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Management System Training Using Leviathan

(A Complex Computerized Organization Simulation)

2 November 1967

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TECHNICAL MEMORANDUM

(TM Series)

Management System Training Using Leviathan
(A Complex Computerized Organization Simulation)

by

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2 November 1967

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ABSTRACT

This report describes a management system training project conducted in 1966 at System Development Corporation by researchers from System Development Corporation and staff members of the Graduate School of Business at the University of Southern California. The vehicle for the study was the Leviathan model, a computerized simulation for studying communication in large social organizations. The learning group and their experience with Leviathan are described and some subjective and objective evaluations of the experience are given. Finally, some reflections on the uniqueness and potential of the model are presented.

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1. INTRODUCTION

During the summer of 1966, the System Development Corporation and the University of Southern California studied the use of an on-line computer-mediated simulation of a large organization. The study was undertaken in support of a course at USC in Organizational Behavior. Students were 28 Air Force officers enrolled at USC in a program leading to a Master's degree in R & D Systems Management. The simulation used the Leviathan Model, developed at SDC by Doctors Beatrice and Sydney Rome.

The Leviathan project was originally undertaken by the Romes as the "the experimental study of large-scale organization structures" (Rome and Rome, 1962). It is achieving its goals in the research realm. The present report covers an attempt to study the use of the Leviathan model for a quite different purpose--education in group behavior. It is not an attempt to study the training values, since the participants were not being prepared to perform any specific set of functions in any specific system. The major objective of the study was to determine whether students' experience in managing the Leviathan "organization" would improve understanding of organization behavior and effectiveness in dealing with it. Since Leviathan had not been previously used as an educational instrument, a secondary objective was the development of procedures that would maximize student learning from participation in the simulation.

This report will describe Leviathan briefly, describe the learning group and their experience with it, and report on some objective and subjective evaluations of the experience. The latter part of the report will consist of reflections on the experience, speculations about its value, and finally some comments on the uniqueness of Leviathan and the meaning of that uniqueness of Leviathan and the meaning of that uniqueness for its future uses in augmenting learning.

2. THE LEVIATHAN MODEL

Leviathan is a computerized simulation for studying communication in large social organizations. It comprises a theoretical framework and a system of computer programs and employs a series of experimental simulations in a laboratory, experimental controls and quantitative measures of organization performance. The method permits the conduct of experiments on the development of social organizations and the impact on individuals of participation in a feedback-oriented organizational environment.

Leviathan programs simulate elements that are common to a variety of organizations; the model operates within an environment created to provide an operational context for the interaction between the organization and the model. The environment is known as "the myth" because it provides an internally consistent framework that appears to give meaning to the operations performed by the computer in response to actions taken by the experimental subjects.

The myth is that the experimental organization operates an Intelligence Communications Control Center (ICCC), whose mission is to receive messages from world-wide sources, process them according to established requirements, and send them to users throughout the government. The ICCC operates in simulated days or "epochs" with amount of input and time for processing subject to experimenter control. The ICCC commander reports to the chief of the national intelligence agency, simulated by the experimental (or instructional) staff. To carry out the organization's mission, the organization commander has 20 to 30 live subordinates and the 704 computer generated "robots." The live subordinates fill the positions of 4 branch heads, 16 group heads, and such staff positions as the commander creates in order to use his personnel effectively. The 704 robots are grouped into 64 working squads, which perform the mythological work of the organization.

Each robot's capacity for work is measured in "taylors." The work units are messages received by the center from all over the "world" for processing and

transmitting to government agencies. The ICCC receives a new allocation of taylorors for each epoch and spends them for the labor performed by the squads for processing messages. The exact number of taylorors charged depends upon the message, the station, and the decision rules. The players are not informed of the unit cost for processing each message, but must induce it from the cost summaries which they receive at the end of each epoch.

There are three ways in which the experimenters can influence the subjects' behavior: by employing conflicting user demands, by reports from the higher agency, and by controlling the number and kind of messages entering the center. The subjects have three resources to enable them to cope with the resulting situations: first, the energy supplied by the robots (the taylor units); second, their information feedback from the computer; and third, their own strategies. The subjects inherit an ongoing system. How effective a social organization they become is ultimately determined by how they communicate with each other, share information, sense changes, interpret demands made upon them, and use their resources--in short, how well they function in their hierarchical environment.

To manage the input, throughput, and output processing activities, the subjects exercise four kinds of functions easily identified as being fundamental for persons exercising managerial decision-making, regardless of the environment in which they work: (a) control of message traffic flow, (b) allocation and assignment of manpower, (c) establishment and administration of priorities, and (d) setting of production rates.

These four types of administrative power define four kinds of functional systems--traffic, manpower, priorities, and production. The squads of robots can be assigned to and by the live managers in any desired configuration, although only one configuration was employed in the simulation reported here because of the short life of the system. The organizational format is determined by the training or research objectives. It can be functional, geographic, or a combination of both. The territorial boundaries are rigid and not particularly

efficient. This characteristic of the system forces adjacent units to cooperate if the system is to succeed; it also forces the players to look for informal methods of communication to get around constraints of the formal methods.

When a message arrives at the ICCC, it is routed to one of the nine processing lines. The message moves down the line at a speed determined by the decision rules, volume of traffic, and available taylor's. If the squads at a station are out of taylor's, the message waits there until the next epoch, when new taylor's are provided. Meanwhile, processing continues at other stations on the line as long as there is room for messages. If no room exists, a backlog of work begins to pile up, as it might in the in-baskets of an organization processing purchase orders.

Each message consists of a heading with seven elements or "tags" identifying subject, source, area, precedence, source evaluation, information evaluation, and addressee. Decision rules by which the robots process messages are stated in terms of the tags and their values. For example, the robots at station C5 might be instructed to examine tag 3 and if they find a value of B, assign it a priority of "1." (The messages have no content, as this would reduce the flexibility of the model and would only add noise to the system.)

Feedback to the players on system productivity and status is provided through computer-generated reports called "indites," which indicate input, backlog, production, breakdowns, taylor's used, robot assignments, priorities, and inspection decisions. The indites go to the group leader responsible for the function or territory. Summaries go to the branch heads and the commander. It should be noted that, although the person getting the information is responsible for the function reported, he may not be the one who needs that information in order to improve the decision process. No one gets a complete picture, except the commander, and his information is realistically filtered. While his reports may look as though the system were functioning well, several lines of high-urgency traffic may be blocked without his knowing it. The program system controls the kinds and amounts of information feedback, most of which must be

"purchased" with taylor's by the players. If too many taylor's are spent on feedback, too few are available for processing messages. If too little feedback information is purchased, taylor's may be wasted or go unused while processing remains uncompleted. The distribution of feedback information and of authority requires the four functional kinds of managers, at all three levels, to interact in many ways to make the system operate effectively in terms of numbers of messages processed through the organization.

The principal means of communications in the system is through consoles, located in the participants' cubicles. Through these consoles, the participants can send and receive messages to and from each other, and to the robots who perform the "work" of the organization. There is a limited set of messages which can be sent, so other means of communication are provided. During an epoch, a message can be sent by a courier; between epochs, players can hold conferences or individual discussions.

2.1 SIMULATION CONCEPTS

Leviathan has five basic features that can be useful in developing managers: abstract realism, complexity, human interaction, cooperation, and information handling.

The abstract realism forces players to concentrate on principles rather than recipes. It is real in the sense that there is an organization with a mission. It is abstract in the terms it uses: epochs, indites, and taylor's. To process the message, the group must look to management concepts for guidance. The rules of thumb that one has learned elsewhere are frequently not valid here. For example, assume that a man has come from an organization where he has had to process requests. He knows that it takes 15 minutes to process a request on the average. Some take more or less, depending on the content, the information handler, and the origin of the request. Being experienced in his business, the man knows that input will fluctuate and he will have some idea about how to cope with the changes. All of this has come from past experience. Now he is

faced with generically the same problem: processing something. His rules of thumb may give insight into the problem, but they will not tell him the best course of action. Relationships between time and costs change. In order to cope with this problem he has to learn the managerial theories for decision making and be able to apply them to a changing world.

