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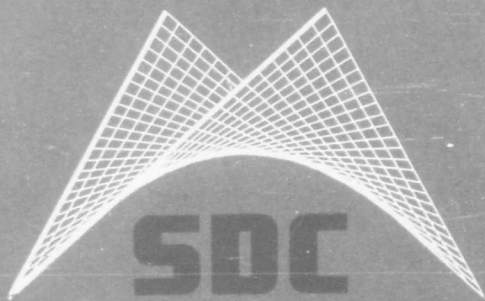
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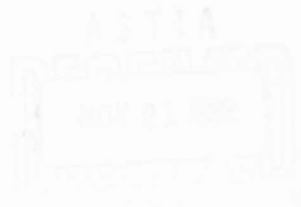
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TM-761

The Leviathan Technique for Effecting
and Monitoring Live-Artificial Communications

26 September 1962



TECHNICAL MEMORANDUM

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The Leviathan Technique for Effecting
and Monitoring Live-Artificial
Communications

by

Sydney C. Rome and Beatrice K. Rome

September 26, 1962

SYSTEM
DEVELOPMENT
CORPORATION
2500 COLORADO AVE.
SANTA MONICA
CALIFORNIA

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1. INTRODUCTION

It is a commonplace that in social organizations people converse with one another. Some individuals give orders; frequently, unauthorized or illegal commands are issued; violations may become known and sanctions against the violators may follow. Some individuals request information; others supply it. Thus, in any social group, the social process is carried by the communications among its members.

In the Leviathan dual-mode simulation (described in "LEVIATHAN: An Experimental Investigation of Large Organizations with the Aid of Computers")*, live subjects occupying managerial roles will be communicating with one another and with automated personnel. This communication takes place over the computer by means of pushbuttons and digital displays. Automated agents, carrying out the productive, technological work of the organization, receive and implement orders and decision rules. These reflect the intentions, policies, and plans of the higher-level, governing, live decision makers.

The process of communication among the live managers is described in the aforementioned paper. The present paper establishes the program requirements for (1) the communication process from live managers to artificial agents, and (2) monitoring transgressions of authority -- that is, violations of territorial rights and of functional responsibilities.

2. EFFECTING LIVE-ARTIFICIAL COMMUNICATIONS

a. Requirements for Communication from Live Subjects to Artificial Agents. The communication process from live decision makers to artificial agents must meet the following conditions:

1. Live subjects should address the robots in exactly the same kind of natural language as they employ in talking with each other.
2. The vocabulary used by the live personnel should be free of any special formatting restrictions other than those of providing the minimum of information needed by the artificial agents to interpret their orders.

* TM-744, Section XI.

3. The artificial agents must be able to receive homologous commands; that is, it must be possible for live subjects to express the same command in more than one way during a given experiment. The computer must be able to interpret diverse expressions as being the same command, and be able to record the incidence of each of the diverse forms as well as their total incidence.
4. The computer must be able to identify, monitor, and reject erroneously framed expressions.

b. How Subjects Intervene During the Operation of the Computer Programs. How are these conditions to be met? To answer this question, it is first necessary to understand the types of instructions or interventions which live subjects can take in manipulating the technological system. These interventions are defined and described by the program requirements for the Leviathan technological system set forth in detail in "The Leviathan Technological System for the Philco 2000 Computer" (TM-713). In Section 9 of this document, the interventions which the live subjects can accomplish in the technological system during the progress of an experiment are listed. The twelve interventions presented there are reproduced in Table 1.

That the total number of distinct interventions is a large number is clear from the following considerations. In a modular assembly of the Leviathan Technological System, there are as many as 50 segments. At each of these, the several kinds of interventions shown in Table 1 can be effected by the live subjects. Interventions can also be effected, as shown, in the routing and distribution elements. Over these territorial areas, furthermore, artificial agents can be assigned and reassigned. Finally, any of these hundreds of distinct interventions can be executed many times during the course of an experimental session.

c. Translating Live Interventions into Dynamic Instructions to the Computer. We now show that this rich variety of possible interventions available for control by

Table 1. Variables in Technological System Specifiable by Live Subjects During Progress of Experiments.

