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MANAGEMENT PROBLEMS
THE RESEARCH AND APPLICATIONS INTERFACE

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December 16, 1969

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"What can you tell me that will help me become a better manager?"

"Not much."

"What's the best way to manage an organization?"

"That depends."

"And you call yourself a professor of management?"

Though this specific dialogue probably never occurred, it certainly exists in the fantasies of both academician and practitioner. Because the questions asked are important ones, they deserve more response and discussion than the laconic answers given above. However, it is almost impossible to tell a man much that will make him a better manager. Good management practices are learned from personal experience, the experience of others, and observation.

What is meant by "That depends" in response to the question above? It means that there are different ways of managing different organizations and of managing the same organization at different times. There are different methods that are best for each manager; these methods should change depending on the situation.

Management is an art developed from experience. Experience involves

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considerable trial and error, which is inefficient in terms of the time and cost of errors. Thus an attempt must be made to teach good management practices in a way that will permit the present or future manager to acquire the art in a minimum time with a minimum number of costly errors.

There are many problems involved in teaching the art of management. First, most management theory is not based on research, but on the experiences and observations of managers in types of organizations that are becoming either less important or extinct. When we use unscientifically gathered data, we tend to rely on biased and anecdotal information which may work well in one environment but not in another. This tends to complicate the problem of helping the manager learn when to apply the appropriate technique. Second, the manager's experience may consist of a repetition of previous experiences rather than acquisition of new experiences which would stimulate learning. Third, it is often difficult for a manager to understand the application of findings of social and behavioral scientists to his specific situation and problems. As academicians, we are challenged to provide the practitioner with well-designed experiences which result in significant amounts of new learning. Most important, we must provide him with ways of perceiving the relevance of scientific findings and with ways of observing and evaluating behavior so that what he learns can be applied with the desired results.

The Management Laboratory at USC was established to deal with these problems. The Laboratory consists of four rooms, one of which is separated from the other three by one-way glass. This central room is ordinarily used as a control and observation area. It contains telephones to the other rooms, voice intercoms, audio and videotape recording equipment, and timing equipment.

One of the major purposes of the Laboratory is to teach management by exposing people to experiences which help them learn by observing their own behavior and that of others in their groups. To accomplish this, students and staff have developed exercises which are analogs of common management or organizational behavior problems. Groups participating in the exercises work to solve the same problems under various experimental conditions. Upon completion of their task, the groups receive feedback on their behavior and on the methods they used to solve the problems; they also receive feedback on the ways in which other groups dealt with the same problem. Material gathered in these experiments is compiled and organized for feedback to later learning groups.

The use of feedback is emphasized as the most essential element for student learning. Effective feedback for learning includes systematically reporting the behavior observed during the exercises. Participants discuss

what they were trying to accomplish, what they actually accomplished, and what relevance these experiences may have to their other activities. It is important to emphasize objectivity rather than evaluation of the behavior involved. The most objective kind of feedback is videotape replay. Such feedback is rather time consuming, however, and often does not focus on the essential elements of the problems which occurred. Thus it is used less frequently than person-to-person feedback.

The best kind of personal feedback is that from peers, because peers operate within a similar value system. Peer feedback is better understood by the receivers and is also more relevant to their behavior. Although groups express a desire to get "expert" feedback from the behavioral scientist in the Laboratory, it is our observation that the best, most efficient, and most useful feedback is that provided by a peer who has received some training in what to look for and how to report it.

It is explicit Laboratory policy that participants in all Laboratory exercises know the general purpose of each exercise. No attempt is ever made to mislead anyone in either the exercises or observation of the exercise. The operation of the observation and recording equipment is described and/or demonstrated to participants who, thereafter, generally pay little attention to it. This helps to alleviate participants' self-consciousness about being experimental subjects and helps build a feeling of trust of Laboratory personnel.

About half the experimental subjects of our NASA-sponsored research are undergraduate and half are graduate students of Business Administration. Graduates are for the most part senior technical people or are working managers from local companies. The majority of the latter group are from the aerospace industry and have engineering degrees. Graduate students who are employed in industry tend to see the applicability of the Interaction Exercises to the problems encountered in their daily work. A statistical analysis of the exercise task performance shows no difference between graduates and undergraduates even though the graduates are better able to apply the learning.

