

71-12,625

WATSON, Robert D., 1937-
A SYSTEMS APPROACH TO INVESTIGATE THE
OPTIMUM COST-EFFECTIVENESS OF A GENERALIZED
MANAGEMENT INFORMATION SYSTEM.

The University of Oklahoma, Ph.D., 1970
Engineering, industrial

University Microfilms, A XEROX Company, Ann Arbor, Michigan

Copyright by
Robert D. Watson
1971

THE UNIVERSITY OF OKLAHOMA
GRADUATE COLLEGE

A SYSTEMS APPROACH TO INVESTIGATE THE OPTIMUM
COST-EFFECTIVENESS OF A GENERALIZED
MANAGEMENT INFORMATION SYSTEM

A DISSERTATION
SUBMITTED TO THE GRADUATE FACULTY
in partial fulfillment of the requirements for the
degree of
DOCTOR OF PHILOSOPHY

BY
ROBERT D. WATSON
Norman, Oklahoma

1970

A SYSTEMS APPROACH TO INVESTIGATE THE OPTIMUM
COST-EFFECTIVENESS OF A GENERALIZED
MANAGEMENT INFORMATION SYSTEM

APPROVED BY

Robert A. Sharp

B. L. Foote

John P. Morris

Arthur M. Mulhally

DISSERTATION COMMITTEE

To my wife, Jean
and two sons,
Robert and Brent,
whose sacrifices
made this possible

ACKNOWLEDGMENTS

"Man is a problem-solving, skill-using, social animal. Once he has satisfied his hunger, two main kinds of experiences are significant to him. One of his deepest needs is to apply his skills, whatever they be, to challenging tasks--to feel the exhilaration of the well-struck ball or the well-solved problem. The other need is to find meaningful and warm relations with a few other human beings--to love and be loved, to share experience, to respect and be respected, to work in common tasks."

--Herbert A. Simon

It is for this and much more that the author wishes to express his appreciation to Dr. Robert A. Shapiro, Dr. B. L. Foote, Dr. Arthur McAnally, Dr. John R. Morris, and Dr. W. C. Price for their sincere personal contribution to the realization of this effort.

Expression of appreciation is also due to Sister Alvera, Sister Coletta, and Mr. Joe Pozza of Mercy Hospital, Oklahoma City, Oklahoma, for their valuable assistance in making this effort worth-while.

TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS.	iv
LIST OF TABLES	vii
LIST OF ILLUSTRATIONS.	viii
 Chapter	
I. INTRODUCTION	1
Statement of the Problem and Its Environment Functional Properties and Assumptions of the Generalized Model	
II. DEVELOPMENT OF INFORMATION AND SYSTEMS IMPLICATION.	11
The Role of Communication in the Management Information System Elements of Communication in the Formal Organization Validity of Systems Design in Decision- Making Systems Analyst in the MIS Design Information a Reality in the Decision- Making Process	
III. MANAGEMENT INFORMATION SYSTEMS OVERVIEW, OPTIMIZATION, AND COST-EFFECTIVENESS	26
What is a Management Information System? Data Base, an Integrated Concept Optimization and Allocation Models Cost-Effectiveness and Justification	

IV. TOTAL SYSTEMS APPROACH AND MODEL FORMULATION.	43
Group Selection	
Orientation, Information, and Costs	
Organizational Objectives	
"Delphi" A Consensus of User's Opinion	
Time Value of Money	
Optimum Cost-Effectiveness Model	
Evaluation and Modification of Information	
V. MODEL APPLICATION AND EVALUATION	60
Establishing the Objective for the Cost-Effectiveness Study	
Orientation Period	
Organizational Objectives	
"Delphi" Application	
Costs Determination	
Application of the Optimum Cost-Effectiveness Model	
Evaluation of Results	
VI. CONCLUSIONS AND RECOMMENDATIONS.	79
BIBLIOGRAPHY	83
APPENDIX I	89
APPENDIX II.	91
APPENDIX III	148
APPENDIX IV.	158
APPENDIX V	160
APPENDIX VI.	165

LIST OF TABLES

Table		Page
1.	Determination of the Upper and Lower Limits for b_i , Where $\frac{\Delta b_i}{\Delta z_i} = 1$	73
2.	Determination of b_i , Where $\frac{\Delta b_i}{\Delta z_i} = 1$	74
3.	Ranked Order of the Information Documents. . .	76

LIST OF ILLUSTRATIONS

Figure	Page
1. The Life Cycle of the Sequential Phases in the Management Information System	5
2. Sequential Phase Clustering of the Life Cycle in the Management Information System	5
3. Self-Contained Computations.	28
4. Data-Base Computation.	28
5. Horizontal Integration	30
6. Vertical Integration	30
7. Integrated Data Base	31
8. Planning-Programming-Budgeting Systems Cycle.	37
9. Total Systems Approach (Flow Diagram)	45
10. Mercy Hospital Organizational Chart.	62
11. Applied Optimization Equation.	69
12. Optimum Relative Value Versus Dollar Resource.	71

Man is limited in his ability to speculate.
Facts about the inherent properties of nature, and the corresponding properties built by man in technological systems, are usually classified as belonging to the scientific domain. In the same domain belong mathematical systems made by man for the abstract formulation and the manipulation of the properties of the real systems.