Complexity adds to the realism. Inputs and user needs vary from one epoch to another. The players can control priority, production rates, man-power, and traffic at each of 56 stations, using the 704 robots whose efficiency varies from station to station. Additional problems arise because a squad of robots generally covers stations on different lines. If a squad uses up its taylor's, it shuts down all stations it works on. So when a player makes a change at one station, he has to be ready for consequences throughout the system. This complexity prevents quick discovery of the model behind the simulation. In fact, the complexity is sufficient to discourage participants from trying to determine the equations which make up the model, and thus from interfering with their own exercise performance or even learning from it. The dynamic nature of the model, and the variations which are subject to control by the experimental staff insure that no attempt is made to "psych" the model will succeed.

The third characteristic is the human interaction. The system managers not only have to deal with the mechanical task of message processing, but also have to supervise 20 to 30 people--(responsibility without authority) though generally they possess little or no real power. This conflict presents an interesting human relations problem in focusing individual effort on mission accomplishment. It requires the leaders to use methods that do not depend upon application of sanctions or formal authority. Practice with such methods can be excellent preparation for position of greater responsibility, especially those involving committees and boards.

Cooperation is closely allied to human interaction. The territorial division does not allow any message to be processed solely by one branch. If a station

goes out at the end of the line, processing on the entire line can come to a halt soon after. If a station is continually overloaded, the strategy has to be changed. This change involves a meeting of five to nine people who must reach a consensus in limited time. When the grand strategy shifts (say in response to a crisis), interbranch cooperation becomes important. If a decision is to be implemented in time, the button-pushing has to be done by everyone and not just by those with primary responsibility.

The final aspect of learning deals with the increasingly important area of information processing. The leaders have first to decide who needs what reports, then find out who is getting the information, and finally, change the flow to bring it in line with needs. This is not as easy as it sounds. First, some information is required for policy planning and some for operational decisions. Second, an intersecting set of information is needed for management by exception. The information provided is easily understood but must be converted into an easily interpreted form before it can serve either policy making or operations. All of this must be done despite the fact that Taylor costs for indites and time costs for people limit effective action. This simulation can drive home the point that a person who creates a reporting system must carefully analyze cost versus effectiveness before putting the system into effect.

3. THE LEARNERS AND THE LEARNING ENVIRONMENT

It is traditional in research reports to describe the experimental subjects, the stimuli presented to them, and their responses. In a reactive system, however, that kind of report would overlook half of the data--perhaps the more significant half. The reactive system described here included the experimenters as well as the subjects all of whom learned from the experience. The following description will attempt to indicate what happened to whom in what sequence. If reading a description of the process leads the reader to feel that the participants were less interested in proving something specific than in learning something generalizable, the correct impression has been conveyed.

The class participating in the Leviathan interaction consisted of 28 Air Force officers enrolled in a master's degree program in R & D Systems Management (referred to as the RDSM program) in the USC Graduate School of Business. All class members had degrees in science or engineering, approximately half of them from one of the military academies. Rank ranged from lieutenant through major; length of service from 2 to 15 years. Median age was 33 years.

The decision to use Leviathan was the result of feedback from previous classes, who felt that there would have been more learning if they had had a chance to practice in a penalty-free environment what they had learned in the classroom. Arrangements were therefore made with SDC for a cooperative project to study the use of the Leviathan simulation in support of course work.

The summer curriculum consisted of Accounting Concepts, Quantitative Methods, and Organizational Behavior. The simulation activity was in support of the Organization Behavior course, in which the students look at the behavior of individuals by themselves, in small groups, and in larger informal and formal organizations. Emphasis is given to understanding and prediction of behavior in and of groups.

The objectives of the exercise in the Organization Behavior were the following:

1. To provide an environment for the students to appreciate the dimensions and limitations of a complex managerial task.
2. To develop a capability for effective management of what can be managed and the ability to "live with" the balance.
3. To provide a setting for group interaction.
4. To assess and develop abilities and skills, including:
 - Identification of values, establishment of objectives, and criteria for measuring managerial performance.
 - Preparation of plans, commitment of oneself to them, and carrying them to completion.

- Personnel assessment, assignment, and training.
 - Securing of the optimum performance from subordinates.
 - Understanding of informal organization and communication in large organizations.
 - Management and utilization of information.
5. To establish attitudes through "internalization" by doing rather than "identification" by intellectual activity.

Most research reports, while containing a good deal of information about the experimental subjects, treat the experimental staff as anonymous, selfless scientists whose biases (if they have any) are not considered worth reporting. But everyone involved somehow influences the outcome: no measurement is independent of the measuring instrument, no stimulus independent of the stimulator, and no experimental environment without one or more interfering gods whose influence is seldom felt as intended or understood as expected. Especially in the study of group phenomena, where the experimenters interact with the group of subjects, should all members of the cast be identified (without undue modesty or criticism).

Directly interacting with members of the class were:

- Dr. Milton G. Holmen, professor of management at USC, and the instructor of the class;
- Dr. John V. Zuckerman, Director of the R & D Systems Management Program in which Dr. Holmen taught, and in which the class was enrolled;
- Mr. Stanley Terebinski, Laboratory Manager for the project (and for the previous Leviathan experiments as well), who doubled as Chief of NIA during the exercise runs;
- Captain Otis Bryan, Jr., a member of the class, who was functioning as research assistant for the project (in lieu of taking a course in the regular RDSM curriculum which would have been a repetition of previous work for him), and

- Mr. Dwight W. Jeffrey, chief courier between the ICC and NIA, and between units of the ICC, supervisor of the non-technical support staff and a former experimental subject in Leviathan experimentation.

These five operated together to use the Leviathan simulation in support of the educational objectives of the RDSM program (particularly the Organizational Behavior course) and to collect evaluative material which SDC could use in determining future training use of Leviathan. The five, referred to in this report as "the staff," were present during all experimental runs, and met frequently between runs to plan succeeding activity. The staff, in turn, was influenced by:

- The Romes--Beatrice and Sydney, the "parents" of Leviathan, who encouraged and supported the work but never came near enough to interfere;
- Kenneth Yarnold, Director of Research of SDC, one of the principal sponsors of the project, who kept in close touch with it as it progressed, and whose observations about it appear in Section 4;
- Mildred Almquist and Robert Krouss, the computer programmers of Leviathan, who kept the computer system operating;
- Frank Tierney and Arthur Kochman of the Defense Systems Division, whose official role was to observe and to prepare material enabling DSD to evaluate Leviathan's suitability as a vehicle for command post training in a military organization, (and who also plugged many holes in the dike around the experiment--briefing visitors, pointing out problems about to arise, etc.); and
- Marv Adelson, a frequent observer, supporter, and conceptualizer, whose observations will be presented in Section 4.

The most significant preparation for the simulation experience came during the third week of the Organization Behavior course, which consisted of a Leadership Laboratory conducted by Capt. Marion E. Reed, Assistant Professor of Psychology

at the U. S. Air Force Academy. The Leviathan participation was from the 6th through the 12th week of the course, with two sessions per week, each of 3 to 4 hours duration. The first three periods were for training in operation of the equipment. The fourth session was organizational, with the group choosing a leader, assigning other positions, and setting general policy.

The remaining eight periods were spent operating the simulation. About every two hours during the last five sessions, play would cease while the instructor "debriefed" the group and led its members in discussing the causes and effects of their behavior. The debriefings were felt by the instructor to be necessary to maximize the learning opportunities presented by the simulation. The initial plan was for debriefing during regular class periods. That plan was followed at the start but was abandoned when it became evident that even the most exciting incidents stimulated little discussion a few days later. In order to move the attention of the class from ICCC accomplishment to study of the behavior of the class and its members, the course instructor interrupted formal conduct of the exercise to discuss interesting behavior problems which arose during the exercise. This worked so well that, to add opportunity for learning, two crises were introduced; one involved a major shift in workload, and the other a replacement of the commander.