The findings of the studies described below are not intended to provide managers with directly usable solutions to management problems, but rather to suggest new ways of looking at these problems and new avenues in which to search for solutions.

RESEARCH

Organization Change and Task Complexity

One of the first problems formally studied in the Laboratory was brought by a student in an organizational behavior class which met in the Laboratory. The student was an engineer employed by a large aerospace firm. Faced with the problem of integrating into one program a work group composed of people from three separate space projects, the student was concerned with the kind of organizational structure that would be needed. Class discussion of management theories did not provide an answer to this problem.

Research data and theories from social psychology indicate that our perceptions of a situation depend on our expectations of it or on our previous experience with similar situations. So we decided to conduct a laboratory experiment to see whether this general concept applied to organizational structures. The study attempted to develop a theoretical basis for understanding one aspect of the relationships between task complexity and organizational structure. It tested the hypothesis that an organization can best deal with increasing task complexity by decreasing its organizational structure.

Communication net research by Bavelas (1950) and Leavitt (1951) and others has shown that different organizational structures are best for different kinds of tasks. More centralized (or highly structured) groups can best accomplish simple tasks, and less structured groups can best accomplish more complex tasks.

Later studies by Cohen and Bennis (1959 and 1961) show that groups which are highly structured when they begin working will decentralize (or decrease the amount of structure) if given the opportunity, but that they prefer to retain some structure. Our study dealt with the interrelationships between task and structure. Since dealing with tasks of increasing difficulty seemed the most relevant half of the problem, this study dealt only with tasks of increasing complexity.

Method

The exercise used in this experiment is called "3-D." Each of the 54 five-man groups in the study performed the same four tasks in the same order. The tasks were building puzzles or structures from Tinkertoys to match color photographs of completed puzzles. The first two puzzles, which were relatively simple, consisted of 28 and 38 pieces, respectively. The next two were

approximately twice as complex; they had 59 and 64 parts, respectively. Most groups took about twice as long to build these puzzles as they did to build the simple ones.

Nine two-part experimental arrangements were used, with six groups for each arrangement. The nine arrangements were all possible combinations of three organizational structures, where structure could change after the second puzzle was completed.

The first of the three structures used one leader (who had sole access to the picture of the puzzle to be completed) and four workers who assembled the puzzle as the leader directed. The leader had to stay at one end of a 4' x 8' table opposite from the workers and puzzle parts; he could not show them the picture or touch the puzzle parts. The second organizational arrangement involved two leaders (both could see the picture; one could also touch the puzzle parts) and three workers. The third organizational structure was essentially leaderless and structureless; all group members were able to see the picture and handle the puzzle parts. In most groups, all members exercised some leadership functions in this mode.

The criterion was time required to assemble each puzzle correctly. If there were errors (parts not connected correctly) when the group thought it was finished, the experimenter told them that the puzzle was not correctly assembled and continued to time the group until correction was made.

Analysis and Results

In preparing the data for analysis, the times for completing the first two puzzles were combined, as were the times for completing the last two puzzles.

The six groups in each of the nine experimental conditions consisted of three groups of undergraduate students and three groups of graduate students. The first analytic step was to determine whether data from groups of graduate and undergraduate subjects could be combined for analysis. For each of the three starting conditions, we tested for differences between mean times for graduates and undergraduates using Student's "t". All three t's were below .35, indicating no significant differences in initial task performance between graduates and undergraduates. The data from the sub-groups within each experimental condition were, therefore, combined for the rest of the analysis.

Analysis showed that the best performance on both the simple and complex task was by groups with the least organizational structure. However, the

groups which best accomplished the simple tasks did not do best on the complex tasks. The best performance for the two complex puzzles was by the groups which had done the first two tasks under medium structure and then had decreased structure as task difficulty increased. Are these findings significant or mainly sampling phenomena? Statistical tests clearly indicated the superiority of decreasing structure over constant and increasing structure. The test showed that the performance of groups with decreasing organizational structure was better than groups with constant or increasing structure ($p < .05$).