ELEMENT OF TECHNOLOGICAL SYSTEM	INTERVENTION	REFERENCE SECTION IN TM-713
Routing	Field Inspected	3b
	Routing of Items in Field to Various Processing Lines	3c
	Processing Rate	3e
Segment	Field Inspected	5a
	Priority Assignments	5b
	Processing Rate	5e
Distribution	Field Inspected	6
	Priority Assignments	6
	Processing Rate	6
Artificial Agents	Number of Agents of Each Kind on Each Squad	8c & 8d
	Number of Agents of Each Kind in Transfer Pool	8d
	Transfer of Agents	8d

live subjects can be specified in terms of just five dynamic instructions to the computer programs. A "dynamic instruction" is one (a) issued by a live subject while the computer is operating that (b) either changes specific operations of the computer or changes a decision rule by which the computer operates. Intuitively, one can quite appropriately think of a change in a decision rule as a change in the position of a control knob that affects the operation of an electronic circuit. The five dynamic instructions are these:

- INSPECT (F,T)** In Table 1, the three elements, "Routing," "Segment" and "Distribution," involve an intervention to inspect a field. This intervention can be expressed unambiguously to the computer as the single instruction: "Inspect F (Field) at T (Segment)."
- PROCESS (R,T)** Similarly, they involve the common intervention: processing rate. This can be expressed as the unique instruction: "Process at R (Rate) at T (Segment)."
- ASSIGN (P,V,T)** Again, "Segment" and "Distribution" both involve the intervention: priority assignments. This can be translated into the instruction: "Assign P (Priority) to V (Value) at T (Segment)."
- ROUTE (V,L,C)** "Routing" calls for a special intervention to route items in a field to various processing lines. It can be expressed: "Route V (Value) to L (Line). Route if C (Condition) is 1; do not route, if C (Condition) is 0."
- TRANSFER (A,S)** Finally, the three interventions relating to the "Artificial Agents" can all be realized by the single instruction: "Transfer A (Agent) to S (Squad)." This dynamic instruction is interpreted and implemented in one of three ways:

Table 2. The Fundamental Dynamic Instructions.

INSTRUCTION	VARIABLES	REFERENCE SECTION IN TM-713	CATEGORY	INTERPRETATION
Inspect	F,T	3b, 5a, 6	Traffic Control	Inspect F (Field) at T (Segment)
Process	R,T	3e, 5e,6	Processing Rate	Process at R (Rate) at T (Segment)
Assign	P,V,T	5b & 6	Priority Assignment	Assign P (Priority) to V (Value) at T (Segment)
Route	V,L,C	3c	Routing	Route V (Value) to L (Line). Do route if C (Condition) is 1; do not route if C (Condition) is 0
Transfer	A,S	8c & 8d	Manpower Allocation	Transfer A (Agent) to S (Squad)

Table 3. Basic Variables of Dynamic Instructions.

SYMBOL	MEANING	RANGE	REFERENCE SECTION IN TM-713
F	Field	Eight fields	2a
T	Territory	Segments, plus routing and distribution	4a & 4b
R	Rate	Zero to 255 per scan	5e
P	Priority	Four	5c
V	Value	Up to ten values	2a
L	Line	Up to ten lines	4a
C	Condition	Two	3c
A	Agent	Up to 1000 agents	8a & 8b
S	Squad	Up to 100 squads	8c

(1) If the agent to be transferred is not assigned to any squad, that agent is in the transfer pool. (See TM-713, Section 8d.) Then the dynamic instruction is interpreted to mean that the agent is to be reassigned from the transfer pool to the designated squad. This reassignment is effected as soon as possible in simulated time. (2) If the agent to be transferred has already been assigned to a specific squad, that agent is first moved to the transfer pool and, after a period of simulated time, the agent is transferred to the designated squad. (3) An agent can be removed from a squad but not assigned to another squad. This is accomplished by designating the transfer pool as a special (non-productive) squad. Then "Transfer A (Agent) to S (Transfer Pool)" moves A from the squad to which it is assigned to the transfer pool.

The foregoing five dynamic instructions are listed in Table 2, together with their respective variables, interpretations and reference sections in TM-713. Only nine variables are involved in these five instructions. They are defined in TM-713. Table 3 lists these variables, their meaning, their range, and the sections of TM-713 wherein they are respectively defined.

d. How Subjects Issue Commands to the Technological System. All that the live subjects can say to the artificial agents in the initial Leviathan laboratory experiments can be expressed by the five dynamic instructions listed in Table 2. Now the question is, how can the subjects express themselves to the computer? How do they physically implement their decisions?