--Dimitris N. Chorafas
1968

A SYSTEMS APPROACH TO INVESTIGATE THE OPTIMUM
COST-EFFECTIVENESS OF A GENERALIZED
MANAGEMENT INFORMATION SYSTEM

CHAPTER I

INTRODUCTION

Many contemporary organizations and institutions are in a state of information crises. Lewis Carroll observed in his Alice in Wonderland, ". . . that it was necessary to run as fast as possible just to keep up where one is. . . ." This best depicts modern management as it attempts to resolve the information dilemma. In its attempt to survive and adapt in a world of rapid and incessant change, management of organizational hierarchy is turning increasingly to the use of automated management information systems. In its effort to resolve the information dilemma, management is placing very little emphasis on optimum cost-effectiveness during the life cycle of the management information system.

Management advocates that the economic justification for the management information system is predicated upon the need for information which possesses both quality and

timeliness. Thus, this timeliness of goal-oriented information will enable management, as the user,¹ to make better decisions in view of its organizational objectives.²

Obviously, management should determine its own needs as a user. Who else knows what information is necessary except the user? Consideration of user-needs is becoming a very important concept, and computer systems personnel are becoming more aware that a management information system exists for the prime purpose of providing the user with information he needs--economically and efficiently.

But how economical and how efficient? To what extent must the computer systems personnel go to meet these requirements? These questions can be resolved only by the management hierarchy and the systems experts in their formulation of the "turn key" management information system.

However, this is not the real issue. Management, as the user, justified the need for the management information system and likewise has defined the information resources that are essential for the decision-making process. Each user in the management information system focuses his request upon what he thinks are the overall objectives of the organization. Each user also has sub-objectives which

¹Valerie A. Tucci and Norman Horrocks, "User-Oriented Information System," American Documentation (July, 1969), pp. 279-80.

²Rudolph B. Hirsch, "The Value of Information," The Journal of Accountancy (June, 1968), pp. 41-45.

are taken into account. To the user, what he requires in information documentation may be critical to his functioning in the integrated structure of the organization. Viewed from the user-perspective, his requests are valid and deserve consideration. Not only him, but all users in the system deserve the same consideration.

It must be pointed out that after the systems design and costing formats are in proposal form, management must accept, reject, and/or compromise the total proposal package. If the costs are excessive in view of management's limited resources, to curtail some of the users' information requests in order to bring costs into perspective without first investigating the optimization of the total systems resources,³ would be an act of "Topless Management."⁴

To allocate a fixed or limited amount of scarce-resources⁵ at a given cost for a management information system, the modus operandi would be to maximize the information output that contributes to the overall goals of the

³Luther Urwick, The Elements of Administration (New York and London: Harper and Brothers Publishers, 1943), pp. 17-18.

⁴Harold Temmer, "Topless Management or the Anatomy of Data Systems," College and University, Vol. XLIV, No. 3 (Spring, 1969), p. 213.

⁵C. L. Allen, The Framework of Price Theory (Belmont: Wadsworth Publishing Co., Inc., 1967), pp. 3-5.

The term, scarce-resources, commonly refers to both human and non-human resources which possess utility. It is a relative term, and advocates a limited supply in relation to demand.

organization and, at the same time-interval, minimize the total costs imposed in obtaining that information. Not only is the optimum cost-effectiveness a prime consideration, but the timeliness of the optimization strategy in the system's life cycle, a priori,⁶ is a critical factor.

In the life cycle (Fig. 1), Rosove and Simmons concur that there are basically six sequential phases in the birth to earth philosophy of the management information systems.⁷ They are: (1) Requirements, (2) Design, (3) Production, (4) Installation, (5) Operation, and (6) Evaluation of System's Performance.

By clustering combinations of the sequential phases in the life cycle (Fig. 2), three definite stages appear that reveal a more natural partition of the functional activities. They are: (1) Planning-Proposal Stage, (2) Implementation Stage, and (3) Testing Stage.

