

PHILOSOPHY PROJECT

SOCIO-ENGINEERING PROBLEMS REPORT No. 181-F

"Weighting of Display Space for Political and/or  
Religious Organizations by Use of the Product  
of the Probability times the Information  
(Negative Entropy)."

by

Frederick B. Wood, Ph.D.

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In 1959 I circulated SEPR No. 7, "Problems to be Referred to the Society for General Systems Research," with a sample calculation included of the distribution of Community Exhibit Space determined by the negative entropy of the membership statistics. This was prepared in response to the question stated as "Problem 7.1.1" reproduced on page 'B.' --- 'D.'

This same example was used in SEPR No. 65-E (5/23/63), "Abstract of A Research Plan for a Book on /COMMUNICATION THEORY IN THE CAUSE OF MAN/."\* As a result of comments received on SEPR 65-E, I issued SEPR No. 7-B, which clarified the concepts of the allocation of public display space. This material is reproduced on pages E --- G.

The revised example was further explained and illustrated in my conference paper, "Cybernetics and Public Order," at the November 1964 Conference on Cybernetics and Society at Georgetown University, Washington, D.C. (SEPR 93-A, pp. 53-54; edited in SEPR 93-G, Appendix C, pp. 57-59)

This concept was further developed in a handwritten draft memo, File No. 191 (July 20, 1968), "Review of a Proposal of Peter M. Wood of July 1967 on 'What IBM Can Do!.'" The example from File 191 was further developed for use in SEPR No. 181-D which is included in this memo, SEPR No. 181-F.

Further editing is contemplated, before publishing the material of SEPR 181-D.

Frederick B. Wood

\*Presented to the A.I.E.E. Cybernetics Committee Workshop at the Spring Joint Computer Conference, Detroit, May 1963.

PROBLEMS TO BE REFERRED TO THE SOCIETY FOR  
GENERAL SYSTEMS RESEARCH:

Problem 7.1: What should be the aims, goals, activities and services of the Society for General Systems Research for the period 1959-1961?

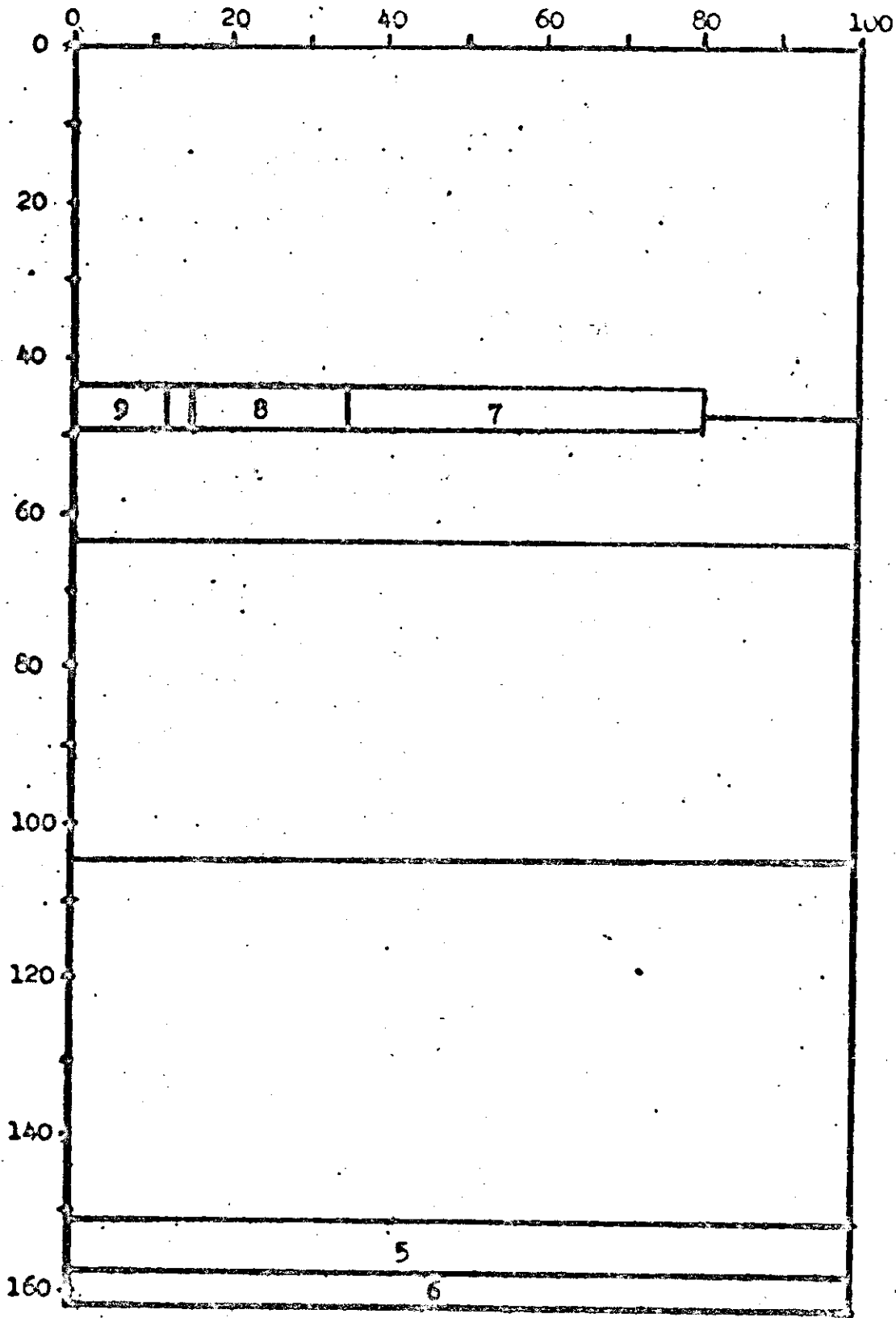
Problem 7.1.1: Should the ultimate objective be to help provide the people of the world a better understanding of themselves and the groups, corporations, associations, governments, and United Nations agencies of which they belong so that each individual can find a rational way to apply the highest ethics available to him in his culture?

I realize that bringing the question of ethics challenges the concept of science as an entity by itself - the search for truth. In considering this problem the thoughts from Rodenstock-Huey on the stages of Western Civilization (Socio-Engineering Problems No. 5, p. 123) may be useful. My thought is that it is not necessary for the Society to get involved with the selection of a particular set of ethics. We can list the statements which are representative of the principal religious faiths. This would show a certain amount of common ideas in all the major cultures in the example given in THINK, October 1952 (SEP 1, p. 15).

Another approach would be to describe the different viewpoints on ethics with an amount of space proportional to the negative entropy of the statistical distribution of the different viewpoints. An example of this is as follows: Consider an hypothetical city of 100,000 adults (children not counted in this study). The distribution of adult members of the different religious faiths is as follows:

City D

<u>Religious Group</u>	<u>N Members</u>	<u>P, Probability</u>	<u>-p, log<sub>2</sub> p, negentropy</u>
1. Roman Catholic	60,000	0.600 0	0.442 0
2. Protestant	20,000	0.200 0	0.463 0
3. Lutheran	15,000	0.150 0	0.411 0
4. Protestant Episcopal	3,000	0.030 0	0.152 0
5. No Church	1,000	0.010 0	0.066 5
6. Buddhist	600	0.006 0	0.044 3
7. Unitarian	230	0.002 3	0.020 2
8. Jewish	100	0.001 0	0.009 95
9. Eastern Orthodox Catholic	60	0.000 6	0.005 4
10. Ethical Culture	10	0.000 1	0.001323
<b>Totals</b>	<b>100,000</b>	<b>1.000 0</b>	<b>1.616 7</b>



16,167 unit squares

Fig. 1. Sample Distribution of Community Exhibit Space Determined by Negative Entropy of Membership Statistics.

