts what they consider their special territory. Even at home, most of us have favorite chairs, and will be quick to assert our territorial rights should it be invaded by one of the children or sometimes even when a guest makes this mistake.

From this point of view, the chances for successful operation of the non-territorial scheme appeared slim. To help offset this, occupants were advised that they could maintain no personal artifacts in the new area. All photographs and even books had to be taken home. Needed personal books would be replaced by the company and remain departmental property. While this approach seemed necessary,

it was feared that in addition to being unsuccessful it might engender some resentment on the part of participants. To see whether it could be the source of any dissatisfaction displayed later on, an inventory was made of the number of personal artifacts displayed by each engineer in his old office. These ranged from a single motorcycle helmet to several family photographs and a series of company awards and engineering certificates. It included maps, plants, office equipment and drawing easels.

In fact, rather than laying claim to any specific position, the occupants seem to prefer to move about considerably over the course of a day. No one spent more than 50 percent of his (at table) time at a single table, and the median proportion of time allocated to a single table by any individual is less than ten percent (Figure 3). People do have preferred tables, but there are usually two or three of these and they tend to be in very different parts of the office area. An engineer, typically, can be found moving back and forth between these tables during the course of a day. Specific tables also become identified somewhat with function. Those near the laboratory benches are used when considering or discussing test results. Tables near the windows seem to be used more for solitary, more analytic work. The total quiet room and partial quiet area were both seldom used. In a total of 71 samplings, someone was found in total quiet room three times and in the partial quiet area five times. The low utilization factor, however, should not be taken as an argument against such areas. It may well be an absolute necessity to provide these "safety valves" in order to make the non-territorial concept acceptable.

Product engineers spend a reasonably high proportion of their time outside of their office area. They have to visit the production line frequently and coordinate their work closely with people in other parts of the plant. In addition, there are the usual meetings which must be attended outside of the area, training courses and absences from work.

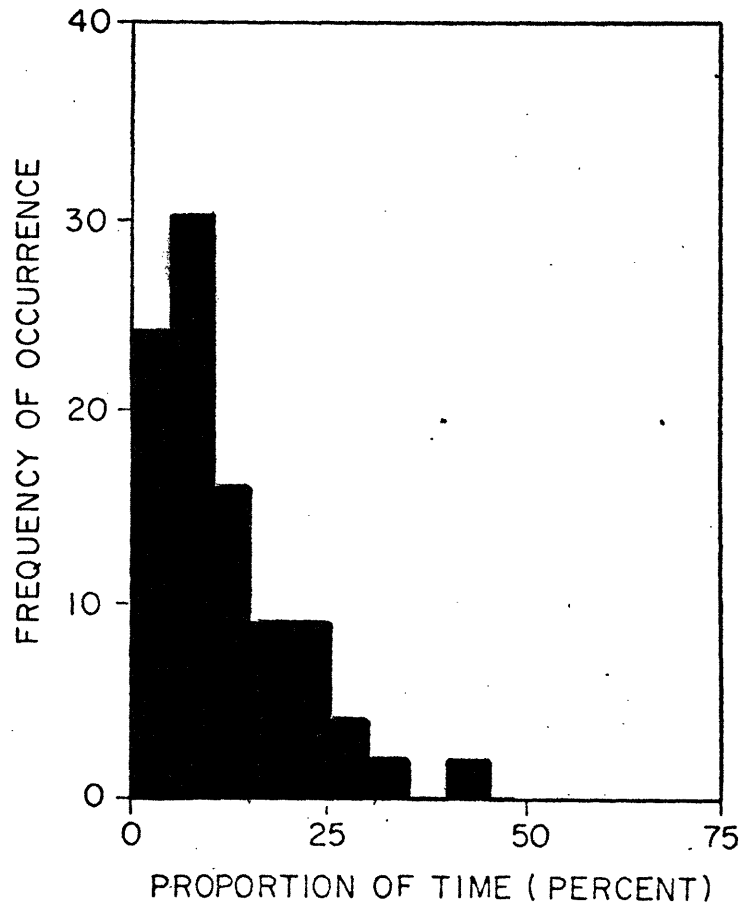


Figure 3. Proportion of Time Spent Working at Tables, Which is Allocated to One Table.