Some results of this experiment are better presented descriptively than statistically. The way in which the groups worked is an example. Groups that started with everyone having access to the picture built the puzzle efficiently, but they did not seem to develop much effectiveness for dealing with other similar tasks. Different people performed different tasks, but no one seemed to develop much awareness of what others were doing or why; a language to describe the puzzle parts did not develop. Thus, when the task became more difficult, those groups did not have the tools for coping efficiently with the greater task complexity. By contrast, the groups which started with only one or two persons able to see the puzzle learned group skills and habits useful for dealing with the more complex puzzles.

Another finding was that very often the most disorderly looking process was most efficient for completing the task. Work groups were seldom able to evaluate their own efficiency (as compared to other groups); observers frequently expressed surprise at how fast the job was completed when confusion reigned from beginning to end. Most groups enjoyed the disorderliness, especially if they had worked together on other tasks; but some groups (especially undergraduates) wanted a little more structure than the unstructured environment provided. Strangers worked together as diligently as did friends, but generally more quietly, with less fun and more order.

Conclusions and Implications

Our organizations best dealt with increasing task complexity by decreasing their organizational structure. There are a number of ways these results can be described and discussed. We have discussed the experiment in terms of how many persons had access to detailed information about the task. It seems that in most organizations, structure correlates negatively with detailed job information, and job information correlates highly with job autonomy. Recent research (Roby, 1963) shows that more structured groups are relatively more effective when internal coordination is necessary, while decentralization seems to be preferable when most people's actions depend upon information from outside the group.

The aerospace engineer thus received a preliminary solution to one aspect of a perplexing problem. He would have to start the new, integrated group with a tight structure. He should loosen it up as each member learns his job and learns how to communicate effectively. He should really loosen up when the project reaches periods of crisis or stress. These preliminary findings were supported by the results of the later runs.

We can also discuss these findings in terms of training organizations versus operating organizations. While an organization is in training, it should be tightly organized; it should be "opened up" when it is performing operational tasks. In any case, the findings suggest starting a new group on a new task with as much structure as the group will tolerate, then reducing structure and increasing individual autonomy on the job as people learn all aspects of the group's work on the task, develop a language with which to communicate about it, and learn each other's interests and skills in dealing with it. What is needed is any way of bringing all aspects of the job to the attention of all team members who can influence how the task is performed.

Effect of Leadership Choice on Organization Structure

In debriefings of the exercise described above, participants frequently asked what effect group choice of leaders would have, in contrast to the process of random selection used in their exercise. In order to examine that question, we used the "3-D" task as a base for a series of experiments in which we varied the method of leader choice as the independent variable.

Method

We conducted 20 sets of exercises, always starting with one leader for puzzle A, then two leaders for puzzle B, then five leaders for puzzle C. Half of the groups were given the opportunity to select the leader or leaders for conditions 1 and 2. The other half of the groups selected leaders randomly by drawing cards from a deck. Prior to the beginning of the last puzzle, the groups were told that they could choose their organizational structure. Half of the groups were told that their leaders would be determined randomly. The other half were told that they could select a leader if they chose conditions 1 or 2. There were four experimental conditions:

- 1) the groups were given the choice of leader at all times

- 2) they were given a choice of leader on the first two puzzles, but were not given a choice on the third puzzle (if they chose a condition that required leaders)
- 3) the groups were not given a choice of leader on the first two puzzles, but were given a choice on puzzle four (if they chose a condition that required leader selection)
- 4) the leader was always selected at random.

Five of the 20 groups were used for each of the four conditions.

Results and Implications

The groups never chose a structure with one or two leaders unless they were able to choose the leaders themselves. Three of the ten groups which were given a choice of leaders picked a structure in which leadership selection was necessary. It is interesting to note that the only groups which chose a structure requiring leaders were those which had no leader choice on the first two exercises. We can speculate that either the groups wanted to experiment with the most difficult exercise with the leader or leaders they considered most effective from their previous experience, or that participants in the groups wanted to be leaders and thus voted for a situation which would require the use of leaders.