Fig. 1 shows the distribution of space to scale for the above statistical distribution of religious groups. Consider the situation described in "San Jose 2008 A.D.," SEP 2, P. 7, where The First National Bank Building is devoted to an experiment in political democracy. Suppose that a 100'x50' section of the main lobby is devoted to exhibit space consisting of four foot wide bulletin board around the room. Then 16,167 unit squares of Fig. 1 correspond to 1000 sq. ft. Each unit on Fig. 1 is 9.4 sq. in. This makes the Group No. 19 (Ethical Culture) space of 13.3 units correspond to 125 sq. in. or one legal size sheet of paper.

Suppose one individual developed some new ideas he wished to advertise in the community exhibit space. On the scale of the sample in Fig. 1, he would be entitled to one third of a page space. On this he could put a brief statement and list his address for inquiries about further information.

A public policy of allocating display space in accordance of the relative entropy of the membership distribution could help prevent the democratic ideal from being distorted to allow the majority group to suppress minority ideas. This proportional representation in the community activities building should help maintain a respect for the right of individuals in a society which emphasizes conformity.

.... from SEPR 7E

Frederick B. Wood, Ph.D., Socio-Engineering Problems,  
~~P.O. Box 55, San Jose, California 95108~~ \*

"ALLOCATION OF SUPPLEMENTARY PUBLIC EXHIBIT SPACE BY  
NEGENTROPY OF MEMBERSHIP STATISTICS."

Note

This memorandum is a revision to pages 3-5 of SEPR No. 7, "Problems To Be Referred To The Society For General Systems Research," 8/11/59; and also a revision to pp. 5-7 of SEP No. 65-E, "Abstract of A Research Plan for a Book on 'COMMUNICATION THEORY IN THE CAUSE OF MAN!'," 5/22/63.

My concern over church meeting and exhibit space comes from a series of experiences since World War II principally in California in which churches have been forced out of strategic locations through the state's use of eminent domain for expansion of schools and freeways. Juries and local judges understand financial injustices easily and thus have corrected any unfair awards in regard to the monetary compensation. The location of the principal churches and synagogues in strategic points around central parks, squares, and civic centers used to be a symbol of the role of the religious organizations in helping man develop a conscience and to look forward from the past struggles toward a better more just society. Even though some of the churches may be a generation behind in adjusting to the advances of modern science, discussions of the problems of our civilization in church discussion groups serves an important role in developing understanding of the problems of our civilization.

The economic trends and city planning policies of large American cities result in the 'socialization' of an increasingly larger fraction of the property in the center of our cities. Public buildings and freeways eat up the land area in the centers of our large cities, while skyscrapers shield the remaining central squares from general view. If a new religious group should develop in a typical large American city, it would have a very difficult time acquiring a strategic site for their central temple. We may have a conflict between the principle of separation of church and state and the guarantee of religious liberty when the percentage of publically owned property in the centers of our cities exceed a certain fraction.

When this level of 'socialization' exceeds a certain critical fraction, it may be necessary for the state or city to allocate supplemental space in the form of bulletin board space in a central square or civic center to different religious and philosophical groups. The purpose of this memorandum is to explore a hypothesis that the concept of negentropy from electrical communication theory can be used as a guide in such circumstances for determining the ratios of supplemental space to allocate to each religious group.

The reason for considering "negentropy" rather than some other property for a guide in this allocation of space is that there is a loose relationship between maximizing negentropy and an ethical principle of "reverence for life." The analogy can be seen partially by noting how biological systems preserve or increase order, thereby decreasing entropy ( or increasing negative entropy). This is discussed more fully in SEPR No. 83-3, "Negentropy and the Concepts of Freedom, Democracy and Justice."

Reviewing the situation of a city that has been cut up by freeways and in which the original center formerly holding the central core of principal churches has been shrunk by expansion of a college and by schools and public buildings. The churches which have been eliminated can be found relocated out in the suburbs, with the exception of the largest denominations the diversity of religious belief of the city no longer can be seen at a glance as one stands in the center of the city.

Consider an hypothetical city of 100,000 adults (children not counted in this study). The assumed distribution of adult members of different religious faiths is as listed in Fig. 1. It is assumed that each religious group has bulletin board space as indicated on its church property, but visible from the public street. For some locations the bulletin board may be in a strategic place, but for others it may face on a side street in a suburban area and the church may be obscured from view by a freeway and a set of skyscrapers. We shall experiment with a way to allocate supplemental bulletin board space in a public building or public square to guarantee that all religious groups have some prime public bulletin board space for the benefit of their own members, visiting members of their faith from out of town, and to be a symbol of the cooperative existence of differing faiths in a democratic community.

The results of a sample calculation are tabulated in Fig. 1. The supplementary public bulletin board space is taken proportional to the negentropy of the membership statistics. In addition the privately owned bulletin space and the total values are tabulated. These values are drawn graphically to scale on the bottom part of Fig. 1. Suppose that a 100' x 30' section of the main lobby of the civic center building is devoted to exhibit space consisting of a four foot wide section of bulletin board around the lobby. Then 16,667 unit squares of space would correspond to 1040 sq.ft., making each unit be 9.4 sq.in. This makes the smallest group (No. 10, Ethical Culture) have 13.3 units or 116 sq. in. or one legal size sheet of paper. If one individual developed some new philosophy, by the negentropy formula, he would be entitled to the space of one third of a page space to state in one paragraph his cause and to give his address, phone, etc., for further details.

Frederick B. Wood  
March 31, 1964

Fig. 1 redrawn 5/30/64

Religious Group	Members	$P_i$ Prob.	$-p_i \log_{10} p_i$ Negentropy	Bulletin Bd. Space		Total
				Private	Public	
1. Roman Catholic	50,000	0.600 0	0.441 0	6,000	4,420	10,420
2. Protestant	20,000	0.200 0	0.463 0	2,000	4,630	6,630
3. Lutheran	15,000	0.150 0	0.411 0	1,500	4,110	5,610
4. Protestant Episcopal	3,000	0.030 0	0.152 0	300	1,520	1,820
5. No Church	1,000	0.010 0	0.066 5	100	665	765
6. Buddhist	600	0.006 0	0.044 3	60	443	503
7. Unitarian	230	0.002 3	0.020 2	23	202	225
8. Jewish	100	0.001 0	0.009 95	10	100	110
9. Eastern Orthodox Catholic	60	0.000 6	0.006 4	6	64	70
10. Ethical Culture	10	0.000 1	0.001 33	1	13	14
	100,000	1.000 0	1.616 7			