The time span to investigate the optimum cost-effectiveness must take precedence during the planning-proposal stage which encompasses both phases (1) and (2). Planning for implementation without realistic consideration

⁶ a priori is defined in the context of this dissertation as the time span covered by the planning-proposal stage, prior to final approval and commitment of capital by management.

⁷ Perry E. Rosove, Developing Computer-Based Information Systems (New York: John Wiley and Sons, Inc., 1967), p. 18; W. W. Simmons, "The Keystone of the Management System," Long Range Planning (December, 1968), pp. 2-8.

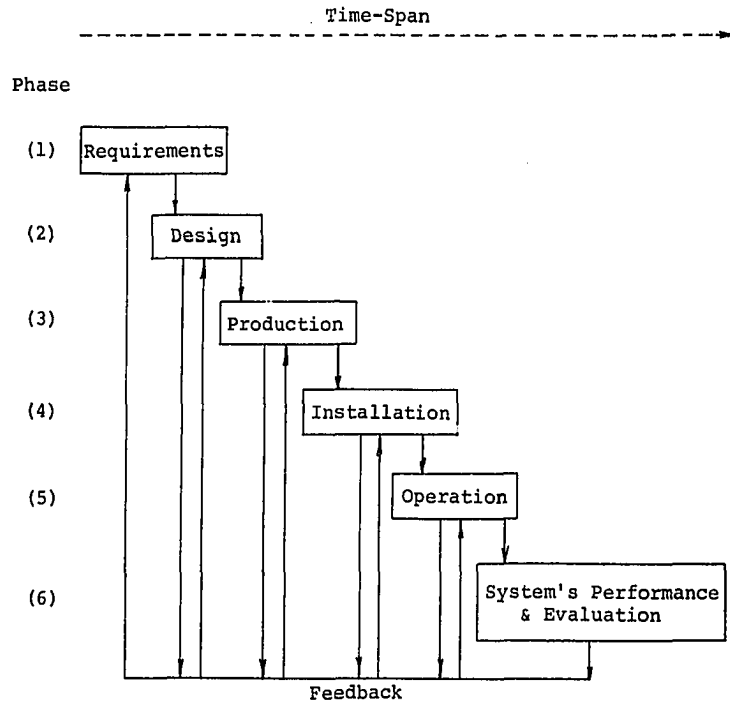


Fig. 1.--The life cycle of the sequential phases in the management information system.

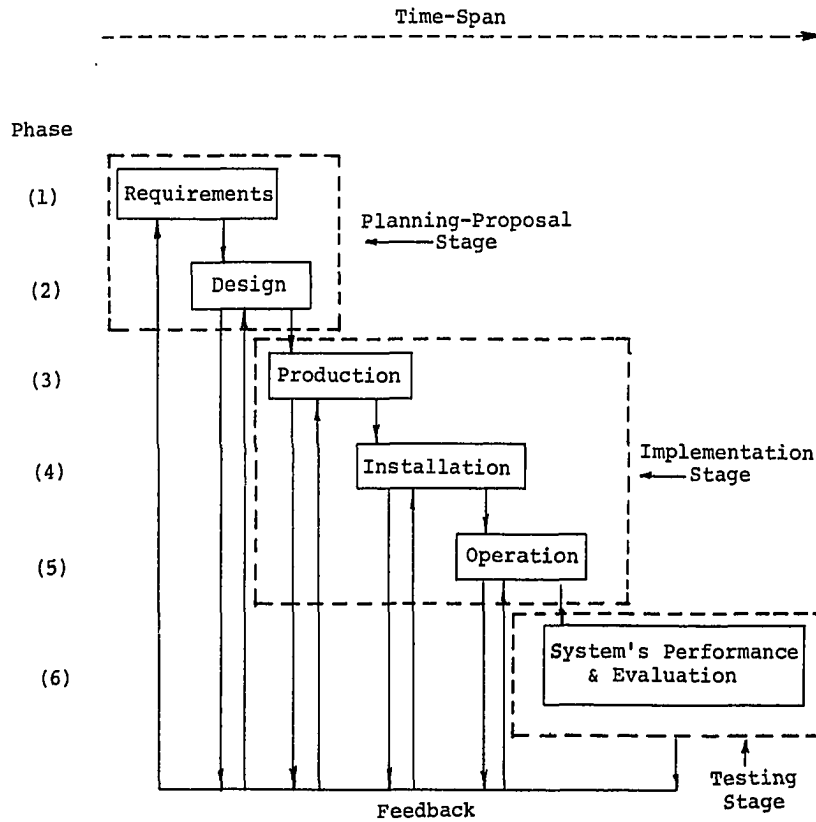


Fig. 2.--Sequential phase clustering of the life cycle in the management information system.

in the planning-proposal stage in respect to organizational goals and limited resources is only abstract consideration.