In most organizations, management imposes a leader on the group and also tells the group what its structure shall be. In some of the newer "management by objectives" and "participative management" kinds of organizations, the leader is imposed or the structure is imposed rather than both. Almost never in commercial or government organization is a group free to determine its own structure and leadership. These findings suggest that an organization which wants to impose a structure on a group might well permit the group to assign its own members to positions of leadership within it.

Feedback Tone and Organizational Effectiveness

A doctoral candidate (Mints, 1970) in the USC Graduate School of Business Administration conducted an experiment to test the hypothesis that groups which received supportive feedback from management auditors would improve their performance and do better than groups which received critical or negative feedback. In this experiment, run in the Management Laboratory, there was an "expert observer" who was a part of each work team. These observers gave feedback to the participants regarding how they were doing the task and how they might improve their performance.

In the "positive feedback" groups, the participants were encouraged to perform the tasks using methods which the observer told them had been successful in the past. In the "neutral feedback" group, the observer merely described how other groups had improved their performance. In the "negative feedback" groups, the same information was provided, but in a negative rather than positive tone.

It was found that "positive feedback" groups completed their tasks in less time than the "neutral feedback" groups, which in turn took less time than the "negative feedback" groups. It was further learned that the "negative feedback" groups disliked their observers and felt they hindered performance of the task. Observers giving "positive feedback" were not perceived as useful to their groups; persons giving "neutral feedback" were perceived as most useful, even though their groups were not as effective.

Method

We decided to test a similar hypothesis where there were no auditors. With four groups of students from each of three classes, we used two different experimental conditions. In half the groups, the exercise conductors gave feedback in a positive or supportive tone; in the other half of the groups, the feedback was given in a critical way. In all the groups, information on how to improve performance was given following completion of each puzzle; information given was held constant in all groups. Feedback was given by members of the Laboratory staff and by the professors of the classes involved.

Results and Conclusions

To our surprise, the students did not detect any difference in the manner

in which the feedback was given. There were no differential effects on their performance.

The groups participating in both these experiments achieved faster task accomplishment times than did similar groups performing the exercise without feedback. It is useful to compare the experiment run with auditors and the one run by Laboratory exercise conductors. In both cases, the same feedback information was given to the participants. However, the auditors were described as "part of the team"; further, they were chosen in advance because they could play their roles convincingly. In contrast, Laboratory staff members were randomly assigned roles which did not necessarily fit the personality of the individual involved. When we were not responding as ourselves, the students responded to us as we appeared as people, and not to the way in which we presented information. We feel that this fact, plus the fact that the Laboratory has a reputation for being supportive, tends to make the students see the critical feedback from Laboratory exercise conductors as helpful, not hostile. Because of frustration experienced by the Laboratory staff in attempting to play the critical roles, we stopped the experiment after three classes.

Awareness of Need and Task Accomplishment

Almost all managers seem to be highly aware of the interdependence of their subordinates in performance of tasks assigned to the group. They generally assume that the subordinates themselves are aware of these interdependences, and thus they do not deal explicitly with them in assigning tasks or reviewing the progress of work. We developed a laboratory exercise which served the goals of demonstrating the interdependence of members of a class on each other as they performed a group task, and of demonstrating the difficulty of performing a group task under restricted communication conditions. The exercise further showed that if one kind of communication is cut off, members of a group will find other ways to communicate.

Method

The exercise used in this experiment is called "Scrambled Squares". The task for each member of the five-man group is to build a square on the table in front of him using puzzle parts which have been distributed among the participants so that no person has two parts which fit together. Each set of

puzzles consists of 15 pieces of aluminum; there is only one way in which each set can be assembled completely.

The specific hypothesis we tested was "If the interchange of resources for the accomplishment of a set of tasks is structured in such way that each person must become aware of the needs of all, the task will be more efficiently accomplished than if each member concentrates on his own problem and seeks the resources needed to solve it."

We used 24 groups, with each group assembling two sets of puzzles. No verbal communication was permitted. In one version of the task ("give" only), no participant was permitted to indicate his need to anyone else; however, he could give parts to other group members. No player could have less than two parts nor more than four. In the other version ("take" only), no participant could offer a part to anyone else; he could get what he needed only by taking it or by indicating his need to someone else. Half of the groups did the "give" version first, and half did the "take" version first. Half started with puzzle A and half with puzzle B. Each puzzle was associated with the "give" version half of the time, and with the "take" version the other half.