One approach would be to design equipment to complement the simplicity of this basic set of instructions. A set of keys might be allocated to the basic instructions themselves, with one key for each instruction and a few spares for enlarging the formulation. A second set of keys might be assigned to the nine variables. In addition, 30 keys might be provided for alphanumeric values. The resultant layout might appear as

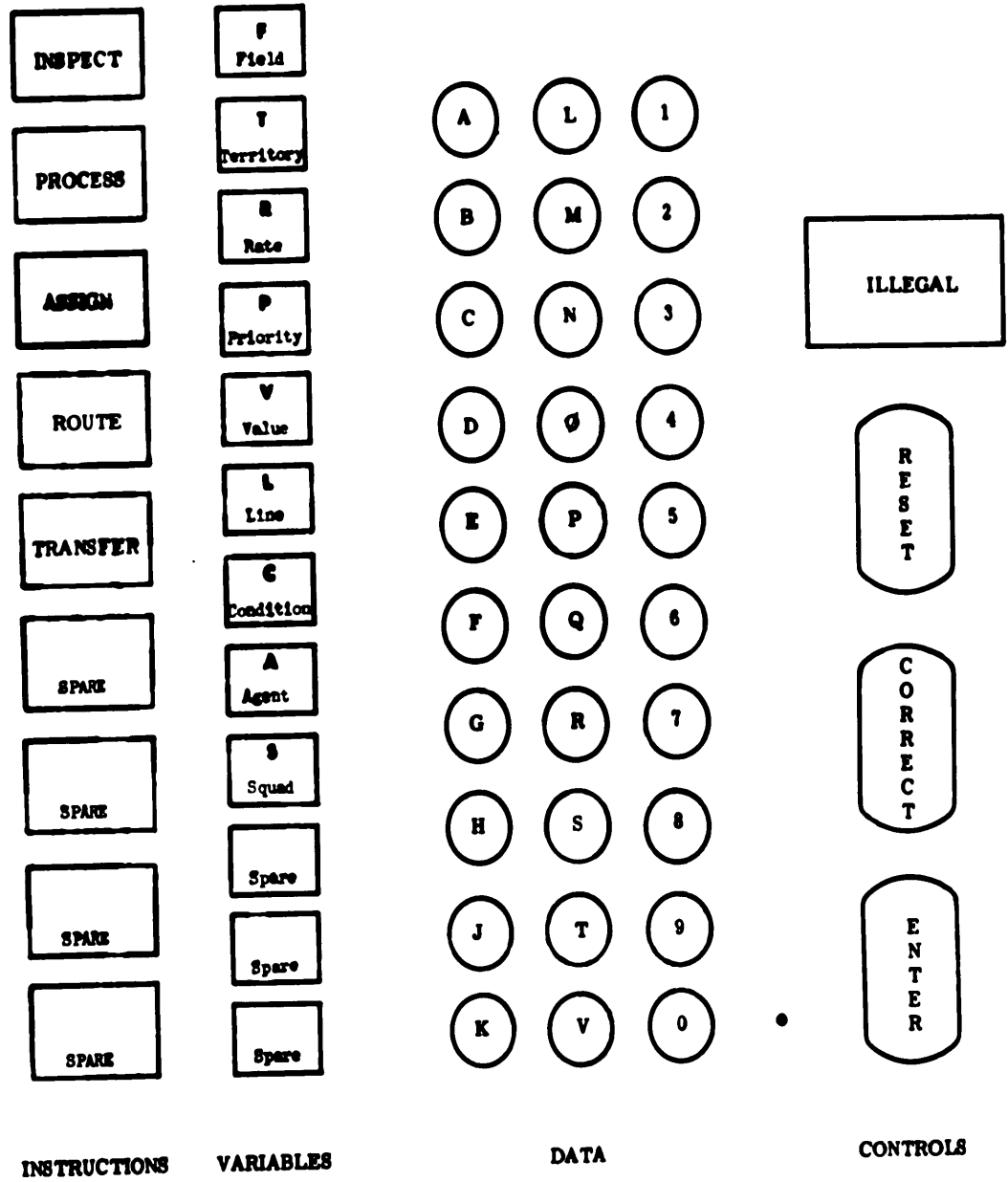


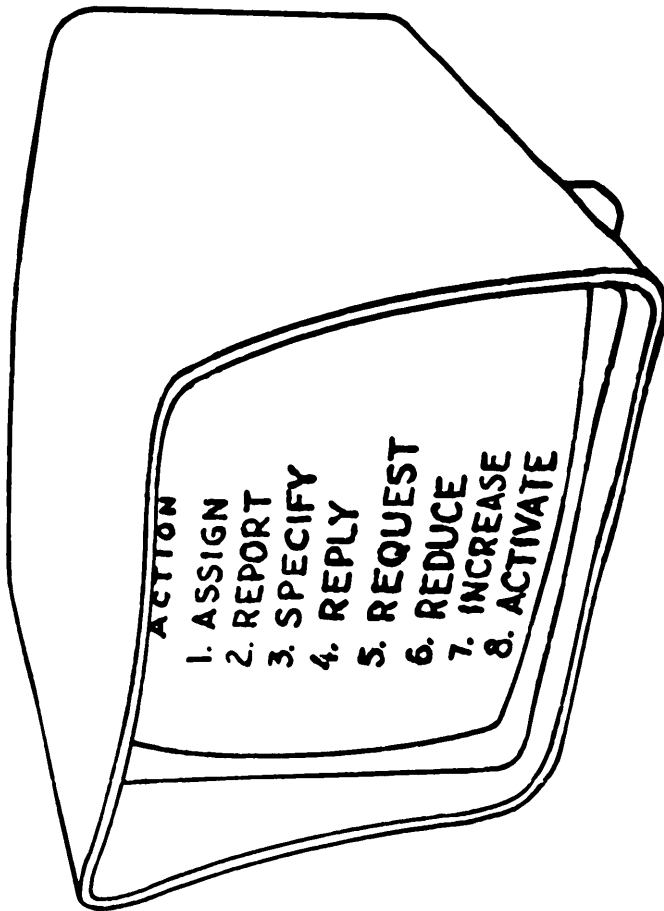
Figure 1. Special-Purpose Keyboard Layout.