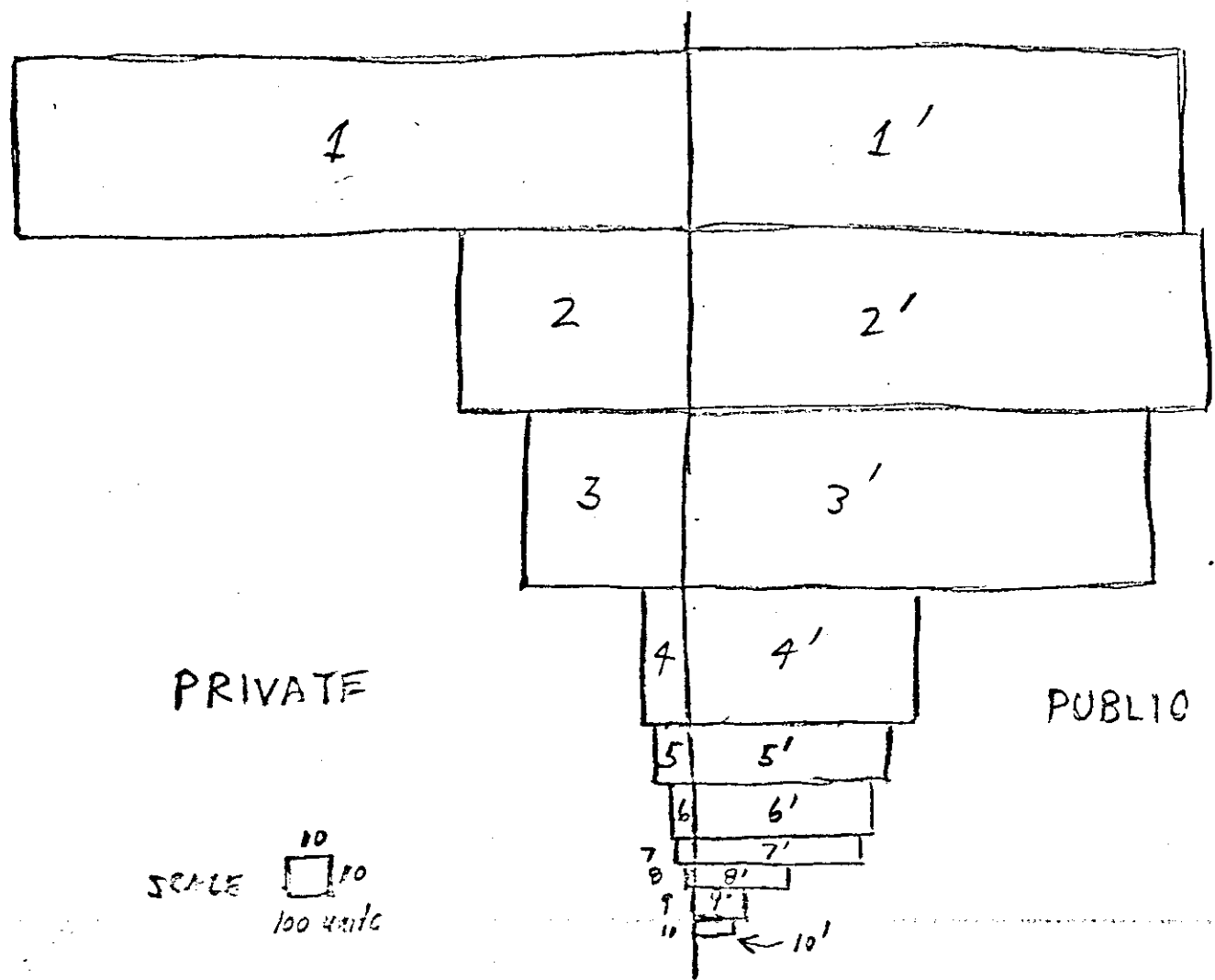


Fig. 1. Sample Distribution of Private and Supplemental Public Exhibit Space Determined by Negentropy of Membership Statistics



"CYBERNETICS AND THE M.B.A."

By Frederick Bernard Wood, Ph.D.

John Jaguar, a fresh M.B.A., has just been hired on by a large corporation to be a special assistant to the manager of one of their engineering development laboratories. The manager has just called Mr. Jaguar into his office and says:

"Welcome on board, John. I've heard a lot about the case method at HBS. We got another case study all ready for you, only this one is for real.

"The problem is this:

(1) We've got a few engineers and computer programmers who are grumbling about various things. They don't seem to be complaining about wages, working conditions, and the usual things workers used to complain about. Their complaints are about not being able to put notices on the company bulletin board about all sorts of external meetings that have nothing to do with the business of this corporation. They want to have luncheon speakers like Eldridge Cleaver, Caesar Chavez, and Bridgit Bardot.

(2) A union formerly the American Federation of Technical Engineers, which has consistently been rejected by engineers in the past, has now changed its name to "American Federation of Professional and Technical Engineers," in order to appeal to engineers. We are not interested in promoting the union, and hence are following a tight bulletin board policy, so the union organizers will have no precedent for claiming bulletin board space.

(3) To our amazement a number of engineers and programmers who never gave a thought to unions, are now inquiring whether a union organization would help them fight for bulletin board space for community meetings on race relations, problems of the ghetto, etc. We seem to be in a bind, namely our policy on bulletin boards, intended to reduce contact with unions, is stimulating thoughts about unions.

(4) We hired an outside management consultant to examine this problem, but he died of a heart attack after a few days of study. The nurse at the hospital says his dying words were "Try Cybernetics."

(5) We have checked out all the books on Cybernetics and Management, but we don't find anything that clearly applies to this problem."

The laboratory manager then told Mr. Jaguar that he had thirteen days in which to come up with a proposed solution. Below is a copy of the report that Mr. Jaguar delivered to the laboratory manager on a Sunday evening fifteen days later, just before the manager took off on a trip to corporate headquarters in New York.

Case Study: Cyber-0001

THE USE OF CYBERNETICS TO SOLVE  
AN EMPLOYEE COMMUNICATION PROBLEM  
AT XYZ CORPORATION.

By John Jaguar

INTRODUCTION

This problem centered around employee demands for bulletin board space within the plant---private property of the corporation---presents some unusual features. For this special case I have decided to recount my sequential steps in searching for a possible solution to the problem.

The first thing that strikes me is that in a Business History course, we studied Peter F. Drucker, The Future of Industrial Man (1942). These demands of the employees appear to be related to the problems Drucker was talking about:

"In other words, the plant must be made into a functioning self-governing community. It must be made capable of serving industrial society in the same manner in which the village served the rural society and the market the mercantile society" p. 205.

"The central fact in the social crisis of our time is that the industrial plant has become the basic social unit, but that it is not yet a social institution." p..207.

These problems of the evolution of social institutions seem to be interterring with the management of an engineering laboratory. Let us explore what the outside consultant meant by 'Try Cybernetics.'

#### WHAT IS CYBERNETICS?

Webster's Seventh New Collegiate Dictionary defines Cybernetics as "comparative study of the automatic control system formed by the nervous system and brain and by mechanical-electrical communication systems."

To understand more about Cybernetics, I had to study Norbert Wiener's books: The Human Use of Human Beings (N.Y.: Houghton Mifflin, 1950) and I Am A Mathematician (N.Y.: Doubleday, 1958). I found that Cybernetics deals principally with defining the feedback loops in complex systems and with measuring the information contained in the messages going over the feedback loops. There is some emphasis on the analysis of errors in these feedback communication systems.

I found the situation in Cybernetics confused in some areas on account of specialists objecting to cybernetics as it impacted their special field, instead of improving Norbert Wiener's first approximations.

The steam engine governor of Fig. 1 has become a symbol of the feedback signals in cybernetic systems maintaining equilibrium.

#### FEEDBACK LOOPS IN BUSINESS ORGANIZATIONS

To get a glimpse of the more complex feedback loops in a business organization, let us look at a diagram from HBS LOB Course. Fig. 2 is from John A. Seiler, Systems Analysis In Organizational Behavior (Homewood, Ill: Irwin and Dorsey, 1967), p. 33.