The workload ran at a constant level for several epochs. Then it increased. The increase coincided with a change in customer requirements and forced a major change in strategy. During the period prior to the change, system training still occurred in an informal manner. Even though the players knew the names of the parts and where they fitted, the group was still not familiar with its operation when the workload crisis was introduced.

The group spent the remaining sessions trying to find a good strategy for processing messages. At the end of the ninth session the CO appointed a four-man planning staff. Using the indites and information they could gain from the

* The Chief of NIA.

operating members, the planning staff was to study the system and advise the CO on proper policy. During the next session, this staff was able to operate for only an hour and a half before there was a major personnel change.

Between the ninth and tenth session the teaching staff decided to create some stress on the group by pulling the commander out of the simulation and letting him watch the remaining sessions. The only requirement was that he, the branch heads, and planning staff had to choose a new commander before he could depart. The other players would watch on closed circuit TV and report what they saw to the group in academic session.

The meeting produced some striking interpersonal behavior. The old commander chose to have a new one elected by secret ballot, then apparently tried to insure that "his man" won by restricting the nominees to the branch chiefs. This, combined with his comments to the group, brought forth considerable resistance by the other members, who did not like the way he was holding the election. After 45 minutes of discussion, a new commander was elected "unanimously." At the end of the ensuing academic session the old CO said, "I should have walked in, announced that I had been promoted, and appointed a new CO. It would probably have been accepted." Most of the group concurred.

The new CO made changes that reflected a different management style. First, he put the group to work running epochs without stopping for strategy sessions. Second, he appointed one staff member to be chief of staff. Play ended before the staff could function adequately.

One more day was devoted to the debriefing. This consisted of some written evaluations, small group debriefings, and a large group debriefing.

4. EVALUATION MEASURES

4.1 INSTRUCTOR'S EVALUATIONS

An evaluation of the exercise experience against the objectives set for it will be useful, as will an evaluation against a more general set of objectives

established by means of games in a management development program. The following are the instructor's evaluation of the Complex Computerized Organization Simulation Program exercise in terms of the specific objectives set for it.

1. The first objective--to provide an environment for the students to appreciate the dimensions and limitations of a complex managerial task--was partly met. It would have been more completely met had more time been available and had more epochs been run.
2. The second--to develop capability for effective management of what can be managed and the ability to "live with" the balance--was also partly met, but was limited mostly by the relatively few number of epochs that could be run in the time available.
3. The third objective--to provide a setting for group interaction--was very well met. In fact, after we learned to alternate (or mingle) debriefings with game activity, we were able to take excellent advantage of this opportunity, which was missed earlier in the program.
4. The fourth--to assess and develop abilities and skills in various areas--was met in some respects. Both in the identification of values and in the establishment of objectives and criteria for measuring managerial performance we were again limited by the short time spent on the exercise. The same comment applies to preparation of plans, committing oneself to them, and carrying them to completion. The class appeared to do a good job of personnel assessment, assignment, and training; however, their abilities in this area were not stressed and little increase in these abilities was observed. Similarly, securing optimum performance from subordinates was not a major problem, although channeling the energies available to the organization leaders was more difficult. The exercise was valuable in improving understanding of the values of, and problems presented by, development of informal organization elements. The exercise was not long enough nor the class large enough to provide sufficient opportunities for learning about communication in large organizations. The management and utilization of information was stressed, and many problems of information management made clear by the simulation.

5. The fifth objective--to establish attitude through "doing"--was achieved noticeably. Attitudes toward group management and participation were affected by participation in the exercise. Almost every debriefing raised discussions of one or more course concepts seen in behavior of members of the group.

In summary, many of the objectives of the exercise were met; the remainder would probably have been met if the exercise had been two or three times as long.

It is interesting to note that more of the objectives of management games from Remington Rand's Management Development Program were met than of those set by the instructor for this particular simulation. The game certainly demonstrated to the students the tremendous amount and importance of personal interactions involved in group decision-making, although the intermittent debriefings during the exercise were necessary to permit everyone to see what these interactions were and how they operated. A major disagreement within the class developed long-range vs. short-range goals, making the importance of effective compromises in this area obvious to them. The effect of time pressure on decision-making effectiveness was often discussed in the debriefings and feedback sessions. The making of unilateral decisions was difficult because of good communication among elements of the class, but was best seen in actions taken by the branch managers before hearing thoroughly the suggestions of the planning staff. The shortness of the exercise precluded the establishment of sound control criteria against which to measure performance. It also precluded development and use of budgets and other decision-making tools. The lack of these was evident as a problem, but how we could have built them during the exercise runs was not clear. The role of proper organization, communications, functional delegation, and coordination in decision making was increasingly obvious during each epoch, as was the difficulty of proper performance of these functions in a rapidly changing situation.

4.2 EVALUATION BY STAFF AND PARTICIPANTS

At the beginning of the CCOSP exercise, the USC staff decided to obtain three measures which would help evaluate the usefulness of the exercise for management education. It was recognized that these were, at best, substitutes for the "ultimate criterion" of measured change in the ability to manage, but "ultimate criterion" measures were not obtainable.

The exercises had been included in the curriculum as a result of comments by former students on the inadequacy of unsupplemented lecture or discussion as a means of learning group behavior; therefore, the most obvious criterion measure was to ask the students who participated whether they felt they had learned by participating. In order to obtain measures for statistical analysis, we used Likert-type scales of attitudes toward the experience as one of our "self-report" measures. In order to be able to compare responses of the group on these scales with other responses of the same group toward a similar experience, we used modified questions from a similar instrument administered at the end of the Leadership Laboratory earlier in the summer.

To discover whether attitudes toward the exercise were a function of level of responsibility in the Leviathan hierarchy, we compared responses of the top managers (commander, branch heads, and staff) with those of the group heads.

Since Likert-type scales answer only those questions the staff thinks to ask, it was decided to obtain less-structured responses in two ways. At the end of the CMSTP period, the class was divided into small groups and asked to comment on a number of aspects of the experience. Recorders summarized the responses of the small groups in writing. The small groups then met for a class debriefing, during which group reports were made and discussed.

The second open-ended measure consisted of anonymous individual written comments by the students at the end of the course which the exercise supported.

Finally, changes in management behavior or attitudes were measured by before-and-after administration of a managerial values test. The "before" testing followed the Leadership Laboratory (sensitivity training) mentioned earlier.

In summary, the following measures were obtained:

<u>Before</u>	<u>After</u>
Likert-scale on attitudes toward the Leadership Laboratory	Likert-scale on attitudes toward CCOSP
Managerial Values Test	Managerial Values Test
	Small group debriefing and class discussion
	Written individual evaluations at the end of the course

4.2.1 Measurement of Attitudes on Likert-Type Scale

The questions asked to measure attitudes on the Likert-type scale are shown in Figure 1. Figure 2 shows the responses of the class to these Likert-scale items, with the class divided into upper and lower groups on management responsibility in the Leviathan hierarchy. It indicates that both parts of the class generally felt that the experience was worthwhile, and that the two subgroups did not differ significantly in their assessment of its value for them. However, the less structured feedback indicated the class felt that the upper management had learned most. As we will see, the Managerial Values test scores tended to confirm this finding. The mean class response to the Likert-scale items was 4.23, which indicates generally good acceptance of the CCOSP experience.

It is also interesting to analyze the pattern of highest and lowest responses on the attitude scale. Note that in Figure 2, all data are transformed so that a high score favors the simulation. A low score indicates a negative attitude. A neutral score would be one between 3 and 4. A negative attitude would be reflected by score below 3.0 and a positive attitude by scores 4.0 and higher.