shown in Figure 1. Instruction, variable and control keys are illuminated respectively in green, amber and white. These keys remain illuminated and data buttons remain depressed until computer accepts the interventions of the subjects.

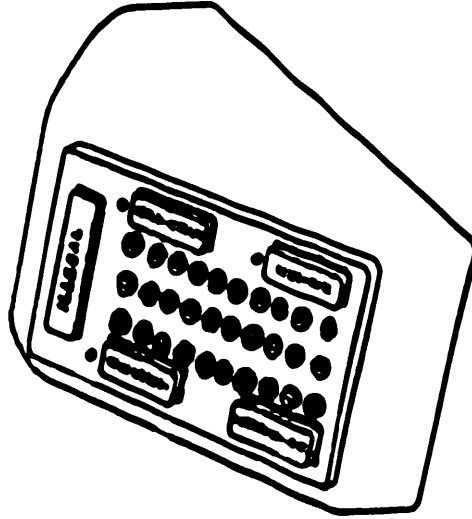
This approach, while traditional and simple to operate, is not adequate to the Leviathan objectives. (1) It requires that subjects learn how to translate the particular operations of the system into instructions to the computer. Such indoctrination has to be quite specific and has no transfer value for other laboratory situations. (2) It fails to provide for other experimental requirements. These, in turn, would entail adding many more special-purpose keys. (3) Computer programs are forced to be tailored narrowly to the equipment. (4) In the Leviathan executive command experiments, the central system functions to be explored relate to strategy and policy formation and to policy interpretation and control. The basic dynamic instructions to the technological system, on the contrary, express far more specific executive intents; they are of the stuff of direct, lowest-level supervision. It would detract from the development of command functions during an experiment if the subjects required extensive specific indoctrination in the use of special-purpose equipment.

Accordingly, the Leviathan approach to operator-computer interaction has been to design general-purpose equipment and general-purpose programs that exhibit a flexibility as great as that of the computing machinery with which they operate. How the subjects communicate with each other is fully described in TM-744, Sections X and XI. Each subject has a digital display—a television tube on which the computer writes alphabetical letters and numbers. Ten lines of writing can appear, with as many as 16 characters on each line. A set of pushbuttons enable the subject to communicate through the computer. During a Leviathan experiment, the computer writes questions on the digital display and the subject responds by pushing buttons. The equipment is shown in idealized form in Figure 2.

The same equipment and similar programs can be used by live subjects to address artificial agents. For example, suppose that a live subject wishes to have an artificial agent, CT4, transferred from squad T5 to squad M3. The following set of



DIGITAL DISPLAY



**INTERVENTION
CONTROL
UNIT**

Figure 2. Leviathan General-Purpose Equipment.

activities might occur. (The successive displays forced upon the digital display scope by the computer are shown at the right. The actions of the subjects and operations accomplished in the computer are explained at the left.)

OPERATIONS

DISPLAYS

On the display scope appear the questions:

DO YOU WISH

•

1. TO SEND A COMMUNICATION
2. TO RECEIVE A COMMUNICATION

Assume that the subject wishes to send a communication. He depresses key number 1 and the Enter key. The computer accepts these two elements of information, acknowledging acceptance by releasing the pushbutton and the Enter key.

•

•

At once the previous display on the scope vanishes and is replaced by the display:

TO WHOM?

The subject addresses his communication. In the present case he wishes to issue an order to the artificial non-commissioned officer in charge of squad T5. He depresses buttons T and 5 and the Enter key.

When the computer accepts the foregoing information and releases pushbutton T and 5 and the Enter key, a display appears as follows:

ACTION

1. REQUEST FOR
2. REPLYING
3. REQUEST THAT
4. REQUEST APPROVAL
5. ASSIGN

The subject selects "Request that ..."
by pressing the 3 button and entering
this element of information.