In fig. 2, we see the total system divided into two segments: Forces in the Environment and The Organizational System.

The material relative to this particular problem has been organized in the format of the framework of Fig 2. Rather than comment on the details, I suggest that you study the specific notes in Fig. 3 which outline the main parts of this problem of communication in XYZ Corporation

(from Ernest Nagel, "Self Regulation,"  
 Scientific American Book:  
 Automatic Control (N.Y.: Simon &  
 Schuster, 1955) p. 5)

Fig. 1. Steam Governor as Example of Feedback Control Mechanism.

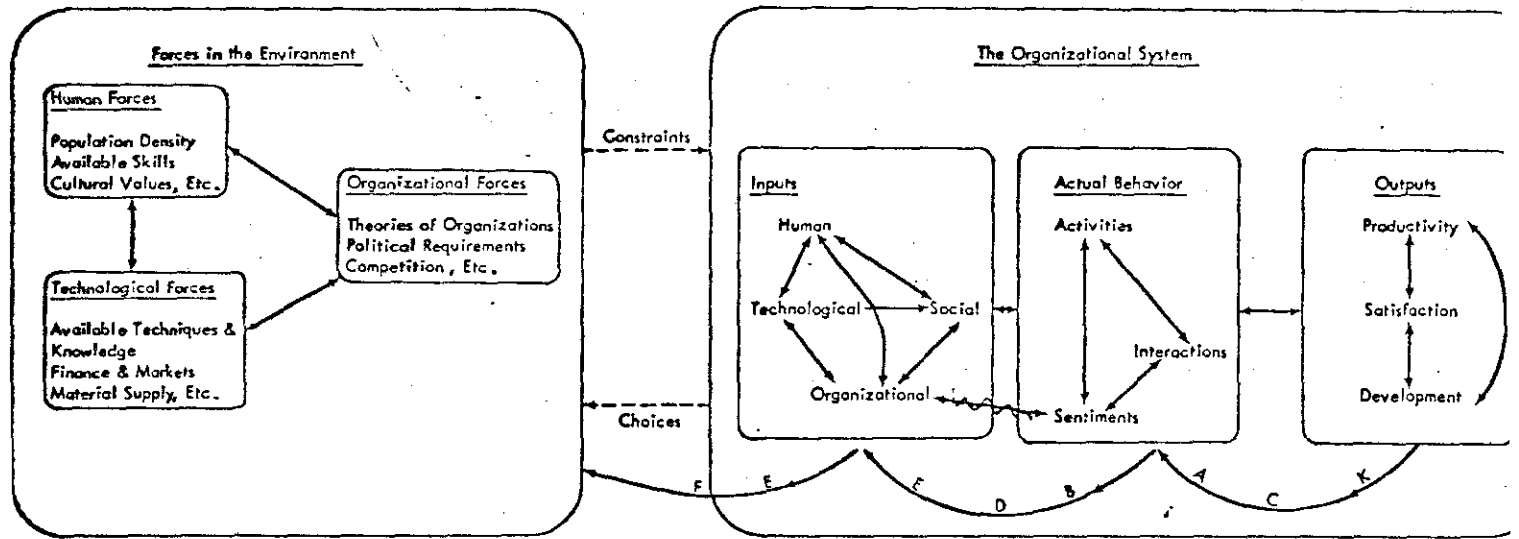
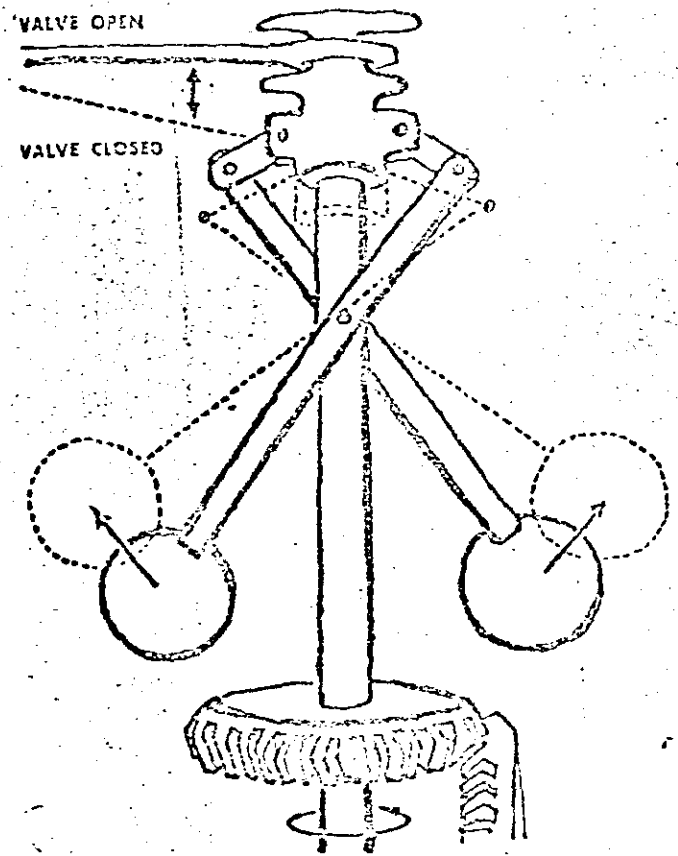


Fig. 2. An Elementary Framework For Diagnosing Human Behavior In Organizations Showing The General Concept of Feedback.

(from John A. Seiler, Systems Analysis In Organizational Behavior, Homewood, Ill: Irwin & Dorsey, 1967, p. 33)

For the M.B.A. with an engineering background who might be dissatisfied with the lack of precision of the diagrams of Figures 2 and 3 compared to electronic circuit diagrams, I wish to point out the tradition established by Karl W. Deutsch in his book, The Nerves of Government -- Models of Political Communication and Control (The Free Press of Glencoe, 1963). This reference illustrates the impact of Norbert Wiener's 'Cybernetics' on the analysis of political systems.

#### ANALYSIS OF THE ENVIRONMENTAL FORCES IN THE PROBLEM FEEDBACK DIAGRAM

Electronic technology, particularly TV, has both pushed people to their channel capacity, and made it easier for people to know what is going on all over the world. Furthermore the work of XYZ Corp. has improved the tools of the social scientists, so we can analyse social problems with more precision. At the same time modern corporations, including XYZ Corp., have unintentionally caused a deterioration in democratic political institutions in the United States. This means that the citizens are ill-prepared to use the results of the research of the social scientists supported by advanced computer technology.

A fundamental fact is that approximately seven thousand years ago tribes of men developed more complex organization of human society through (1) division of labor into soldiers, farmers, and artisans, and (2) development of elementary force amplifying tools which characterized most of recorded history as being in the "Force Era." About three hundred years ago the First Industrial Revolution started which shifted the organization of human society to rely primarily on power amplifying devices such as the steam engine, electric generators and motors, internal combustion engines, atomic fission, and atomic fusion.

We are now in the Second Industrial Revolution in which communication equipment and processing are becoming the main technological base of human society. Therefore some people call the new era the "Communication Era." Our entry into this new era has potential of much more creative opportunities for human communication. This means that the citizens are ill-prepared to use the results of the research of the social scientists supported by advanced computer technology.