An examination of the proportion of the department actually present in the facility at any given time produces some interesting possibilities (Figure 4). The median proportion present during any sampling is 62.5 percent. The distribution is very skewed, however, so that there is a reasonably high probability of finding as many as 80 percent of the department present in the area. The amount of floor space allocated to the department could thus be reduced by as much as 20 percent (or the number of people assigned to the areas increased by 25 percent) with little danger of overcrowding. The proportion of people present in the area appears independent of the number of people assigned to the department, at least within the range of 13 to 17.



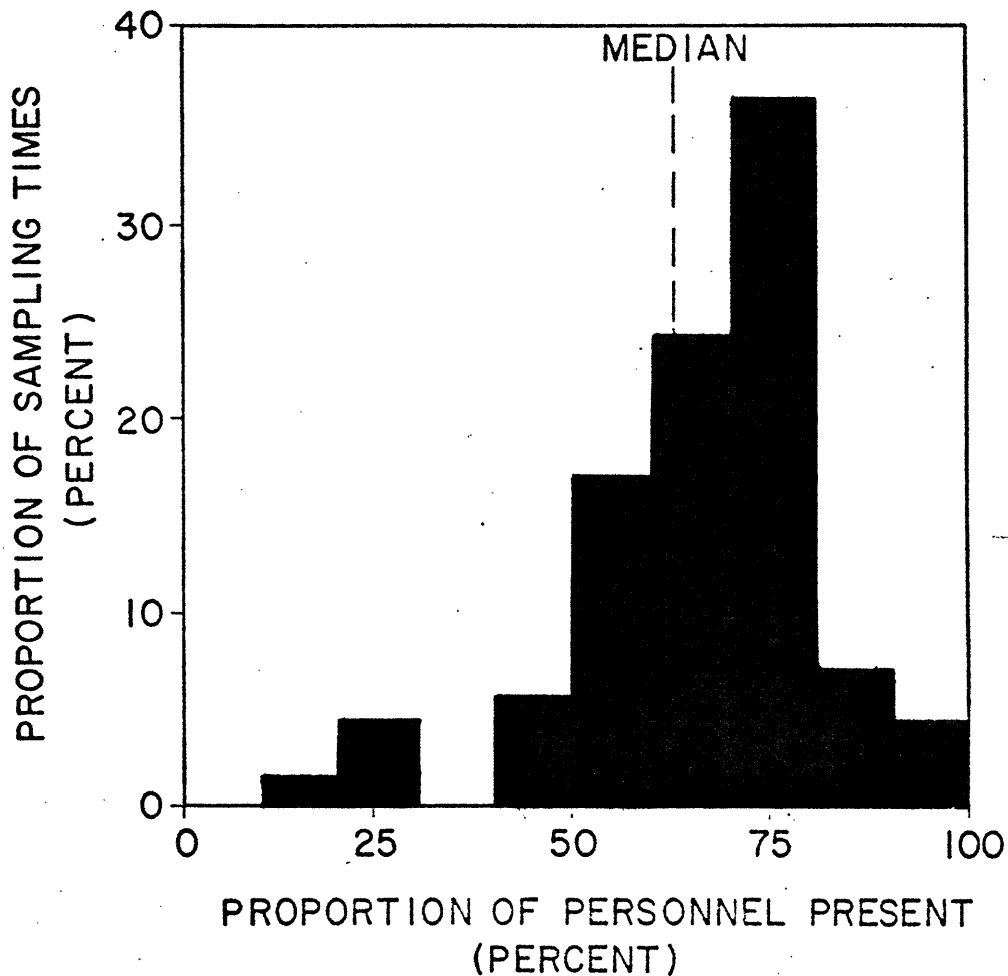


Figure 4. Proportion of Time That Various Proportions of the Total Departmental Complement Are Present in the Area