Barnard states:

. . . a plan is not a plan until it is accepted as a basis of action. Decision "to proceed according to" is essential. Prior to acceptance it is either an ideal construction of abstract factors, or is a preliminary and tentative stage of the process of planning, or thinking. Many a man has found what he thought a beautiful plan defective when faced with the responsibility of adopting it.⁸

For management to determine the feasibility of a planning-proposal is often a major effort in the decision-making process. Unless a plan can be executed, it is no plan. Barnard goes on to say about planning:

. . . it will also be complemented by the next element, positive provision for uncertainties. These uncertainties are of three categories: (1) as to the past, i.e., the significance of history and experience; (2) as to the present, i.e., the facts of the situation and the estimate of inherent trends; and (3) as to the estimates of the future.⁹

Henri Fayol, a famous French industrialist, used the term pre'voyance as one of the key functions of administration. When translated from French to English, pre'-voyance means "to plan" and really covers two functions. He wrote "prevoir (literally 'to foresee') as used here means to foretell the future and prepare for it." In other words, this one word means both forecasting and planning.

⁸Chester R. Barnard, Organization and Management (Cambridge: Harvard University Press, 1948), pp. 166-67.

⁹Ibid., pp. 167-68.

Fayol concluded that planning must be coupled with the ability to foretell the future and prepare for it.¹⁰

Urwick proposed that an investigation in planning was the vehicle to determine the feasibility of the proposed plan under consideration.¹¹ The Russians advocate that forecasting the optimum cost-effectiveness of the allocated resources in long-range social-economic planning is the instrument of their success. I. V. Bestuzhev-Lada states:

. . . this is not new, the history of forecasted planning is over a century old. It was revealed in the works of K. Marx, F. Engels, and V. I. Lenin, who struggled with utopianism in their approach to the problems of the future, with agnosticism in relation to these problems, and with positivistic approach to the solution of these problems.¹²

No doubt, planning contains uncertainty, but the ability to predict with some assurance the optimum cost-effectiveness of a planning-proposal will, in effect, give management an investigation tool that will aid in decision-making for the optimum allocation of scarce-resources.

Statement of the Problem and Its Environment

Because capital allocation has future implications and denotes future commitments, management's inability to

¹⁰Henri Fayol, General and Industrial Management, translated by Constance Storrs (London: Sir Isaac Pitman and Sons, Ltd., 1949), p. 19.

¹¹Urwick, Elements of Administration, pp. 6-16.

¹²I. V. Bestuzhev-Lada, Soviet Cybernetics, in the Rand Collection (Santa Monica, Calif.: The Rand Corporation), Vol. III, No. 5 (May, 1969), p. 59.

predict the optimum cost-effectiveness of scarce-resources, a priori, will cause solidification of future capital commitments. Therefore, because of the absence of a theoretical base, management commits capital involving both human and non-human resources without a comprehensive understanding of the optimum cost-effectiveness of their return on investment. Unless a sufficient theoretical approach can be determined, assessment of optimization in management information systems, a priori, will continue to be ineffective.

The purpose of this dissertation is to set forth a methodology utilizing a total systems approach that will investigate the optimum cost-effectiveness of a management information system. By means of design it formulates a mathematical model that will optimize the relative values of a fixed amount of information resources, yielding the optimum return of information value per dollar invested.

Functional Properties and Assumptions

of the Generalized Model

In formulating an optimization model that performs the prescribed functions (as stated above), and in order for the model to be applicable, certain functional properties must be pre-supposed. To sufficiently formulate this problem requires the development of a systems approach that performs at least the following functions:

1. Provides a means to determine the "Relative Importance" of each organizational objective.
2. Provides a management tool that will predict for a given amount of information, the maximum dollar value received per given amount of resource dollars expended.
 - a. Provides a means for management to establish the "Relative Worth"¹³ of each information resource that it requests.
3. Provides through sensitivity analysis a means to gain further information by varying the costs parameters about the problem structure.

These prime considerations in the development of the allocation model are the essence of the underlying foundation. In order for the total systems approach to be applicable, certain basic assumptions must be predetermined to establish the modus operandi in which this dissertation is concerned. They are as follows:

1. The user understands the organizational objective and places in perspective the information that is essential for decision-making.
2. The design of the management information system is the prime assessment of the user, in accordance with management; the systems personnel concentrate their efforts on the consideration of the users' needs.

¹³Relative Worth denotes the amount of money that the user is willing to spend for an item or source.