Fig 3

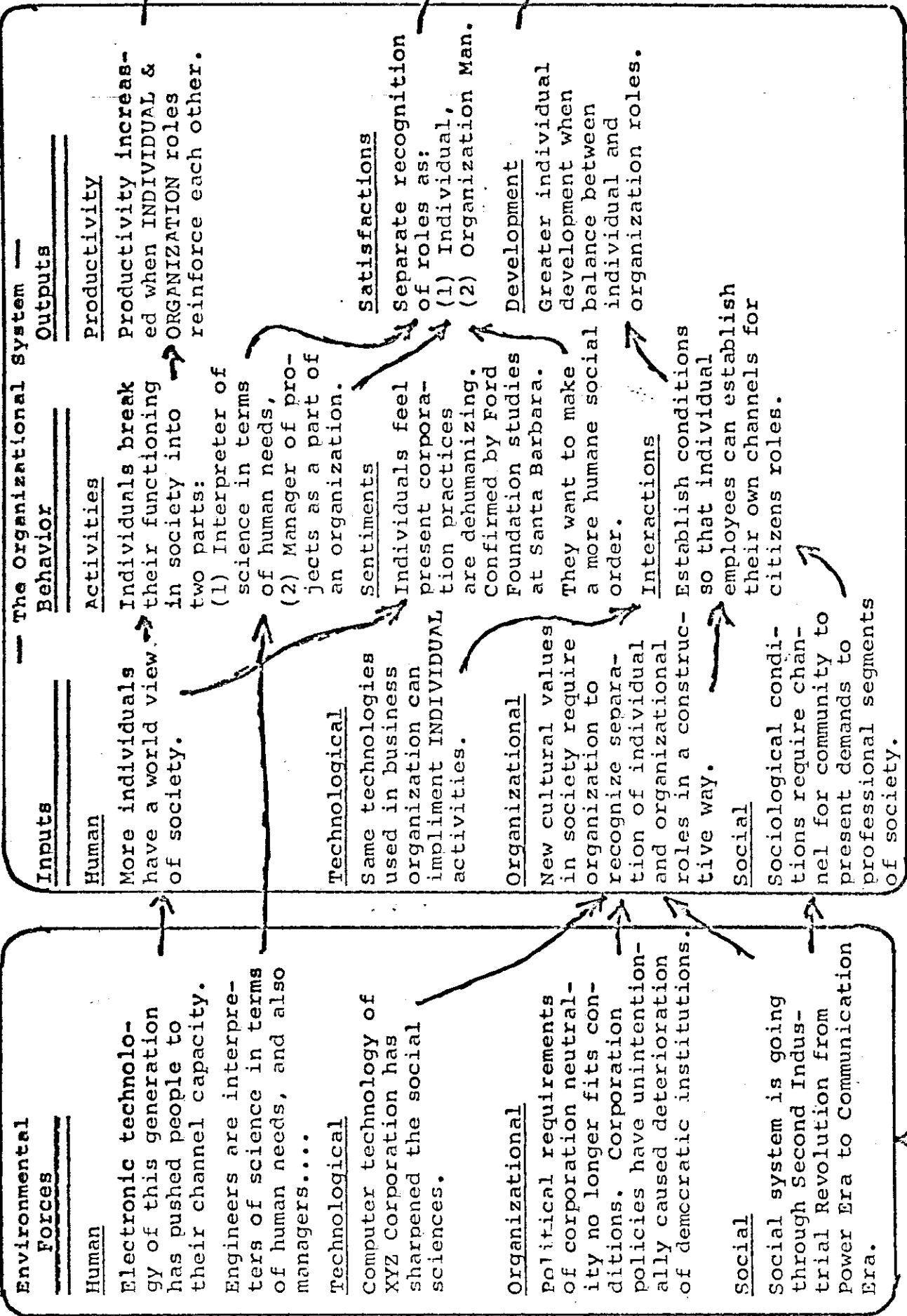


Fig. 3 - Diagrammatic Analysis of XYZ Corporation

A fundamental fact is that approximately seven thousand years ago tribes of men developed more complex organization of human society thorough (1) division of labor into soldiers, and farmers and artisans, and (2) developigng elementary force amplyfing tools which became characteristic of most of man's recorded history ~~XXXX/XX/~~ in the Force Era.

About three hundred years ago the First Industrial Revolution started. It shifted the organization of human society to rely primarily on power amplifying devices such as the steam engine. We are now in the Second Industrial Revolution in which communication equipment and systems are becoming the main technology base of human society. Therefore some people call the new era we are entering -- the "Communication Era." Our entry into this new era has potentialities of much more creative opportunities for human communication.

The existence of the bulletin board probelm in XYZ Corp. is a forerunner of a series of problems in human communication that our society is encountering in this transition period. In the absence of well tested hypotheses, the one criterion that we can be sure of, is to improve our sensitivity for listening to what people are saying. At the minimum we can say that this bulletin board problem means that some small percentage of our employees feel that important channels of human communication are blocked and need to be opened.

Without going into a detailed discussion, let us examine what choices exist in connection with the environmental forces listed in Fig. 3 . Suppose we are considering providing some additional bulletin board space either on the company premises or in cooperation with other community groups on some neutral territory off company proprety. We have a decision to make as to whether the distribution of space on a bulletin board be based on national political parties or on the internal distribution of choices of our own employees.

#### NATIONAL POLITICAL PARTY CRITERION.

One way to provide bulletin board space is to expand human communication would be to allow no space in the laboratory, but make a financial contribution to the town Chamber of Commerce to put up a bulletin board in the town plaza. The space allocation on the bulletin board would then be up to the Town Council or the Chamber of Commerce.

Another way would be to give equal space on a bulletin board in the laboratory with equal space to each national political party that ran a candidate for president for at least one of the last four presidential elections. From examination the vote tabulations for the 1952, 1956, 1960, and 1964 elections in the annual issues of The World Almanac, we obtained a list of the political parties to which we added ones which are active in the current 1968 campaign. Such a bulletin board is illustrated in Fig. 4.

#### INTERNAL CRITERION.

If we wish to use internal criterion such as the distribution of preferences among the employees of the laboratory, we first have to make a survey. Last week we made such a survey by distributing a confidential questionnaire to all the employees of the laboratory. We distributed the questionnaire to all 350 employees, and received returns from 300. Of the 300, ten were returned blank or with comments objecting to the bulletin board project. The results of the survey are tabulated in Fig. 5. The second column in Fig. 5 is the probability that an individual in the laboratory would prefer space be given to the party or group indicated. In this survey we stated that preference could be given to any political party, religious group, social group, or even to a one-man project.

The next question is what formula to use to allocate the space. One simple way to try is to allocate space in proportion to the probabilities that employees in the laboratory prefer the indicated groups. Such a distribution of bulletin board space is shown in Fig. 6. This allocation appears logically fair, but somewhat



AFRO-AMERICAN PARTY	DEMOCRATIC PARTY	PROHIBITION PARTY
AMERICAN INDEPENDENT PARTY	INDUSTRIAL GOVERNMENT PARTY	REPUBLICAN PARTY
AMERICAN LABOR PARTY	LIBERAL PARTY	SOCIALIST PARTY - SDF.
COMMUNIST PARTY	NATIONAL STATES RIGHTS PARTY	SOCIALIST LABOR PARTY
CONSERVATIVE PARTY	PEACE AND FREEDOM PARTY	SOCIALIST WORKERS PARTY

Fig. 4 - Allocation of Bulletin Board Space with Equal Space for Each Political Party.