To these actions by the subject, the
computer responds with a new display:

WHICH REQUEST

1. YOU SEND COPY
2. YOU REPLY
3. YOU INVESTIGATE
4. YOU COMPLY
5. YOU SEND
6. YOU TRANSFER

The subject selects the sixth item:
"You Transfer."

The "You transfer ..." display now
elicits the following:

TRANSFER WHAT?

1. AUTHORITY
2. RESPONSIBILITY
3. OBLIGATION
4. AGENT

Up to this point, the subject has
made two selections from among the
displays that guide him while com-
posing his communication. He has
composed the beginning of his order:
"Request that you transfer ...". He
now enters the number 4, signifying
his intent to say: "Request that you
transfer Agent ...".

The computer responds by asking:

WHICH AGENT?

ENTER TWO
LETTERS AND
A NUMERAL

Note that when the computer asks its
question, it also instructs the
subject how to reply.

The subject has the liberty to enter 1,000 different responses to this question (as shown in Figure 2, the pushbutton unit has three columns of ten pushbuttons each). The subject depresses button C in the first column, T in the second, and 4 in the third; and he sets the Enter key.

Having answered the question, "Which Agent?" the subject is now asked, "Where to?" Note that on this display the computer instructs the subject what action to take in order to trigger off the next display.

WHERE TO?

1. TO SQUAD

ENTER
BUTTON
NUMBER 1

The computer completes the interrogations that guide the composition of the present communication with the display:

TO WHICH
SQUAD?

ENTER LETTER
FROM SECOND
COLUMN AND
NUMBER

Since the computer calls for the selection of buttons from two of the three columns of ten keys each, there are 100 possible responses to this question. The subject selects M and 3.

The computer now gives the subject the opportunity of correcting his communication by displaying:

END OF
COMMUNICATION

TO CORRECT
COMMUNICATION
ENTER RESET

Table 4. Example of Communication From Live Subject to Artificial Agent.

SEQUENCE OF ACTIVITIES	FUSHBUTON INTERVENTION	MEANING
Election to send	1	"I wish to send a communication."
Addressing	T5	"To non-commissioned officer, T5:"
Message Composition		
Order of Interventions:	1	"Request that ..."
	2	"You transfer ..."
	3	"Agent ..."
	4	"CT4 ..."
	5	"To squad ..."
	6	"M3."
Message Review	Reset	Discard Above Communication and Start Over.
	or Advance	Send Communication as Addressed and Composed.

TO SEND
COMMUNICATION
ENTER ADVANCE

To address, compose and send his communication, the subject has entered the succession of items shown in Table 4.

As explained in TM-744, the process of communication from live subjects to artificial agents follows the same pattern as that from live subjects to other live subjects. The two kinds of communication are not distinguishable by format and in many cases have identical intent. The only way they can be distinguished is by addressee, and the computer has to use this method for distinguishing between them. Communications to live subjects are addressed to live subjects (two letters are used, one from each of the first two columns of buttons shown in Figure 2). Those to artificial agents are addressed to squads (a letter: L, M, ..., T, V, and a number).

The mode of interaction between operator and computer that was just described and that has been adopted for the Leviathan laboratory experiments differs in two important respects from the more traditional approach sketched above in which the pushbuttons are given specific designations. (1) In the Leviathan approach, the digital display provides the labels for the pushbuttons. Hence we have variable labels for a fixed array of pushbuttons. For most purposes, only ten data buttons are used (often less than ten are active - sometimes only one or two). For some purposes, principally for entering data, all three sets or columns of buttons are used, providing for as many as 1,000 distinctions. Even when the labels on the buttons are used for entering values of variables (for example, Agent CT⁴), the computer program and the display define the variable to the subject. (2) The computer programs that respond to the pushbuttons and drive the displays are perfectly general. The words that appear on the displays are parameters to the program, entered on punched cards, transferred to magnetic tape, and then compiled into the general purpose interaction program without altering the previously produced program. This program is called the General Operator-Computer Interaction (GOCI) Program. It is described in TM-744, Sections X and XI.

e. How the Computer Accepts Variable Format Instructions.
We can now state how the communication process from live managers to artificial agents is actually accomplished.

The present GOCI programs are being modified to permit live subjects to address artificial agents. The programs will direct all communications destined for artificial agents to the squad leaders. The squad leaders will have the same designations as their respective squads. (These designations will consist of a letter chosen from the set: L, M, N, O, P, Q, R, S, T, V, and a number from the set: 1, 2, 3, 4, 5, 6, 7, 8, 9, 0.)