Evaluation of Managerial Simulation Exercise (Leviathan)

Please make a value judgement utilizing the scale presented below. Indicate your choice in the blank provided to the left of each statement.

(1)	(2)	(3)	(4)	(5)	(6)
Strongly Agree	Agree	Mildly Agree	Mildly Disagree	Disagree	Strongly Disagree

- ___ 1. Management Training Exercises like Leviathan are a waste of time.
- ___ 2. Most people are too sensitive and will be hurt by participating in a Leviathan-type exercise.
- ___ 3. I benefited very little from the Leviathan Exercise.
-

The Managerial Simulation Exercise (Leviathan) increased my sensitivity to and understanding of:

- ___ 4. Self Processes.
- ___ 5. Interpersonal and inter-role processes (one person to one person).
- ___ 6. Fact-to-face group processes.
- ___ 7. Organizational Processes.
-
- ___ 8. I will recommend Leviathan training to members of the next class.
- ___ 9. Leviathan brainwashes the participants but doesn't teach them anything.
- ___ 10. The time spent in Leviathan was well utilized.
- ___ 11. I would like to have an extended Leviathan debriefing with all products of the exercise available for discussion.
- ___ 12. The exercise and debriefings raised sensitive issues and handled them too bluntly.
- ___ 13. The group worked on some very important issues during the exercise and debriefings.
- ___ 14. I believe that I will be more effective as a leader of people as a result of the Leviathan experience.
- ___ 15. The Leviathan experience was OK for me, but would be of little value to persons with more military rank and experience.

Figure 1. Likert-Scale Items

**Responses* to 15 Opinion Items Concerning the
Cooperative Management Simulation Training Exercise****

Item No.	Top Management and Staff	Middle Management	Difference Between Groups	Overall Opinions
1.	4.90	5.25	0.35	5.10
2.	5.25	5.76	0.51	5.50
3.	4.73	4.75	0.02	4.74
4.	3.64	3.75	0.11	3.70
5.	3.82	4.14	0.32	4.00
6.	4.37	4.19	-0.16	4.26
7.	2.82	3.68	0.86	3.34
8.	3.36	3.94	0.58	3.70
9.	5.00	5.45	0.45	5.25
10.	2.82	3.00	0.18	2.92
11.	3.92	4.00	0.08	3.96
12.	4.63	5.50	0.87	5.12
13.	3.109	3.62	0.53	3.40
14.	3.46	3.44	-0.02	3.44
15.	4.63	5.06	0.43	4.88
—	—	—	—	—
Mean:	4.03	4.50		4.23

* Six-point scale, where "1" is least favorable, "6" most favorable, to the exercise. (Scores on the "favorable" items were reversed to make statistical presentation less confusing.)

** Scale administered at the end of 12 sessions, 42 hours in the CCOSP.

Figure 2. Responses to Likert-Scale Items

The only clearly negative attitude (shown by response to item 10) indicated doubt that time spent was well utilized. (While this response cannot be ignored or "explained away," it is possible that subjects' attitudes were affected by the fact that their CCOSP participation represented, in part, an added requirement which did not count toward class grades--a requirement to spend 13 half-days, plus driving time to Santa Monica, in addition to full academic loads requiring extensive day and night study.)

The six highest scores (#'s 1, 2, 3, 9, 12, and 15) all are associated with general evaluation statements about the exercise, all stated on the questions in negative terms. Further, the middle management group indicated more favorable attitudes on these items than did the top Management group. Although these differences are not great, their consistent direction is motivating.

4.2.2 Measurement of Changes in Managerial Values

In order to secure a quantitative measure of the impact of the simulation on the managerial values held by the participants, a research instrument was administered to the group before and after simulation exercise.

The measuring instrument, "A Comparison of the Managerial Values," (CMV) is the work of Scientific Methods, Inc., Austin, Texas and was used with the permission of the authors.

CMV categorizes values based on a two-dimensional analysis of the management process. The values relate to the interaction between managerial concern for people and managerial concern for production. The values, described in detail in Blake and Mouton (1964), are plotted on a geometric "Managerial Grid." Briefly, they are as follows:

9,9* implies full and equal concern for people and production. This value holds that the accomplishment of work is by committed people, employing the participation of all concerned in decisions affecting them, and that interdependence through a common stake in organization leads to relationships of trust and respect.

*The names of the Managerial Grid values are based on descriptive geometric notation for positions on the x and y axes of a two-dimensional grid.

5,5 (a compromise approach, balancing some concern for people with some concern for production) assumes that for every action which shows concern for production, a counter-balancing action showing concern for people is necessary to maintain morale of people at a satisfactory level and production at a satisfactory rate.

9,1 (maximum concern for production, minimal concern for people) assumes that the conditions of work will be arranged so that people interfere as little as possible with production.

1,9 (maximum concern for people, minimal concern for production) assumes that thoughtful attention to the needs of people for satisfying relationships leads to a comfortable, friendly atmosphere and tempo of work.

1,1 (minimal concern for people and production) assumes the exertion of the minimum effort necessary to maintain the organization, often termed "organizational apathy" or "defeatist" management.

Figure 3 shows the results for the group which participated in the simulation. The participants were divided for the purpose of this analysis into two sub-groups; one, called "top management," consisted of those men who occupied at some time during the simulation exercise the positions of commanding officers, branch chiefs, deputy branch chiefs and staff. The group titled "lower management" occupied the positions of group leaders throughout the simulation exercise. The top management group showed shifts away from 9,1 and 5,5 and toward 1,1 and 9,9 values (though these shifts were not statistically significant).

The lower management group indicated statistically significant shifts from 9,1 and 5,5 in the direction of 1,1.

When the two groups were combined, the shifts from 9,1 and 5,5 and toward 1,1 were significant.

The difference between the top management and lower management groups could be accounted for by the differences in their tasks. Even though the lower management group received management titles and talked about their work as managers,

	9,9	9,1	5,5	1,9	1,1
Top Management and Staff N = 11	+1.4	-2.2	-1.5	-0.3	+2.1
Lower Management N = 11	+0.7	<u>-3.8</u>	<u>-3.9</u>	-0.7	<u>+6.2</u>
Total Group N = 22	+1.0	<u>-3.0</u>	<u>-2.7</u>	-0.4	<u>+3.2</u>

- (-) single underlining beneath figure indicates statistically significant difference at .05 probability level;
- (--) double underlining beneath figure indicates statistically significant difference at .01 probability level.

Figure 3. Mean Differences Between, Before and After Administrations of a Comparison of Managerial Values.

	9,9	9,1	5,5	1,9	1,1
U. S. Air Force Officers*					
N = 27	30.6	22.1	32.9	24.4	8.9
Industrial Middle Managers**					
N = 750	35.2	24.8	32.7	20.2	7.1
U. S. Army Officers***					
N = 393	30.6	24.6	35.5	21.2	8.0

* Data taken just prior to the beginning of the simulation exercise.

** Data from 94 groups of men, just prior to attending a seminar of Scientific Methods, Inc., during the year 1965 in the United States and Canada. Data from private communication, Robert R. Blake, Scientific Methods, Inc., December 6, 1966.

*** Data from Appendix II, page 13, "Changes in Managerial Philosophies as a Result of Training," (representing scores of three classes at the Army Management School, Fort Belvoir, Virginia, just before beginning of training (during 1964), Research Report 65-1, January, 1965.

Figure 4. Comparison of Managerial Values of Air Force Officers With Those of Industrial Middle Managers and Army Officers.

the task in the simulation exercise did not give them an opportunity to interact with other people. Their task was more one of technological management. This is not unlike the type of task that occurs in a large weapons systems acquisition program, but it is quite different from the task of a commander of an operational unit.

Data have been collected by Blake and others concerning Army officers and middle managers in industry. A comparison of the values of the participants in the simulation with values of middle managers and army officers is given in Figure 4.