	Interest Group or Project	Number of Employees Voting for:	$P_i$ Probability
1	Democratic Party	100	0.333
2	Republican Party	60	0.200
3	Council of Churches	30	0.100
4	Open Doors	30	0.100
5	S.C. Against Racism	20	0.067
6	Peace & Freedom Party	19	0.064
7	YMCA - YWCA	15	0.050
8	-- blank --	10	0.033
9	Midpen. Free Univ.	8	0.028
10	Jaybirds Assoc.	3	0.010
11	Black Panthers	1	0.003
12	Project #2	1	0.003
13	Project #3	1	0.003
14	Project #4	1	0.003
15	Project #5	1	0.003
	Total:	300	1.000

Fig. 5 - Results of Employee Questionnaire on Preferences for Allocation of Space to Political, Religious or Social Groups

inefficient. The Democratic Party and the Republican Party have more space than they have details to post. The Black Panthers and Projects #2 through #5 have barely enough space to list their name and telephone numbers. Isn't there some way of weighting the the probability distribution that will make more efficient use of the space and still be an equitable division of space?

Claude Shannon in The Mathematical Theory of Communication (Urbana, Ill: 1949) gives formulas for the information content of letters of the alphabet and words in a language. For our purposes we don't have to get involved with mathematical derivations, we can use the empirical methods of Samuel F. B. Morse, the inventor of the telegraph.

#### A MEASURE OF INFORMATION

In 1838 Samuel F. B. Morse demonstrated his electric telegraph system to the President and Congress of the United States. To make an efficient telegraph code, he counted the type slugs for the different letters in the alphabet in a printers shop, and then assigned the short code to the most frequently occurring letter and the longest code to the least frequent letter. This is illustrated in Fig. 7, where we see the 'E' the most frequent letter is assigned one dot, 'I' the next most frequent is assigned two dots, and the least frequent letters -- 'J,Q,' are assigned different sequences of one dot and three dashes -- the long code length. S. F. B. Morse in attempting to make a more efficient code was also making the time assigned to each letter approximately proportional to the amount of information conveyed by the letter. In 1949 Claude Shannon published The Mathematical Theory of Communication in which he defined the information conveyed by a symbol as,  $I_i = -\log_2 p_i$ , where  $p_i$  is the probability of occurrence of symbol  $i$ .

Thus, if the probability of an event is one, then a message saying that event occurred would not convey any new information. The logarithm of one is zero. If the probability of an event occurring is 0.5, then the information of a message reporting an occurrence would be 1 bit. If the probability of such an event is 0.25, then the information of such a message would be 2 bits of information.

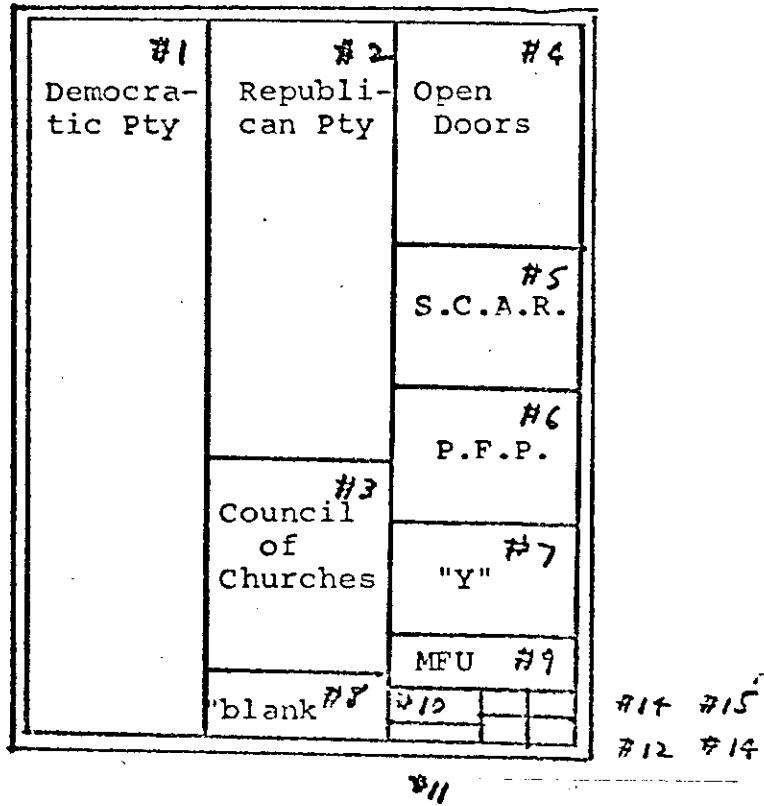


Fig. 6 - Distribution of Bulletin Board Space In Proportion To Probability Distribution.

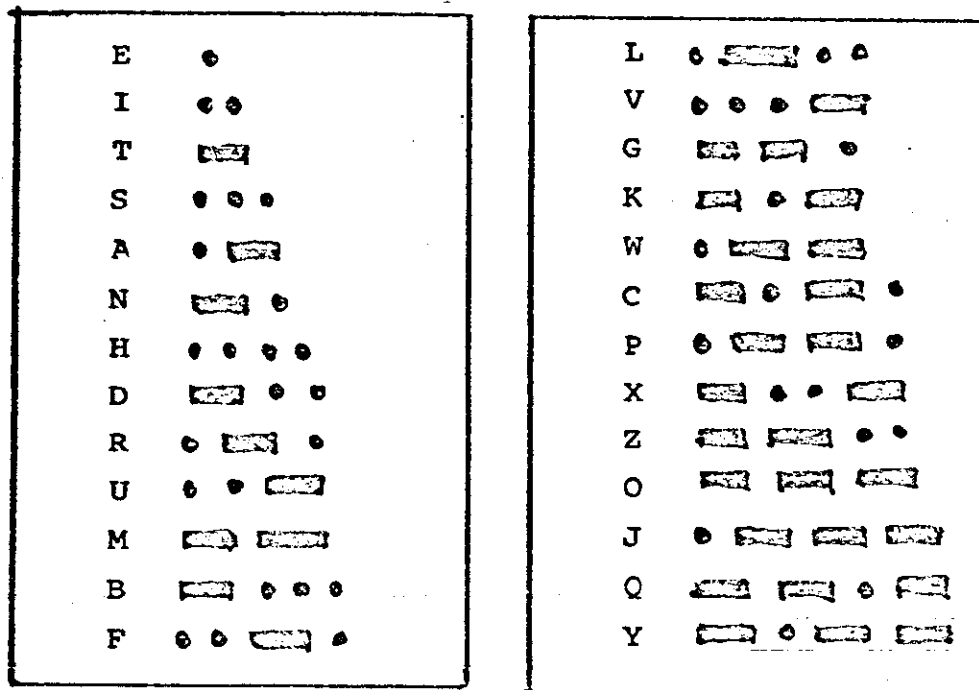


Fig. 7 - International Morse Telegraph Code

This study of the weighting of the length of the code lengths for the letter of the alphabet on a telegraph system in proportion to the amount of information conveyed by the letters suggests the possibility of weighting the space on a bulletin board in proportion to the information conveyed by the different groups.

#### STATISTICAL DISTRIBUTION OF POLITICAL GROUPS

Let us consider some of the procedures we learned in HBS Course MERC. We will need a distribution of probability that an individual will prefer different political or religious groups for allocation of bulletin board space. We need an exact graph of a distribution similar to that of Fig. in Robert Schlaifer, Analysis of Decisions Under Uncertainty, Preliminary Edition, Volume I, McGraw Hill Book Co. (1967).