Suppose now that a live subject composes a communication and that he addresses it to BN, GT, T5 and AS. The computer scans this group of addressees to determine whether any artificial agents have been addressed. It identifies T5 as an artificial agent. At present, we are adopting the conventions (1) that if any live subjects are addressed in concert with an artificial subject, it is presumed that the principal addressee is the artificial subject and (2) that every communication to an artificial subject must contain a dynamic instruction. Thus the presence of T5 among the addressees is a signal that T5 is the principal addressee and that the communication is an instruction to the technological system.

The presence of this signal triggers the following operations of the computer:

1. The communication is withheld from all displays. (Only live subjects require displays.)
2. The GOCI (General Operator-Computer Interaction) Program checks whether more than one artificial agent is addressed for a single communication.
3. If more than one artificial agent is addressed, the computer refuses to accept this demand made by the live subject. The refusal is indicated by the illegal signal lighting up on the push-button box (see Figure 2). When this happens the subject has two choices: he can desist from addressing any more artificial agents, or he can press the "Reset" and "Enter" buttons,

thereby starting anew the composition of his communication.

4. If only one artificial agent has been addressed, then three kinds of consistency checks are made by the computer. (a) If the dynamic instruction to be implemented is Inspect (F,T), Process (R,T), or Assign (P,V,T), then the computer checks whether the squad of the addressed artificial agent has been assigned to the territory designated by the variable T. The meaning of territory and the assignment of squads to territorial 'locations' is described in Section 8g of TM-713. (b) If the instruction is Route (V,L,C), the computer checks whether the squad of the addressed agent is assigned to the routing territorial area. (c) If the instruction is Transfer (A,S), the computer checks whether Agent A currently is assigned to the squad of the agent addressed.
5. With each of these three kinds of consistency checks, if an error is detected by the computer, a copy of the message is directed to the sender with the information: "RETURNED TO SENDER. WRONG ADDRESSEE."
6. If the communication has been properly addressed, then, after an interval of simulated time specified by the experimenters, both the live sender and the live recipients, if any, receive hard copies of the communication, with the legend: "IMPLEMENTED IN EPOCH X."

f. Dictionary for Translating Sequences of Button Pushings Into Dynamic Instructions. All properly addressed communications are implemented in the technological system between periods of laboratory activity by the live subjects. How? Thus far attention has been focused on the extra-content aspects of the communication process. But the question arising now is: how does the computer implement the message-content itself?

For example, suppose the computer is asked to implement the communication shown in Table 4. How the computer interprets and effects the sequence of activities included under "Election to Send" and "Addressing" has already been covered. How it effects "Message Review" is obvious from Table 4. What remains to be explained is the execution of "Message Composition."

Prior to any experimental run, the experimenters prepare a dictionary for use by the computer in that run. The dictionary is a parameter to the present computer programs; this is to say that the entries in the dictionary can be altered from run to run without affecting the underlying program. The dictionary is a table that associates acceptable sequences of pushbutton interventions by live subjects with the five dynamic instructions.

For each acceptable sequence of pushbutton interventions, 16 successive interventions are specified. For the message represented in Table 4, the specification would be as follows:

<u>Order of Intervention</u>	<u>Acceptable Intervention</u>
1st	3
2d	6
3d	4
4th	V-1
5th	1
6th	V-2
7th-16th	None

Thus the set of 16 interventions: (3, 6, 4, V-1, 1, V-2, none, ..., none) means "Transfer V-1 to V-2." V-1 and V-2 respectively stand for the first and second variables in the dynamic instruction, Transfer (A,S).

Similar entries are made for each experimental run for each acceptable message content that can be composed by the live subjects. For each pushbutton sequence, only one dynamic instruction is assigned, but more than one sequence can mean a single dynamic instruction. Finally, the computer monitors all sequences of pushbutton interventions.

If any actual sequence partially coincides with a sequence listed in the dictionary but does not do so completely -- or if an actual sequence does not occur at all in the dictionary -- then the computer does not attempt to implement it (even though it could be meaningful) but returns a copy of it to its sender with the notation: "RETURNED TO SENDER. COMMUNICATION IMPROPERLY COMPOSED."

3. MONITORING LIVE-ARTIFICIAL COMMUNICATIONS.

a. Violations and Mistakes. It will have been noticed that thus far all miscalculated errors, that is, simple non-deliberate mistakes on the part of live subjects in communicating with artificial agents, are automatically detected and rejected by the computer. Such mistakes may include (a) multiple addressing of artificial agents; (b) misaddressing or wrong addressing; and (c) improperly composed communications. The ultimate objective of Leviathan research, however, is to explore the dynamics of social behavior in large organizations. Such behavior may be cooperative but also it may be deliberately hostile or aggressive. In short, Leviathan must provide for the possibility of deliberate, conscious violations on the part of live subjects in the communication process.