Results and Conclusions

The results generally supported the major hypothesis. The groups which were instructed to be aware of how each member's work affected the performance of the others completed their two sets of puzzles in an average of 9.18 minutes, while those who did not have such instructions required 12.38 minutes. These differences are significant at the .1 level. It is probably evident that there is less dependence on others in the "take" mode than in the "give" mode. It was found that there was a greater difference between the instructed and uninstructed groups in the "give" mode than in the "take" mode; the uninstructed groups took 40 percent longer for the "give" version of the game. In the "take" mode, the difference was not so great.

Individual versus Group Creativity

Creativity of individuals and organizations is becoming increasingly valued. The generation of new ideas by individuals and groups has been studied and practiced as a group process called "brainstorming". Osborn (1957) recommended that the best method to obtain a wide variety of ideas from a group of people was to have individuals separately write their ideas on a piece

of paper. Then each person would tell the group his ideas, and the group would try to develop new ideas from them. The members of the group would then work individually again for the last few minutes of the session. Vroom, et al, (1969) conducted a study which corroborated previous experience that interaction during the idea generation phase is dysfunctional.

In a study by Taylor, et al, (1958), dictating machines were used to record brainstorming ideas. In the group mode, one machine was used, while in the individual mode, each person had a dictating machine to himself.

Other studies, which have used group members or secretaries to write down ideas, and the Taylor study which used dictating machines, have in common an unequal opportunity for expression of ideas. We were concerned, therefore, that the difference these and other researchers found between effectiveness of individuals and the group might have been due to the number of secretaries or tape recorders available in the different modes.

Method

Thus we decided to experiment with the various methods of expressing and compiling ideas, and to equate the recording capability of each method. We used four-man groups in three modes: "write only", "talk only", and "mixed". The three stimulus topics were systematically rotated. Under all experimental conditions, each participant wrote his own ideas on a piece of paper. In the "write only" mode, the four persons separately wrote down ideas without talking to each other during the 20-minute work period. In the "talk only" mode, the group talked while writing for 20 minutes. In the "mixed" mode, participants wrote for five minutes without talking, talked for the next ten minutes while writing, and then wrote without talking for the last five minutes.

Results and Implications

The "write only" mode, in which there was no interaction between the individuals, produced the most ideas; however, the ideas did not appear to be any different in quality from those in the other two groups. In the "write only" mode, the groups produced 1057 ideas compared with 938 in the "mixed" mode and 936 in the "talk only" mode.

There were differences in people's preference for each of these modes. Most preferred the "mixed" mode or "talk" mode. Some preferred the "write" mode. There were some comments that fatigue was a significant factor;

people did not feel they did as well in the third 20-minute period as they had in the others. The results indicated, however, that the most ideas were produced during the third writing period, next most during the middle period, and fewest during the first 20-minute period. It should be noted that they had only the briefest rest periods between the work periods.

These findings are contrary to the expectations of most people who would feel that creativity is greatest in the group stimulation mode. It seems that in the group mode, only one train of thought is going in the whole group, so that while many ideas get written down, there are many duplications. This suggests that, whereas committee action may be best when commitment to an idea is important, individual action may be more efficient for developing ideas when that is the goal.

Project Planning Experiment

We had observed in the course of a number of experiments that most participants began work on the task without adequate communication regarding management of the task activity. In such cases, there was no formal agreement on process and no establishment of organizational structure for accomplishing the task or solving the problem.

Method

Using two exercises which are similar in concept and different only in materials employed, we developed a simple experiment to explore this problem. In both exercises, three five-man subgroups are required to complete a set of products from resources which have been distributed randomly to the three groups. The task cannot be completed without an interchange of parts between the groups. The task is ended when all three groups have assembled their products. All communication between the subgroups is by written message only; there is no restriction on communication within the subgroups.