To obtain such a distribution, we prepared a questionnaire which we distributed to all employees at the specified laboratory. The questionnaire asked the employee to write in the name of the political group, religious group, hobby club, or whether he preferred a blank space. The results of the survey are ~~plotted~~ <sup>tabulated</sup> in Fig. 5.

The probabilities of employees preferring different groups are reproduced in Fig. 8. Then a weighting factor proportional to the information content of the group is calculated. The formula used is the logarithm of the probabilities. Note that this gives a curve in Fig. 9(B) similar to right hand edge of the list of the morse tabulation in Fig. 7.

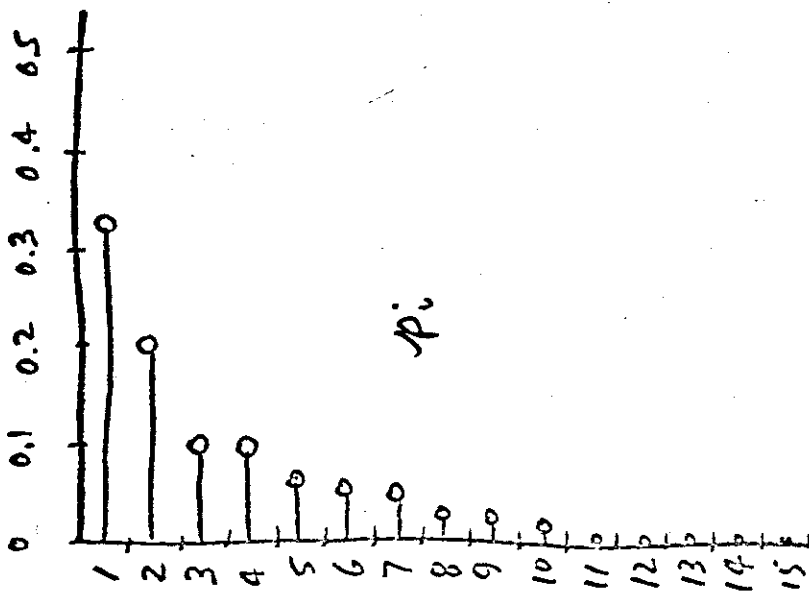
#### DISTRIBUTION OF BULLETIN BOARD SPACE IN PROPORTION TO THE PROBABLE INFORMATION CONTENT.

Next the probabilities are multiplied by the weighting factors and then are normalized to give the allocation probabilities  $P_i$ , which are tabulated in Fig. 8 and are plotted in Fig. 9(C). Then the number of lines of computer print-out on 8½" wide sheets are calculated. To allow minimal space to one-man projects a minimum of three lines was specified. Further the requirement that notices be keyed into a computer-controlled text editing system permits the legal department of the corporation in another city

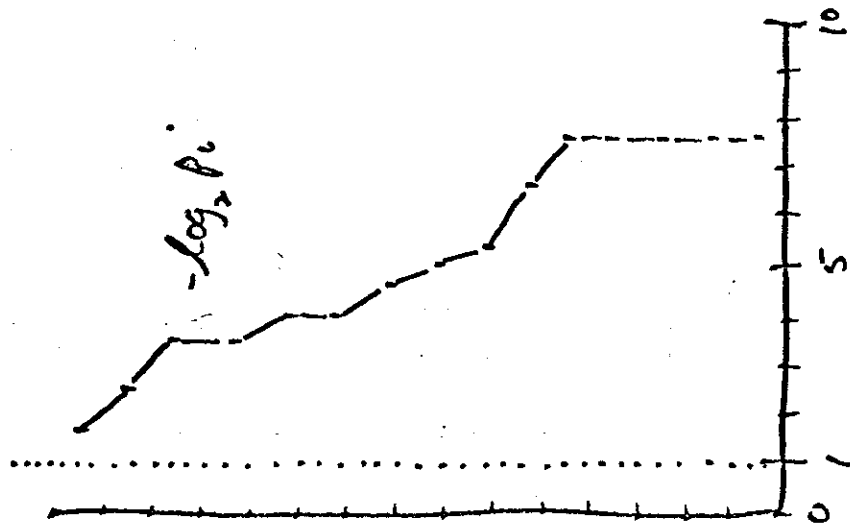
A	Preference Probability $P_i$	Weighting Factor $-\log_2 P_i$	Weighting Factor Product $-P_i \log_2 P_i$	Weighted Allocation Prob $P_i$	Print Lines [Computer] N	Length (inches) $S=1 + N/6$
1	0.333	1.58	0.5282	0.183	63	11.5
2	0.200	2.32	0.4643	0.161	54	10.0
3	0.100	3.32	0.3321	0.115	45	8.5
4	0.100	3.32	0.3321	0.115	45	8.5
5	0.067	3.91	0.2612	0.090	31	6.2
6	0.064	3.98	0.2512	0.087	30	6.0
7	0.050	4.32	0.2160	0.075	26	5.3
8	0.033	4.92	0.1627	0.057	19	4.2
9	0.028	5.25	0.1706	0.049	17	3.8
10	0.010	6.64	0.0664	0.023	8	2.3
11	0.003	7.95	0.0251	0.009	3	1.5
12	0.003	7.95	0.0251	0.009	3	1.5
13	0.003	7.95	0.0251	0.009	3	1.5
14	0.003	7.95	0.0251	0.009	3	1.5
15	0.003	7.95	0.0251	0.009	3	1.5
	1.000		2.8800	1.000	353	73.8

Fig. 8 - Tabulation of Preference Probabilities, Weighting Factors, Weighting Factor Products, Weighted Allocation Probabilities, Print Lines, and Length of Space (Width 8 $\frac{1}{2}$ " )

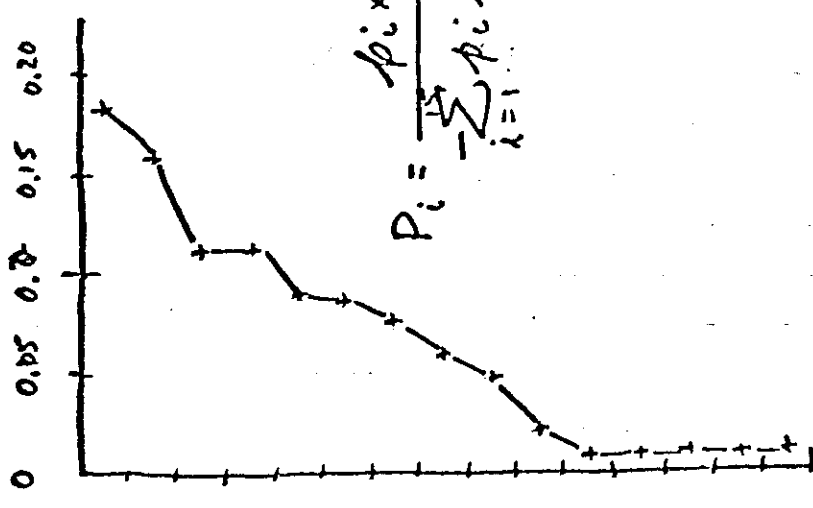
File No. 181-D  
Fig. 9



(A) Probability of Different Preferences



(B) Weighting Factor



(C) Weighted Probability Distribution for Space Allocation.

$$\pi_i = \frac{\pi_i \times [-\log_2 \pi_i]}{\sum_{i=1}^n \pi_i \log_2 \pi_i}$$

Fig 9 - Probability Distribution, Weighting Factor, & Weighted Probability Distribution.

to obtain immediate copies of all new and revised notices to check for any violations of elementary rules preventing notices promoting illegal acts or libelous statements. The space allocation is then calculated on the basis of N lines plus a on-half inch margin at top and bottom. These results are tabulated in Fig. 8 and a layout of such a bulletin board is shown in Fig. 10.