This brings us to the second task of this paper -- to establish the program requirements for monitoring transgressions of authority, that is, violations of territorial rights and of functional responsibilities.

b. Authority Matrices. A set of five tables (or rectangular arrays) is established in the computer, one for each of the five basic dynamic instructions. Thus there is one table for Inspect (F,T), another for Process (R,T), and so on. In each table, there are 24 rows, one for each possible subject. The columns are understood to be the 100 squads of artificial agents (of course, the images of these

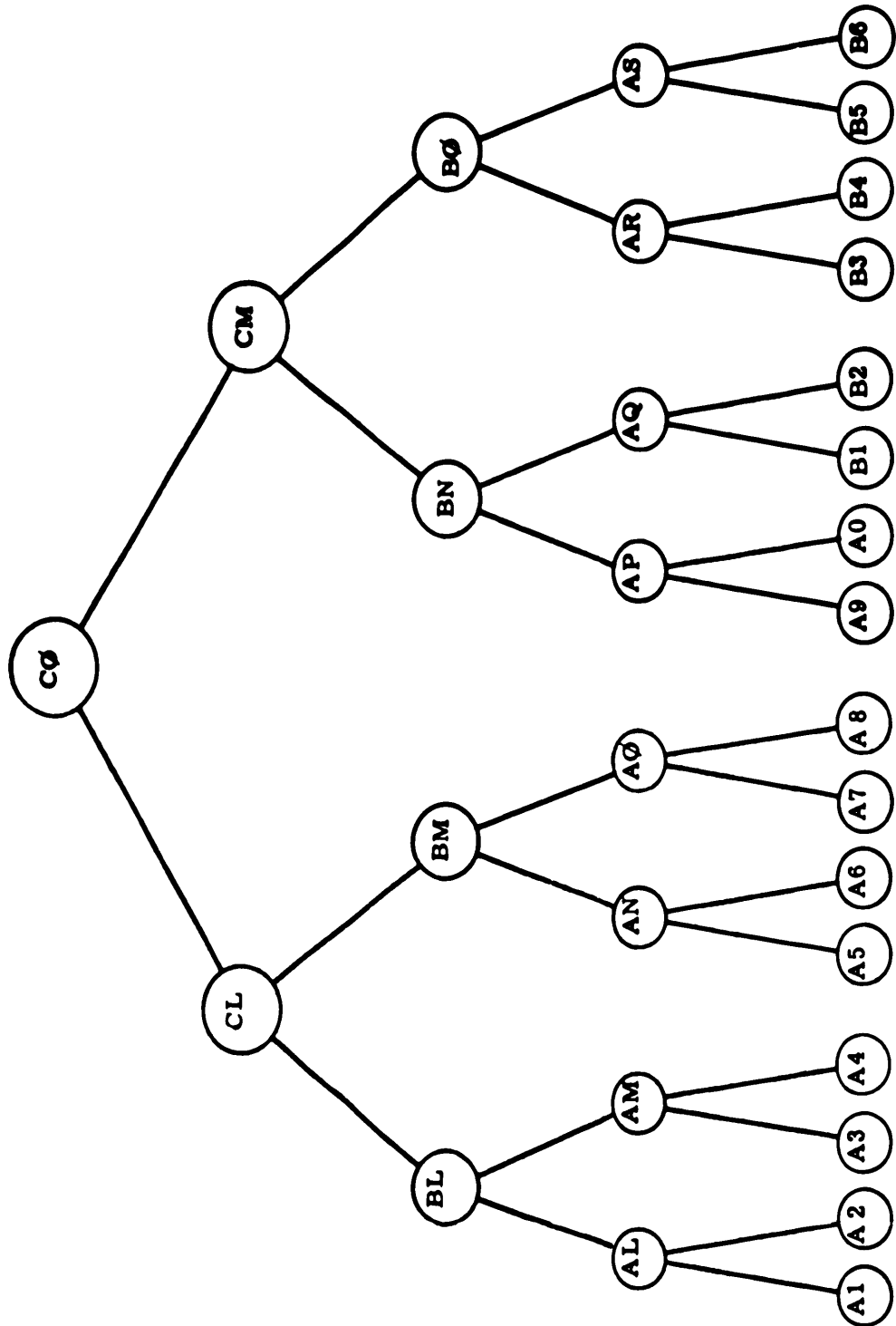


Figure 3. A Simple Hierarchical Organization or Directed Graph, as Specified in Table 5. Upper Echelons Occupied by Live Subjects; Lowest Echelon Manned by Artificial Agents.

Table 6. Five Dynamic Instructions Mapped into Four Functional Responsibilities.