In the exercise called "Name Game", letters printed on 3 x 5 cards are distributed to the three subgroups. The groups are instructed to build the names of two months of the year from letters which they either have already or can get from the other groups. The parallel exercise, called "Toy Tower", requires the groups to build towers to certain specifications, using Tinkertoys which are distributed among the three groups.

We used twelve groups of 15 persons each for this exercise, six of them participating in "Name Game", and six in "Toy Tower". Within each set of six, three groups were permitted to begin the exercise as soon as they understood the instructions. The other three groups were told that they could not begin to assemble their product and could not exchange materials with members of the other groups during the first five minutes. They would have five minutes for planning.

Results and Implications

Planning time was included in the total task time for the "planning" groups. Groups which did not plan required 47 percent more time than the groups which were forced to take some time for planning. This is particularly interesting in view of the fact that the planning time was so short (five minutes) that no set of three subgroups ever agreed on a solution to the problem before beginning the task. It appeared that there was some communication about group processes and group structure before the task began. When the "planning" subgroups ran into difficulties in carrying out the task, they seemed to complete the planning process which had been begun earlier. Being forced to deal with the abstract problem before being given access to the parts set a pattern of less frantic and more thoughtful activity on the part of those groups.

The reader may well say "What does this prove? Doesn't everyone know that one ought to plan before beginning a complex task?" Certainly, everyone knows that. But never once in over 50 runs of this laboratory exercise have we seen a group which consciously planned before beginning work on its task. We suspect the same kind of behavior is typical of groups working on many tasks in government agencies and private business. Our findings suggest that work groups should be required to take time to plan prior to starting any project.

In exercises using the "Name Game" and "Toy Tower", we have observed some things we had not looked for at the beginning. One of these is that competitiveness tends to develop between subgroups even though they have been told that the task is cooperative. There is, for example, a trading of parts rather than a giving away of unneeded parts. We also noted that a good solution to the problem was generally offered early in the game but was not accepted by the group at that point. Either the solution was offered tentatively, or the group was so involved in task accomplishment that it gave no thought to the process needed to facilitate completion of the task. We have also noted that groups which began with simple versions of this exercise find simple solutions to the simple tasks. They then continue to apply simple solutions unsuccessfully on the more complicated tasks. We will subject this observation

to formal testing next year.

APPLICATIONS AND PARTICIPANTS' FEEDBACK

Interaction Exercises such as we have described may prove to be an important method of developing managerial experience. Within the non-threatening environment of the laboratory, individuals and groups may acquire some understanding of and insight into group processes which they may apply to their real-life situations. In general, we have found that the less well groups do on analog tasks, the more they learn about group processes. For this reason, we try to make our exercises sufficiently difficult to provide task stress and therefore learning to all groups.

Feedback we have received from our students, Executive Program participants, and Organizational Development groups from industry indicates that these exercises may be very effective organizational development and management education tools. Comments from participants focused on the following points:

- 1) The exercises provide an opportunity to discover that communications within an organization are poor; they also show why communications are poor. Behavior patterns that function as barriers to effective communication are made obvious.
- 2) Participants acquire a certain degree of awareness of their own bad habits which need correction. They may learn, through observation or feedback, means of achieving this correction.
- 3) Participants discover that it is difficult to find or to establish a common language when they are attempting to communicate within a non-homogeneous group.
- 4) The exercises demonstrate that it is difficult to find a satisfactory solution to the need to delegate work so that effectiveness is multiplied but control is not lost.
- 5) It is possible to recreate in a laboratory in a comparatively short time and in a non-threatening atmosphere

situations which can provide information which may be vital to structuring or restructuring an organization.

SUMMARY

In this paper we have discussed the need for research which will help managers bridge the gap between management theory and application of the theory to their real situations. We have described a number of interaction exercises which we are currently using in the USC Management Laboratory to involve managers in significant learning experiences and in feedback processes which help them relate the exercises to their work situations. We are not certain that information obtained from the games is applicable in industry; nor are we sure that information which is relevant to one organization can apply to another. However, we do provide vehicles by which managers may become aware of the kinds of problems that may exist in their work groups, potential ways to solve these problems, and ways to structure organizations for greater efficiency.

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