Under the territorial approach whether closed office or open plan, a certain number of square feet must be assigned to each individual, and when he is absent, it must remain unutilized. With the non-territorial scheme, an individual is not assigned a specific area of so many square feet, but is allowed the same amount of area (or more) with no specification as to location. An area will, therefore, go completely unoccupied far less often. As one man moves out another moves in. By the time the first returns, someone will have left, and so on. This will be a very important consideration in many cases in which the actual utilization factor can fall far below the 80 percent found in the experimental department.

Inter-departmental Communication. Communication with other departments was measured to determine whether by increasing the cohesiveness and degree of communication within the department, the new facility caused the department to isolate itself more from the rest of the organization. There is a substantial body of evidence to show that as groups increase in cohesiveness they tend more and more to seal themselves off from external contact and influence (see for example Pelz and Andrews, 1966, chapter 13). There was a fear, therefore, that by enhancing the group's internal coordination and identity, the new facility might detract from external communication. It was quite surprising to find that for a short period of time following the facility conversion, there was actually an increase in the level of inter-departmental communication. This led to the tentative decision in December that the non-territorial facility may have improved the degree of contact with other departments. Over the long term, however, communication dropped back to its old level (Figure 5). The temporary increase was most probably due to curiosity which attracted people from other departments into the new facility. After four or five months, the novelty wore off and fewer people were drawn in, Interaction with other departments has returned to its prechange level. The dashed lines in Figure 5 show the level of inter-departmental communication when all members of the department (not just those who were continuous throughout the study) are included in the analysis. Up to the point of facility conversion, this has little effect upon the mean interaction level. After conversion, however, as new engineers are brought in, they retain contact with members of their old group for some period of time and thereby increase the level of inter-departmental communication. By completion of the study, the oldest transfer had been with the experimental department a little over four months and his communication behavior was approaching that of the other department members. New transfers probably communicate more outside of the department for the first six months or so following their transfer but then behave like any other member of the department. The continuous turnover of