FUNCTION	DYNAMIC INSTRUCTION
Priority Administration	Assign (P, V, T)
Production Control	Process (R, T)
Traffic Control	Inspect (F, T) Route (V, L, C)
Manpower Allocation	Transfer (A, S)

tables in the computer's direct access memory are not like this). If a specific live subject has the right to issue an order or a decision rule to a particular agent, a one is entered in the appropriate cell of the table. If not, a zero is entered.

An example of such a table is Table 5. Assume that it represents authorization to reassign artificial agents -- Transfer (A,S). The lines of authority in this table can also be represented in the more familiar graphical terms shown in Figure 3. Note that Figure 3 represents only a partial organization, because Table 5 exemplifies only one among the five kinds of dynamic instructions. A complete organizational chart would include the relationships of hierarchy and authority for all five instructions.*

One may, of course, consider the specific instructions as different functions. Then the five respective tables indicate to the computer which live supervisor is responsible for which function. Actually, five kinds of functional responsibilities are too many for most experimental needs. Thus in the first full Leviathan laboratory experiments (see TM-744, page 75), no more than four functions will be distinguished: priority administration, production control, traffic control, manpower allocation. The present five dynamic computer instructions are easily mapped into these, as depicted in Table 6. This mapping is accomplished by making the authority table for Inspect (F,T) identical with that for Route (V,L,C). In an experimental design in which all five functions were to be performed by all the live managers, all five tables would be made identical. This would represent a simple "line" organization.

* In terms of graph theory, the organization can be represented only by a multicolored or multivalent directed graph, one color for each instruction. (See Figure 17, TM-744 for examples of multicolored organization charts.)

c. How the Computer Monitors Authority Violations.

Given the five computer tables, with all cells filled for the active live managers and artificial squads, the computer proceeds as follows:

1. First it carries out all the previously described steps required to establish a communication from a live subject to an artificial agent. This means that before the authority monitoring routines are initiated, the dynamic instruction punched into the system by a live subject has been implemented in the technological system. It also, of course, means that the computer has identified this instruction.
2. Next, the computer goes to the authority table associated with the particular instruction and tests whether the live manager who sent the communication is authorized to issue that instruction to that squad. If a one is present in the cell at the intersection of the live subject's row and the column bearing the squad's name, the action is legal. At this point the authority check has been completed, after which, as stated above (Section 2e), a copy of the original communication is prepared by the on-line printer for the subject issuing the order; it bears the legend: "IMPLEMENTED IN EPOCH X."
3. If a subject is not directly in charge of a given squad, but is empowered to issue orders to the squad, the column in which the one occurs is searched for still other ones. (The set of all the ones in the column must be made to coincide with the members of the chain of authorized command.)
4. The hierarchy tables, described in TM-713, Section 8g, are then consulted in order to identify the intermediaries between the

subject issuing the command and the subject immediately in charge of the squad. Then, at the option of the experimenters, all subjects in the intervening line of command may receive copies of the communication.

5. If a zero is present at the intersection of the subject's row and the addressed artificial agent's column, the computer understands that the subject may not exercise the function controlled by that particular table over that particular agent. Recall, however, that the instruction has already been implemented. This means that the live subject has overreached his authority and violated the prerogatives of some other live subject.
6. To determine against whom a violation has been committed, the computer searches the column in which the zero occurs. It locates each of the ones in that column and records which live subject has a one in his row.
7. Next it consults its hierarchy tables and decides which live subject is directly in charge of the squad that is the target of the violation.
8. After an interval of simulated time specified by the experimenters, the live subject whose authority has been violated and the violator receive copies of the illegal communication marked: "VIOLATION."

d. How the Computer Monitors Territorial Violations. Monitoring territorial violations requires no additional programming routines other than those already described. The reasons why this is so are as follows:

1. A test for misdirected communications has already been performed. Therefore, in all communications to artificial agents, the squad addressed coincides either with the territory in which the command is to be implemented or else with the squad from which an agent is to be transferred.
2. Next, we require that every squad be uniquely assigned to a territory and every agent be assigned to just one squad.

The consequence of these conditions is that any violation signalled by the authority tables is a violation of territory. For if a zero appears at the intersection of a live agent's row and an artificial squad's column, then that live agent may not address that artificial squad. Therefore he may not effect an order or command in that squad's territory.

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tables

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DESCRIPTORS: Automation. Behavior (Psychology).

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States that in the Leviathan dual-mode simulation live subjects occupying managerial roles communicate with one another and with automated personnel. This communication takes place over the computer by means of pushbuttons and digital displays. Automated agents, carrying out the productive, technological work of the organization, receive and implement orders and decision rules. These reflect the intentions, policies, and plans of the higher-level, governing, live decision makers. This paper establishes the program requirements for the communication process from live managers to artificial agents, and for monitoring transgressions of authority.

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