~~DECISION~~

DECISION TREE FOR COMPARING THE ALTERNATIVES

Let us organize the major decision alternatives in this situation in the form of a decision-tree similar to those used in HBS courses MERC- 2-3. Suppose we try to make decision tree similar to those described in Chapter 1 of Robert Schlaifer, Analysis of Decisions Under Uncertainty, Volume I. (McGraw-hill, 1967) Schlaifer has a number of examples starting from a point on the left and branching to the right through all the possible decisions, ending on the right with the estimated cash balance of the corporation for all the different sequences of events and decisions (acts). Now our problems about bulletin board space has something different than cash balances as the outcome. We have no estimate of the quantitative effect on cash balance. The best we can do is establish a number of qualitative criterion. Therefore we construct a table similar to the way a scientist testing alternative hypotheses would proceed.

In Fig. 11 we show the decision tree on the left with a table of estimated outcomes on the right. A plus (+) indicates that decision makes a positive contribution to the activity noted at the top of the column. A minus (-) indicates a negative influence.

The first branch on the tree is whether the bulletin board decision will be based on external or internal criterion (or national vs. local). If the Laboratory Manager chooses national (or external) he may opt for (a) no political material on company bulletin boards, or (b) for equal space to political parties running candidates for president of the United States during the last four presidential campaigns.

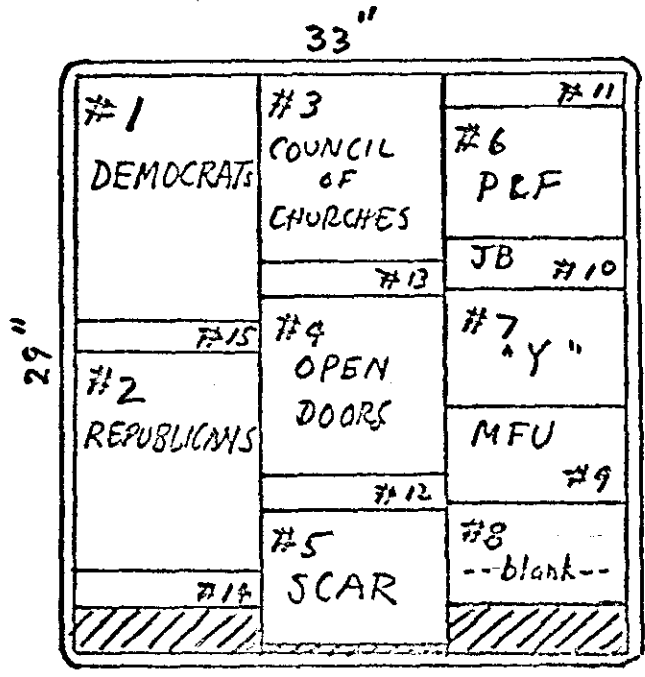
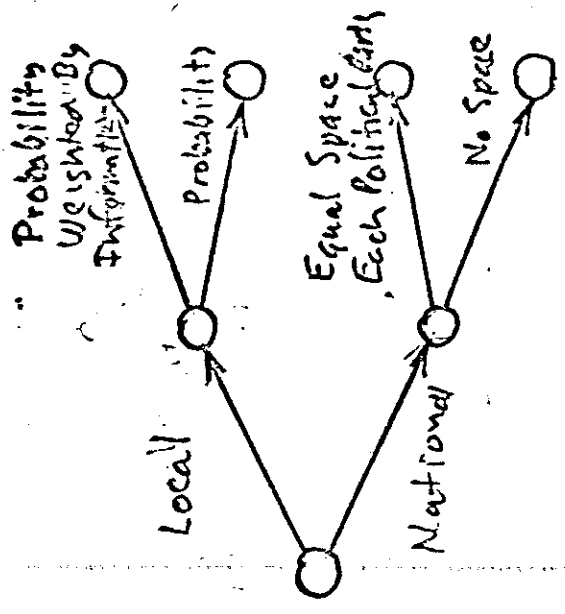


Fig. 10 - Distribution of Bulletin Board Space In Proportion to Weighted Probabilities (Proportional to Measure of Information)





(1)	-	0	+	+	+	+	+	+	+
(2)	-	1+	+	+	+	+	+	+	+
(3)	-	+	+	+	+	+	+	+	+
(4)	-	+	+	+	+	+	+	+	+
(5)	-	+	+	+	+	+	+	+	+
(6)	-	1+	+	+	+	+	+	+	+
(7)	-	0	+	+	+	+	+	+	+
(8)	-	0	+	+	+	+	+	+	+
(9)	-	0	+	+	+	+	+	+	+
(10)	-	0	+	+	+	+	+	+	+
(11)	-	0	+	+	+	+	+	+	+

Resolve problem of employee complaints above bulletin boards

provide bulletin board space for community projects in a neutral manner.

fulfill Peter Drucker's specification of community communication center.

Provide pilot test of assistance international corporations to be socially responsible.

Avoid liability of corporation for possible charges of violation of employee right under Rixth Amendment.

Provide respect for the individual in a mass society.

Promote naturally development of communication feedback loops.

Promote individual social responsibility.

Consistent with transition from "Power Era" to "Communication Era"

Nine aspects of the problem are listed as columns in Fig. 11 in the outcome matrix. If the laboratory manager chooses the first choice of no political notices in the laboratory, the outcome is negative for all aspects except #2, which could be positive, if money is contributed to the community bulletin board project.

If the manager decides to follow the second alternative, we have a positive outcome in three and a half columns out of nine, and a negative outcome in two columns. This alternative still does not solve item #1, the problem of employee complaints about bulletin boards, because a significant part of the activities over which the employees are concerned are special local situations, not handled by the national political parties.

If the manager choose to use local criteria, he could first try giving space in proportion to the probability that local employees prefer different groups as is illustrated in Fig. 6. Reviewing the probable outcomes in the outcome matrix in Fig. 11, we find that this give a probable positive outcome in seven out of nine, and a neutral outcome in the remaining two columns.

Next we examine the probable outcome, if he chooses a more efficient allocation of bulletin board space, i.e., the probability weighted by the information (estimated) in messages from each group. Here we see that the estimated outcome is that we expect a positive outcome in all nine columns, and appears to give extra positive results in four <sup>of</sup> the categories.

#### SUMMARY

We have examined the nature of the problem of XYZ Corporation first from the feedback between the organizational system and the environmental forces, and found that the nature of the new era we are moving into -- the Communication Era -- requires careful attention to the number and nature of the communication channels in an organization. Second we have examined the range of ways to change the communication channels in respect to bulletin boards on the corporation premises, and have found that a probability distribution weighted by the information content of the messages of the different groups is the only one of the alternatives considered that would give a positive outcome for all nine elements in the problem. Thus we have arrived at a proposed solution by use of two concepts from Cybernetics, namely -- feedback loop analysis, and measure of the amount of information in ~~information-content-of~~ sets of messages.

Respectfully submitted,

*John Jaguar*  
John Jaguar

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