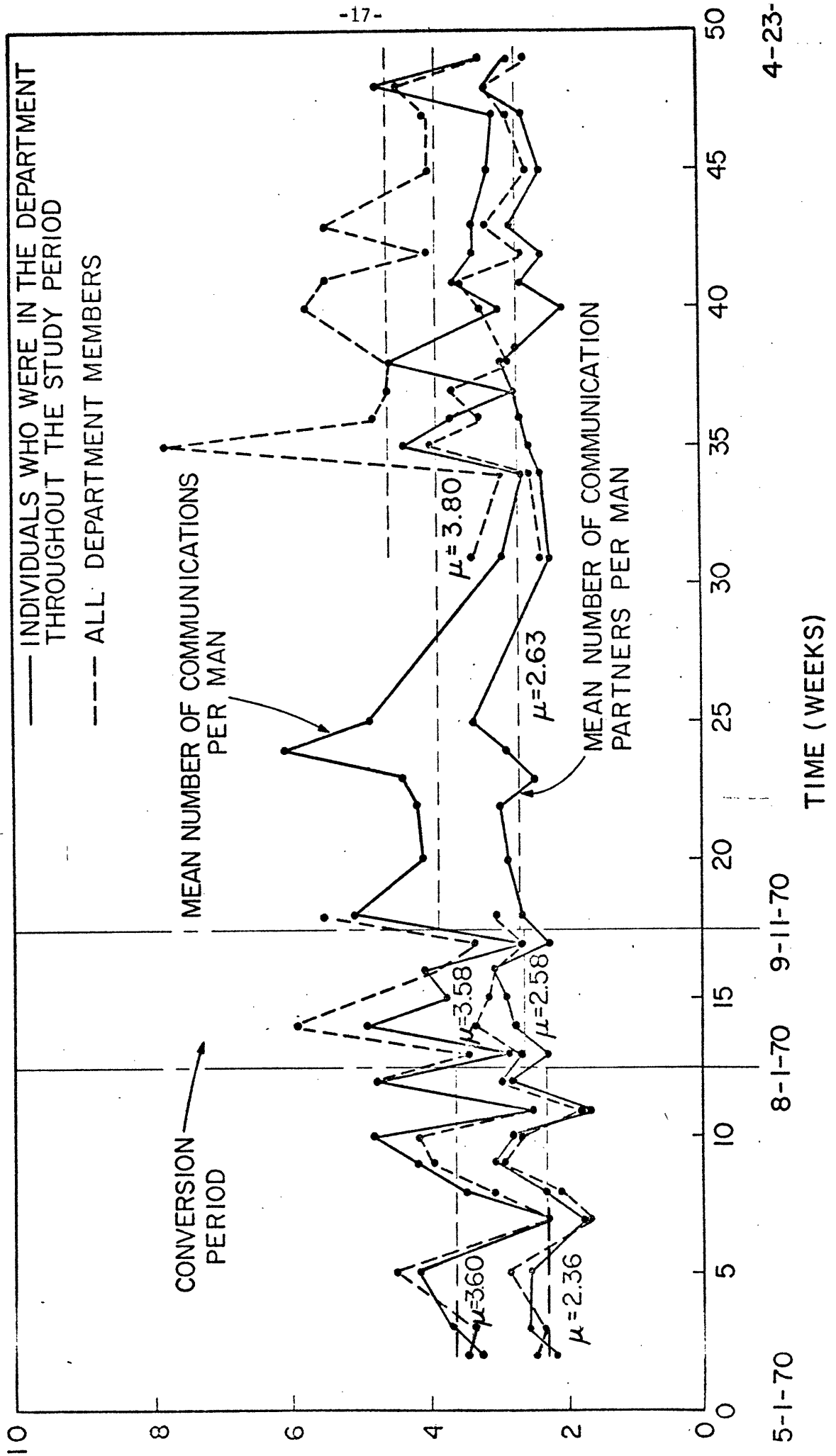


Figure 5. Inter-Departmental Communication Before and After the Introduction of the Non-Territorial Office

personnel between departments has the very beneficial side effect of promoting inter-departmental communication and preventing the isolation of departments from concern with the rest of the organization (Cf. Allen, 1970).

Communication outside of the plant was unaffected by the facilities change. This is to be expected. The measurement was made only as an additional check on any "experimental effect". If the group were inclined to over-report communications within the plant, they might, conceivably, over-report external contacts as well. The fact that they did not lends greater credibility to the internal communication measurements.

#### Performance of the Department

The strongest statement that can be made about the department's performance is that it has not changed as a result of the introduction of a non-territorial office. Performance was measured through structured interviews with members of other departments in the company, who served as internal "customers" to the experimental department. Eleven individuals were interviewed in June 1970 (before the facility change). Of these only four felt they still had sufficient contact with the department to evaluate it in May 1971. For this reason, a man from the same department was substituted for one of the June 1970 evaluators and ratings obtained in December 1970 were used for four more. This gave a total of nine separate before-after evaluations, but with no control over individual differences among the evaluators. There is no way of knowing what the other seven would have said, had they remained in contact with the department, and the reader need hardly be reminded that the use of substitute evaluators provides no before-after control over the tendency for individuals to be either easy or harsh in their evaluations, generally. Any concern over this should disappear, however, once the results are viewed. There is no apparent difference between 1970 and 1971, in the department's performance. While the general performance measure decreased slightly, but not significantly, performance along specific dimensions showed a non-significant increase (Table 2).