The Air Force participants in our study have values more nearly like Army Officers than like those of industrial middle managers. The Air Force and Army officers appear to have a higher amount of 1,9 and 1,1 and a lower amount of 9,9 value. Army officers and industrial managers appear to have more 9.1 than Air Force officers.

4.2.3 Inspection of the Measurement of Values for Future Development of the Simulation

The measurements used in the exercise conducted in 1966 provide some assurance that measuring instruments could be constructed to study the effect of this type of simulation on basic values concerning people and productivity held by managers. The simulation could be designed to enhance or inhibit certain values, by varying the level of operation of the individuals in the simulation, varying the amounts of time for simulation activities, and varying the action of outside environmental forces on the simulation to produce cirses.

4.2.4 Measurement of Attitudes by Unstructured Questions

The third measure of the value of the exercise was obtained by asking the students, in small groups, to answer orally, and to discuss, 19 questions primarily intended to elicit suggestions for improvement of the exercise as a learning experience.

Each group had a student recorder who fed back information from the small group to the whole class. Notes were made of those presentations and discussions. The responses to these questions reflect less enthusiasm for CCOSP than did the Likert-scale material, perhaps because the announced purpose of the group discussions was to elicit criticisms and suggestions for improvement.

The following questions were furnished the chairmen of the student groups to guide their discussions.

Areas to be covered in small group debriefings

1. What was your overall attitude about the value of the total Leviathan exercise as used with this class this summer?
2. What were your attitudes about different aspects of the exercise, i.e., interacting with the computer, the group process debriefings by Holmen, the instructional period at the beginning of the exercise (first two or three sessions), the lack of a familiar Air Force task (such as running a squadron)?
3. What do you suggest for improvement of Leviathan as a training (or learning) tool for officers of their level? How should the exercise be integrated with theoretical learning away from the exercise area (as done in class this summer)? Assuming that the improvements you suggested were implemented, what groups would the training be most appropriate for?
4. What effect did preceding this training exercise with Capt. Reed's Leadership Laboratory work have? Did they overlap? Should either be used without the other? What is the best sequence? Should they be interleaved?
5. Did you discover parallels between the Leviathan simulation and previous military experiences?
6. Were you restrained from questioning the basic system operational philosophy? If so, what restrained you?

7. Why didn't you request a more specific statement of task responsibility from NIA?
8. If given unlimited time, what tests would you structure to better determine system parameters, e.g., Taylor costs as a function of priority?
9. Do you feel that individual performance in the Leviathan simulation can be evaluated? If so, by what mechanism?
10. How can Leviathan best be used in professional officer education?
11. What have you seen and learned in this exercise that can be used on the job as an R & D manager?
12. Can each of you identify at least two significant attributes which you think a manager should evidence? (We are not concerned with idealized and nonbehavioral attributes.)
13. What do you really think all "those people" were observing?
14. Do you think that effective non-job-related managers can actually be developed? How would you go about it? Would you use a tool like Leviathan?
15. What is the effect on the capability of the organization to do its task of the information provided in the indites? Do they contain too much information (a confusing amount)? Do they contain too little (not the right information)? Is it hard to find the relevant information in the indites even when it is there?
16. How did the use of the indite information (and odar information) change as the organization matured?
17. To what extent did you develop, either at group, branch, or ICCC, level, contingency plans and look later for information which would help you select action from among contingency plans or trigger action in a plan?
18. Where did information needed for management decisions accumulate in your organizations? Why?
19. Where there changes in the way the organization divided up its task vis a vis the computer? How did they affect performance?

The responses to the broad interview questions generally indicated that the experience had been valuable; in fact the responses were extremely enthusiastic. In order to preserve their flavor, the comments of the group reporters are presented below as they were made--neither edited, nor grouped by type of response.

Comments from Group A

1. Leviathan should follow the organizational behavior class material so members of the class can try the management tools after having learned them in the course.
2. There was an unequal distribution of learning opportunity with the group heads (lowest ranking participants) receiving little chance to experiment.
3. The learning value was improved because nobody had experience that would give him an edge over other people in the group.
4. They would like to have had time to experiment more with organization structure.
5. Too often in response to technical questions of NIA they received "no comment."

Comments from Group B

1. With respect to management training value, the group's attitude was mixed. Some thought it was great; some thought parts of it were quite good; some thought it had little training value. The attitude depended primarily on the position in the organization.
2. Time was wasted by many people in the peripheral positions who sometimes had no actions to take for two or three epochs.
3. Observing and discussing the individual and group conflicts was a valuable group experience.
4. More detailed knowledge about the management tasks early would probably speed learning. However, some members of the group had the opposite point of view, feeling that the ambiguity forced more attention onto significant group processes. (The latter was the intent of the instructor.)

5. The interaction with the computer was generally good. A more varied interface with the computer would be desirable.
6. The task was similar to that required in many Air Force management jobs. Its abstractness was valuable--that is, a more explicit task would have had less training value.
7. A major Air Force R & D problem could probably be resolved by mixing civilian contractor personnel with military R & D personnel for mutual learning, using a Leviathan-like experience.
8. The sequence "sensitivity lab preceding the Leviathan lab" was good. However, the sensitivity lab should have come sooner. The car pool split in the sensitivity lab was not good.

Comments from Group C

1. There were contradictory findings with respect to training value for the group. Whereas all benefited from the training, some felt that it was too time-consuming for the benefits received.
2. The group generally felt that Leviathan is more valuable for studying group behavior than for learning how to manage. They were unaware of any other effective way to study group behavior, but felt that Leviathan was "tremendous" for this purpose.
3. Lack of knowledge about the system and task hindered performance of the group.
4. The group discussion critiques were very valuable, especially after watching the group through the one-way glass or TV.
5. The group recommended video tape feedback or alternating performance and observer activity.
6. The group recommended making positions in the structure competitive by rewarding with course grades or OER ratings. The total group agreed with the need for some evaluation, but did not agree about the form it should take. Consensus was almost reached with respect to OER's for the Leviathan activity, only they would be given to the man concerned

- privately. An alternative suggestion was to have each man write descriptions of his superior, subordinates, and group peers and for these to be the core of feedback discussions.
7. The group felt that one must know both management behavior and technical content to be a good manager. They felt that Leviathan did well with respect to management behavior and wondered whether more technical content training could be included.
 8. They suggested scheduling a Leviathan exercise as a group-related laboratory to increase group motivation and added that advance notice (before their arrival at USC) would have made the extra work more acceptable.
 9. The objectives of Leviathan and sensitivity training were not clear. Some felt that this improved the learning opportunity, others disagreed. They did agree that why things happen is as important in the learning situation as what happens. They proposed more concentration of the Leviathan effort--for example, eight hours a day for one week.
 10. This group felt that Leviathan was best for junior officers. The class on a whole disagreed, feeling that it was perhaps even more valuable for senior officers. They suggested experiments which studied pre and post-Leviathan management behavior.
 11. The group agreed that a major benefit was that Leviathan creates real-world frustrations without risks to careers. Particularly, it forced the timid to try performing as leaders.

Comments from Group D

1. The group felt restrained from questioning the operational philosophy of Leviathan due to their student status and military background.
2. They felt they needed more time in the simulation to get out what was there.
3. The learning was unequal, with the persons getting the more responsible jobs learning most.

4. The major improvement suggested was that more of the group should get time to observe from behind the one-way glass because one can see so much more from there than when one is in the room. Also the possibility of being expected to participate way distorts one's perceptions.
5. In response to the question on attributes of a good manager, it was suggested that attributes needed are initiative and a capacity for assuming responsibility.
6. The system had very little focus of information accumulation for decisions, although to the extent that any focus existed it was with the CO.
7. The group felt it learned to understand and use in the exercises the models of influence that were covered in class.

Comments from Group E

1. During both the Leadership Laboratory (of the Organization Behavior course) and Leviathan activity, the class was treated as more dissimilar from other classes than its members really are. Further, "we are not the strangers we are assumed to be."
2. Some allegiances and factions developed in Leviathan which would probably have developed more slowly without the Leviathan and Leadership Laboratory activity.
3. Value of the Exercise: The Group's response was mixed, especially with respect to the Leadership Laboratory, but was generally favorable.
4. The feedback by the course instructor was the most favorable single aspect of the Leviathan activity.
5. Interaction within the subgroups of the class (the branches in Leviathan) was not sufficiently emphasized.
6. The whole Leviathan experience, including debriefing, was good for self evaluation.
7. The class felt that the people behind the one-way glass were primarily testing theories and were also concerned with how Leviathan can be used to demonstrate theories covered in class. They felt that there was a

need for more class emphasis on using Leviathan to try out management theories and felt that this would require more time than was provided on Leviathan this.

8. The group felt that Leviathan had considerable training value and would be very good for early officer indoctrination. It would start new officers in the service with a knowledge of group functioning which would be valuable to them. (When asked if it would be useful for the Squadron Officer School kind of training, they replied that Leviathan would be more difficult to use in the purely military environment.)
9. A general discussion of the value of the program followed at this point. The comments which follow were made by class members. "The stress provided by Leviathan was needed to bring out the learning in group behavior which was its principal objective." "It was better to know the system well and get stree from 'weird outside inputs' rather than from inadequate knowledge about system functioning." "People were too involved in the Leviathan myth for maximizing their own learning." "The exercise had value as a part of the total management training the class was receiving and thus was more useful than it would be in a non-training environment." In addition, some class members felt that there was a frustrating inequality of learning opportunity.

Comments from Group F

The reporter indicated that his group had nothing to add to the statements that had already been made and in general concurred with them. Further discussion at this time indicated that the learning value in Leviathan did not develop soon enough, and furthermore, that the glossary prepared at the beginning had no training value for this group.

4.2.5 Summary Evaluation by Students

At the end of the semester all students made anonymous written comments on the course at the request of the instructor. Of the 28 responses, 20 were favorable,

six were neutral, and two negative. A year later, at the end of their masters' degree program, they were given an opportunity to comment on all courses taken during the preceding 15 months. Eight commented on the Organization Behavior course, six of them mentioning the simulation as valuable and one expressing concern that the simulation seemed more for research than for his education. Several of the favorable complements indicated increasing appreciation for the value of the simulation experience.

4.3 EVALUATION BY OBSERVERS

The simulation activity was observed by many people, some of whom provided written comments, which are included to add perspective to reports of the instructor and students.

One of the observers was Brian Usilaner of the Office of Management and Organization, U. S. Bureau of the Budget. His evaluation comments follow.

Basic Advantages

1. The simulation yields abstract and general results.
2. All interactions between subjects and robots take place through the computer, as do many interactions among the subjects. This allows behavior to be operationally accessible to experimenters. The computer automatically records what subjects say to one another and to the robots and who talks to whom and when.
3. (The system) can deal with 20-30 persons in a multi-relationship situation.
4. (It) integrates an environment of task (planning, organizing, coordinating and controlling) development and organizational behavior through interaction. "The intersection of the task and human behavior."
5. The subjects and the experimenter can restructure during the simulation. With the Philco 2000, there are four organization patterns available.
6. Behavior and performance of organization can be controlled and developed with the simulation.

Summary

The Leviathan simulation represents a powerful program for management training and organizational design. Since it was originally designed for an experimental tool, there is much development required in conjunction with the transfer to the IBM 360. The realized capability of the simulation will depend on this development and is still speculative. However, its power for research and training into bureaucratic hierarchy makes Leviathan deserving of further consideration and evaluation.

Kenneth W. Yarnold, SDC's Director of Research, was a frequent observer, whose observations included the final group debriefing on the exercise and how to improve its educational value. He commented:

The things that stand out to me are the following:

1. There was great interest displayed by all members of the Air Force group.
2. Their reactions to the experiments were muddled by three unusual situations. First, they felt that the extra work involved in Leviathan (which they had not been forewarned of, would be part of their course but which was perceived as an extra burden) caused a good deal of resentment which could have been avoided by explaining to them ahead of time that they were going to do this job and get credit for it. Even the goals of the "experiment" were unclear to the participants. Second was the Janus-like point of view associated with the fact that they were trying to learn about management so that they could manage better in the future, but at the same time were also trying to get good grades at USC so as to look good now. It seems desirable next time to make it clear to them that their USC grades would reflect as closely as possible what they had learned rather than how much they had participated. A third factor muddled the situation for the participants: In real life, particularly at junior levels of management, great importance resides in the technicality of what is being managed, and much less in the general process of getting along with people, meeting them, and getting a job done through them. The junior subjects, particularly, felt sharply that they should have had the rules incorporated in Leviathan explained to them in much more detail so that they could understand what they were managing.
3. Opinions as to the cost-effectiveness of Leviathan simulation for a training application depended mainly on the position and opinion holder had occupied in the system. Those who had been in command situations felt they learned a great deal and the C.O., in particular, was enthusiastic. Those who had been relegated to minor roles were not enthusiastic and in some cases were negative. It would seem that if a

- training tool were to be designed specifically for management training, it might omit (i.e., mechanize) many of the junior positions.
4. It was clear that the discussion and debriefing sessions, and the viewing from behind the one-way glass windows, were very valuable parts of the total training experience, yet it was also agreed that these parts could not have occurred had it not been for the Leviathan simulation itself which gave the debriefings a reason for existence and specific topics to focus on.
 5. Leviathan was universally perceived as much more valuable than a T-group training situation.
 6. The laboratory sessions should have been timed in such a way that they followed by a week or two courses taught in class, illustrated them and provided reinforcement for them.
 7. An Air Force officer or any other manager in the real world is often inhibited from experimenting and learning, or sticking his neck out in any other way, because he might get hurt. In the Leviathan situation, in which the problem is a play problem and the group of players is one in which authority is minimal, participants are encouraged to experiment, stick their necks out, and learn by doing in a way they couldn't in the real world. However, as well as helping them learn, this surely changes that visible element of their behavior which forms the raw material of other participants' learning.
 8. People's responses, comments, and interactions are conditioned by their ignorance of the mechanics of the Leviathan system. Their comments during the experience would have been more sensible and would have been less of a waste of time had they had this knowledge. Moreover, many were constrained--perhaps the most capable were--by their ignorance of the Leviathan model.
 9. The ostensible reason for not telling people the mechanics of the system was, as noted by Terebinski, to provide stress. However, stress could have been provided by adding extra demands from the outside, causing breakdowns, etc. While it was agreed that in the real world a manager at first doesn't know much about his system there are always people present who do--or at least think they do.
 10. The group of participants was rather homogeneous (all youngish Air Force officers interested in management) and gemütlich (because all had lived in the same service, moved frequently, made friends quickly). This similarity and gemütlichkeit, while typical of purely Air Force (or other) purely service) organizations, is far from typical in the situations in which they must work with another service, or with officers from another

country, or even, God help us, with civilians. Much more fur would have flown in such circumstances as these, and the C.O. of the group felt that one valuable use of the system would be to train Air Force officers and senior civilian contractors to work together.

11. The USC management course appears to be strongly oriented towards "people-problems" in management: toward a "feel of management in the fingertips." But there are burgeoning sciences of organization and management controls, and if Leviathan is not to be used to illuminate these as well, it is being only half-used. By the same token, a reactive STP, teaching, at once, "people-problems," a real system, and organization and management science, would be quite a tool.