TABLE 2

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Departmental Performance Before and After  
the Nonterritorial Office

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<u>Performance Measure</u> <sup>*</sup>	<u>Before</u>	<u>After</u>	<u>p</u>
General appraisal	3.75	3.52	0.22
Aggregation of evaluations along four dimensions of performance	2.66	3.11	0.15

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\* 1 = low, 5 = high

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It is hardly necessary to enumerate all of the possible reasons for the failure to detect any performance differential. The most obvious is the loss of seven out of 11 evaluators. But then, it is entirely possible that the improved communication does not and will not improve the department's performance. On the other hand, eight months may be an insufficient period of time for the effects of better communication to be realized. Finally (and perhaps this is a very important consideration) there is every reason to believe that at least some of the evaluators were jealous of all of the attention being received by the experimental department and this influenced their evaluations. This was demonstrated during the course of the evaluation interviews when many disparaging remarks were made about the special treatment accorded the experimental group and the attractiveness of the facility they were given. Such remarks as "We don't need such a fancy work area over here. We produce anyway." It is extremely difficult to determine which of the explanations holds the greatest weight. However, after listening to the "sour graps" expressed by some of the evaluators, it is surprising that the measured performance didn't decrease.

## Conclusions

The most important and most obvious conclusions to be drawn from the experiment is that the non-territorial idea works. It not only reduces facilities costs by eliminating the need for rearranging walls, air ducts, etc. every time an area is re-organized (Donofrio, 1970), but it also allows for the allocation of space based upon an expected population density at any point in time. More important than the cost savings, however, is the fact that people find it comfortable to work in. Those who have experienced it, prefer the non-territorial area over traditional forms of office arrangement. Furthermore, communication and coordination with the experimental department have increased significantly. And while it is not yet reflected in the data, this cannot help but improve the department's performance over the long run.

The non-territorial concept has not proven successful with product engineers and can be quite readily adapted to similar groups. It is most likely to succeed with groups who spend high proportions of their time outside of their office area. Groups who spend most of their time in other areas are accustomed to moving around on the job and are more likely to accept the loss of a permanent individual station. It is with such groups, too, that the most return can be gained from designing for expected levels of occupancy.

It is quite easy, at this point, to envision situations in which entire production lines are surrounded by non-territorial areas. Each function (i.e., product engineering, quality control, etc.) would have an area marked off by carpet color, partial walls and other partial visual blocks, and would be allowed positions only within the reach of its switchboard. There would be improved coordination within functions, and due to the absence of full walls, access and communication among the functions would be freer. There are many situations in which such a layout is a feasible possibility. The potential for cost reduction and improved coordination around the production line is certainly great

enough to warrant further experimentation and adaption.

A remaining key question is that of introducing the idea to new occupants. When first suggested, it produces, at best, mixed reactions. In fact, it can provoke a good deal of fear or even panic among those who have not yet experienced it. Table 1 demonstrates effect of experience in reducing this fear. If word were to get around that this non-territoriality were going to be adopted widely through an organization, it is easy to imagine the panic it might cause. Some means must be sought of producing the experience without inducing the fear.

Fortunately there is a solution. Every large organization makes frequent use of temporary teams, such as task forces and proposal teams. Moreover, there is usually some difficulty in locating space suitable for these teams. The non-territorial office with its inherent flexibility is a natural for such use. An area could easily be set aside for the use of temporary teams and laid out in a non-territorial fashion. This would pose no threat to team members since the situation is a temporary one and they will return eventually to the security of their old offices. During their exposure to the facility, however, they may very well come to like it as much as the experimental group in the present study did, and a grass roots demand can thereby develop. In the meantime there is the added bonus of improved coordination within the temporary team.

Additional experimentation is certainly necessary. It must be determined just where the non-territorial office will and will not work. It must therefore be tried in functions other than product engineering, on a small quasi-experimental scale to begin with. Any widespread use must be carefully planned in its introduction. After considerable thought, we believe that the approach through temporary teams is the best one, at least until a sufficient number of people have experienced it, so that the fear reaction can be minimized.

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