Summary

Leviathan is a simulation tool for the study of organization. It has been used experimentally for a quite different purpose: the practice of young Air Force officers in the arts of handling their colleagues and in the context of a course in management. That it has worked at all is surprising, but that it has worked comparatively well is truly remarkable. I had not realized--the Romans had--the enormous dependence of the success of the Leviathan tool as a training device on the details and timing of the training course (lectures, books, debriefings, etc.) in which it was embedded. That Leviathan needs alteration in order to work well as a training tool is clear: It can probably shed a lot of its complexity, a lot of its mystery, and a lot of its junior button-punching processes, but the thing that wants changing the most is its embedding in the matrix of the more usual teaching activities. Of course hindsight is wonderful. I would conclude from what I have seen and heard that there is probably a considerable future for Leviathan as a management training tool if it is redesigned and structured for that purpose. Certainly, we ought to try again, using what has been learned. I must stress, however, that my observations are based almost wholly on the stated opinions of 28 Air Force officers, and cannot be stronger than such a base would support. Measurement of changes in management skill would have been nice and we should strive by all means to get them next time around.

Dr. Marvin Adelson also observed several exercise runs and the final large group session. He concurred with the remarks of Ken Yarnold above, and added the following:

1. One of the striking comments made by the Air Force officers was the importance of evaluation in their usual operational setting, and the notable absence of evaluation in the Leviathan setting. While this lack of evaluation may promote a kind of behavioral freedom and

experimentalism during the sessions, I believe the costs of its omission outweigh its advantages. There is an increasing body of literature in organization theory that stresses the importance of evaluation, not only for individual performance and motivation, but also for organizational stability and task accomplishment. It seems that in future uses of Leviathan for training purposes, an evaluation procedure should be introduced. I would suggest that peer evaluations as well as supervisors' evaluations be recorded, and used during the sessions, and of course destroyed at the end of the entire experience.

2. In addition to the manifest "myth" imposed on the Leviathan vehicle, it is clear that both the Air Force officers and the course instructors brought with them certain mythologies of management that influenced the play. An attempt should be made to explore these mythologies in advance of the use of Leviathan so that the students and the instructors can be oriented to see whether, and to what extent, the training can be used to re-enforce or dispel them. The military notion of how a civilian organization runs appears to be at least as distorted as a civilian notion of how a military organization runs.
3. The participants should be encouraged to restructure or reassign task components in order either to increase team effectiveness, distribute participation more equitably, or relieve certain members from participation altogether where that participation is trivial and can be regarded as a waste of time. In designing future experiences, considerable attention should be paid to whether or not the tasks involved are worthy of the serious attention of the players. There were several comments that in this experience, they were not.
4. My general conclusion is that despite the difficulties and flaws, the Leviathan vehicle can be a valuable resource in training people to operate effectively in organizations, provided that considerable additional effort is devoted to the design of each experience, as contrasted to design of the vehicle itself. Some follow-up work should be done over a period of years to determine whether people who have participated in the exercise feel that it was useful or not, and whether the transfer effect was positive or negative.

Another "observer" was Captain Otis Bryan, USAF, who served as a research assistant for the exercise. His conclusions were:

The Management Skills Simulation has potential for management education. Preliminary results of tests indicate the the simulation and course work shift attitudes toward favorable managerial styles. Before we can say conclusively that it should be used, we have to know for what, and by whom.

Earlier we mentioned that Leviathan had give features that lent themselves to management education. These can be expanded in light of this summer's experience.

1. The abstraction of the system did not seem to cause much difficulty. It did force a training period of three sessions plus an "experimental" period that followed. This is more of a technical problem than a conceptual one. It can easily be overcome with programmed learning texts, and quizzes. Most of the players quickly zeroed in on the task problem and were not upset by the new terms.

There was one attempt to carry over old procedures, and it hurt more than it helped. When intelligence of impending changes in workload and requirements reached the CO, he reacted by telling his subordinates to look for messages of high precedence and to be ready to change the strategy by working on precedence rather than other tags. The proper solution involved other tags. So his behavior was not very successful.

2. The complexity was sufficient that the group was not able to "psych" the system during play. In fact, they did not choose a good strategy until the last day of play; and that was based on a clue that they were given that morning. Coordinated analytical action was not really started until a staff was appointed. One junior lieutenant had the basic idea early, but his "more experienced seniors" were so horrified at the action he took that they quickly "made the correction." By concentrating on his methods, they failed to see that his goal was proper.
3. The human interaction provided the most learning. Debriefings and casual conversations clearly showed that the players were more aware of their behavior and were trying to adapt it in order to be more effective. Several officers commented that they learned a tremendous amount by simply watching the group through the one-way mirrors. The academic sessions with Dr. Holmen provided the players with insight into the interaction of theory and practice. One officer who took active part in the play commented that he could try various methods here without gambling his career.

The group did comment that only the leaders had a chance to learn something because they were the ones who interacted as managers. The 16 group leaders did not get much interaction. Apparently their role was that of specialist rather than manager because the robots are not people. The players recommended that some way be found to rotate the group leaders through higher positions.

4. There were no glaring cases of non-cooperation. Because of sensitivity training, service experience, and common association, the members formed themselves into a mutually supporting team. On the other hand, organizational objectives did not receive much stress for a variety of reasons.

None were effectively stated at the start. The group had no incentives to develop any. In fact, other matters such as classroom work took priority because that is where the grades were. Finally, the group chose not to develop any objectives that took precedence over individuals goals. As a result there was no internal pressure to become a monolithic group.

5. Information processing was an individual effort rather than a group one. Only after the planning staff was created, did the indites go to a single location. Even then a unified information package did not develop before time ran out.

General

The debriefings brought out several factors that needed to be changed before the simulation is used again. First, there was an atmosphere of experiment rather than training. This inhibited behavior to the extent that the players would ask for permission to try something. The atmosphere would have been just the opposite where innovative behavior is emphasized. Second, the group felt that objectives should be clearly stated at the beginning of the simulation; without them they felt lost. They felt the lab should be an integral part of the course material and not a sideline. This would motivate those class members who chose to sit this one out mentally. Finally, they wanted to have video tape recordings of the human interaction so that the group members could see themselves in action.

Summary

The management skills simulation is a technically feasible and suitable method of exercising people in the functions of management. It has the advantage that the basic computer programs can be relatively stable for a variety of groups while only the myth is changed. The message-processing lines can take on a multitude of names: aircraft maintenance lines, operational traffic lines, supply processing lines. All have the basic function of teaching management concepts rather than recipes.

The technology for such a deviation is in existence today. Twency-one computer consoles similar to teletype machines, a digital computer, and a tape recorder are all available off the shelf. The consoles can be attached to the computer through telephone lines making the lab independent of a fixed location. The only limit on such a device is the human imagination and the will to use it.

5. OBSERVATIONS AND SPECULATIONS

The following comments represent the authors' observations of the study reported here. However, if the evaluation of every experiment were based solely upon the results reported in that research project, much that is valuable would be lost; the authors therefore have felt free to draw upon their reading in the field and upon their experience in earlier studies.

5.1 LEARNING AND REINFORCEMENT

Elegant experiments have proved that the rate of learning is negatively correlated with the delay between an act and the delivery of information about the meaning of that act, whether in terms of reward and punishment or more intellectual terms. In an intellectual atmosphere as rare as that in which we conducted the study we also learned that recency of an experience was correlated with learning from a discussion of it.

At the beginning of the study the notes made of what happened were used for feedback at the following class meeting which was four or five days removed from the incident. Only a few incidents occurring on a Wednesday or Thursday were sufficiently dramatic to simulate the class the following Monday or Tuesday. In order to reduce the time between an incident and the discussion of it, the instructor began to suspend the game at the end of any epic in which behavior occurred which was useful for learning. The incident or series of them was presented for class discussion, which was usually more exciting and instructive than the incident upon which it was based.

5.2 PARTICIPATION

People participating, even passively, in an event are presumed to know what happened. So are nonparticipant observers. We learned that participants and observers frequently saw different events, not disagreeing on the same facts usually but seeing different things happen, like the blind man viewing the elephant. If the differences can be characterized, they were that the

observers saw more of the action than the participants, while the participants saw parts of it more clearly than did the observers.

How can they arrange it so that one man can see both broadly and deeply? We can move a man from the ranks of the participants to the observer area. He sees with all of his participation-born insight into the dynamics of the group. He sees all that occurs with the detachment of a man safely behind the one-way glass and thus sees more than anyone else.

We also learned that "leaders" of the experimental group (those given authority over key communication roles) learned more than did participants with less central roles. We observed further that the experimenters learned more than the observers because they knew where the stress would hit and what it might mean to the group and hence could focus their attention better than could the observers who had not participated in the planning of the activity.

So what can we do with all of this information? We believe that the most complete and probably most efficient learning occurs when a man can progress from being a learner to being a low-level participant to being a leader to being an observer to being an experimenter. We are not suggesting that this sequence is very easy to arrange or even possible in all cases, but where it is possible and the learning worth the time and effort, a man should move through as many levels of participation as possible. The time of his moving should ideally be determined by criteria established for what he should be expected to learn at each level. Practical considerations will ordinarily give the man exposure at each level in relation to administrative arrangements for group rather than individual learning. For example, if groups can enter the simulation at weekly intervals and each man participates for a month then each man might be an "Indian" one week, a "chief" the next week, an observer the third week and an experimenter the fourth.

During the first week he would be learning the simulation, getting accustomed to the debriefings, etc. During the second week, he would be getting feedback

from the observers on his attempts to influence the group from within it and would be getting feedback from his peers and subordinates on his role or performance as the leader. During the third week, knowing the problems of the group and its leaders but safe from scrutiny and criticism, he would develop skill in observing group behavior and interpreting it. During the fourth week he could study means of influencing the group from outside of it by modifying the environmental variables and reward system within limits.

5.3 CONCEPT LEARNING

Do students learn concepts of leadership and organizational behavior in a stimulus-loaded simulation environment?

According to the students, most of them learned more about leadership and/or organizations than in any previous leadership program. Certainly from the instructor's point of view, such learning came very fast during the part of the program where debriefings took place frequently. Concepts previously presented in class were used in discussions of incidents from the exercise. New concepts were often made more real by student awareness of having seen very recently the phenomena described.

Probably this learning occurs because of the simplicity of the stimuli and responses and their recency at the time of discussion. Everyone in the simulation can grasp the variables that one of them was trying to deal with and know what other variables of consequence were involved. There are no excuses due to unknown or unexplainable complexities to keep a man from seeing his actions.

5.4 BEHAVIOR CHANGE

Will the simulation experience get men to try new modes of leadership behavior?

Many of the men commented that the exercise gave them a chance to develop a leadership style for the first time or to experiment with modifications of previous methods. Usually the modifications were based on new concepts from the course, but others resulted from retrospective analysis of leadership problems.

Most men felt that "draft effectiveness reports" would have been useful so that each man could get more feedback on his leadership behavior in an environment where a bad eff report would not follow him the rest of his career. Much of the "experimental" leadership behavior was heavily criticized by others in the group; some was seen as a real improvement; but credit was given by the colleagues in all cases for "the old college try" even when the result was otherwise unsatisfactory. Thus the total learning system rewarded experimental leadership behavior.

5.5 GROUP DEVELOPMENT

The experience strengthened the class as a group. Because of the clarity of the stimulus (and in spite of its complexity) and because of the regular debriefings during most of the exercise, the class had a rare opportunity of unity of experience with respect to an event which was common to all of them, in contrast to an event which seems different to each person involved in it. As an indication, many "in group" jokes and phrases developed from the exercise experience. The class organized to help its weaker members keep from doing unsatisfactory work in any course. The class took on more responsibility than its predecessors to interact effectively as a group with the university. Some of us have the nagging concern that if they had developed greater skill and strength they might have "out-coped with" the environment.

5.6 ROLE OF THE COMPUTER

The computer is a valuable asset in a simulation exercise. It provides at the start some glamour and interest. With multiple terminals, it provides flexibility of stimulus and response. It makes possible the use (without annoying delays) of complex, unstable interaction formulas for control of the exercise. Although the "bookkeeping" feature of the computer (to give scores on the various responses) may seem valuable, we made little use of that feature and do not feel that we can appraise its value. The feedback to the participants themselves in the form of computer printouts and displays was valuable for motivation and direction.

6. CONCLUSIONS

Leviathan, or a simulation like it, can be a very valuable tool in management education. Whether Leviathan is the appropriate vehicle for this simulation depends upon the specific purposes of the management education or training, and the cost/effectiveness of Leviathan in relation to other simulations. We do not know of any other available simulation which has the characteristics needed, but such may exist or may be developed in the near future to take advantage of the time-sharing capability now becoming available on many of the medium-sized third-generation computers.

If the objective of the simulation is to train managers with respect to a specific industry or function such as aerospace marketing, automobile agency management, or school administration, a simulation model based on that industry will be needed. A computerized simulation for such a narrow purpose may have few advantages over a manual simulation (such as in-basket exercise series) and may have disadvantages due to the higher cost of operation, less flexibility in terms of location of training, number of participants, etc.; however, an increasingly large number of such simulations is being developed. Of course, a content specific simulation designed to teach the use of a computerized management information, or other systems such as BUIC Air Defense or SABRE Air Line Reservations, should itself be computerized, and should be part of the operating system. (For a discussion of the use of simulation in the development of command and control systems, see Holmen, 1963.)

A general purpose simulation which is computerized should have the following characteristics:

1. Learners should communicate directly to the computer to deal with the program system, and for much of their dealing with each other.
2. The computer should communicate to the learners in response to their inputs and to provide feedback on their actions and the consequences of them.

3. The computer should keep sufficient records to provide summary data to the learners and the instructional staff on an exercise or a series of them.
4. It should be possible to change the myth (simulated operational environment) easily, for example, by changing the print-out instructions or the column headings on printed report forms. Thus school administrators could manipulate pupil schedules, desks, etc., while military logistics people dealt with airlift schedules, and ammunitions re-supply and manufacturing people dealt with machine tools and warehouse capacity problems.
5. The program system should be subject to some instructional staff control to keep the level of effort within appropriate bounds and should contain sufficient stochastic processes that no learner would ever be able to "psych the model."
6. In addition to the people who are part of the myth and operations system, the learning environment must include one or more who are the instructional staff and who are obviously, from the learners' perception, not part of the mythological world. Those who are involved with the myth do not try to interact with the learners except in terms of the myth, while the instructional staff never operates within the myth and deals only with the experiences arising out of interaction among the learners and between them and the model.
7. Desirable, but probably not necessary, in the computer program system would be a capability for the computer to ask the learners why they took certain actions, or how they felt about certain events in the simulation--the learner to answer by inputs through his console to the computer. They could be used in the feedback system so both the respondent and his learner colleagues could get post hoc reports on how they felt about some specific aspect of the exercise about which their feelings may have changed later.
8. Constant flexibility in the use of the simulation for learning will be essential; therefore, the instructional staff must have the authority, education, experience, and confidence to take advantage of every event that excites the learners for any reason.

9. It may be possible to get good training out of simulation models with much less sophistication and complexity than the Leviathan model needs for reaching its research goals. Combining computer feedback with video tape feedback may reduce operating costs while vastly increasing the scope and realism of information given to the participants for their learning.

10. As the costs of computer usage go down, and the sophistication of program systems rises, simulations like Leviathan become increasingly attractive in terms of cost/effectiveness. As managers of both public and private enterprises deal more and more with on-line computer systems, the simulation capability becomes more readily available as a fallout of the system checkout process. As computers make it possible for each manager to influence a larger sphere of his organization's functions without interference or help from peers or subordinates, and as people become relatively more "expensive" and automated processes relatively cheaper, the need for good general-purpose and special-purpose simulations will sky-rocket. Their acceptance requires some dramatic demonstrations of the value of such simulation, of which the present study was a first short step.

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