3. Information value can be judged by the user on its "Relative Worth" in respect to the organizational objectives.

4. The management information system total proposal costs are predicated on the ability of the systems personnel¹⁴ and management, as users, to estimate all tangible and intangible costs that will be incurred.

5. Optimization will be justified upon users' judgment and his ability to rank, weight, and evaluate the "Relative Worth" of the information that is requested by the user in the overall design of the system.

6. Tentative approval of the management information system has been given by management, but total capital commitment has not had final approval.

In an attempt to solidify the validity of a systems approach, chapters II and III will discuss the basic assumptions in greater detail. Their relevance will point out the inconsistency in the management information system design and show the necessity for a consistent management information system philosophy.

It is not the intent of this dissertation to survey in depth the entire field of management information systems, but rather to discuss those areas which are in direct confrontation with the functional properties and assumptions of this cost-effectiveness study.

¹⁴Systems personnel is denoted as the systems designer, analyst, etc.

CHAPTER II

DEVELOPMENT OF INFORMATION AND SYSTEMS IMPLICATION

The Role of Communication in the Management Information System

Communication is the essence of information activity in today's modern organization. Rosove states:

Communication is analogous to the functioning of the nervous system of an organism. It is not the organism; it is the mechanism which coordinates and controls the components so that the organism as a whole can survive in and adapt to its environment.¹⁵

In order to determine how vital communication is to the organization and to its functional role in the management information systems, it is essential to develop some of the major points and show how their factors relate to the formal organization which ties together the communication-information ideology.

Elements of Communication in the Formal Organization

Defining the formal organization is not a difficult task but one of bringing together four essential elements that reappear consistently in management literature.

¹⁵Rosove, Computer-Based Information Systems, p. 3.

1. A system of coordinated activities: This element underscores the fact that all organizations are composed of parts and relationships. The "parts" of the organization refer to activities or functions performed. The formal system appears when these activities are geared into a logical relationship.

2. A group of people: Although an organization can be charted on paper, it needs people for social existence.

3. Cooperation toward a goal: Cooperation is strictly a human phenomenon and is normal behavior. Cooperation is always purposeful; therefore, organizations must have objectives to lend purpose to the actions of people performing functions.

4. Authority and leadership: Organizations are structured on superior-subordinate relationships. As the result, authority is a universal element in all formal organizations. Leadership, however, is a manager's personal quality which prompts willing collaborative effort toward a goal.¹⁶

By combining these elements, a comprehensive operative definition is obtained: A formal organization is a

¹⁶Max Weber, The Essentials of Bureaucratic Organization; An Ideal-Type Construction (New York: The Free Press of Glencoe), p. 52; Robert K. Merton, A Reader in Bureaucracy (New York: The Free Press of Glencoe, 1952), pp. 18-27; Luther Gulick and Lyndall, "Papers on the Science of Administration," Institute of Public Administration, p. 137; Chester R. Barnard, The Function of the Executive (Cambridge: Harvard University Press, 1938).

system of coordinated activities of a group of people working cooperatively toward a common goal under authority and leadership. This could be called a working definition of formal organizations tying together the essential elements. But what role does communication play in the formal organization?

Barnard points out that a formal organization only comes into being when there are persons able to communicate with each other and who are willing to contribute action to accomplish a common purpose.¹⁷ Denoting this foundation of theory, a deeper penetration must be uncovered to give better insight which hopefully will illuminate the rationale to the communication formulation.

The purpose of every organization is found in its goals and objectives. They provide the aims toward which coordinated activities of managers are directed. Communications is the "linking process" that channels information to and from the working parts of the organization, both human and non-human, which are responsible for pursuing the primary goals and sub-goals of the organization.¹⁸

March and Simon suggest, not only is

communication characteristically specific with respect to the channels they follow, but they also

¹⁷Barnard, Function of the Executive, pp. 83-91.

¹⁸Robert D. Watson, "Management Centralization-Decentralization Syndrome" (unpublished paper, April, 1968), pp. 3-4.

exhibit a high degree of specificity with respect to content. Not only can organization communication be detailed, but it can be cryptic, relying on a highly developed and precise common technical language understood by both sender and recipient.¹⁹

Communication is the essential ingredient that allows the organization to function and stimulates managers to make goal-oriented decisions predicated on the vascular flow of information from one level of the organizational hierarchy to another. Communication is the activity that "links" individuals to each other, management to all levels of the management hierarchy, and gives essence to its being.

Validity of Systems Design in Decision-Making

Management's role in the human aspect of innovation is the central vertex for the management information system. Components for human innovation are creative individuals with various talents, wants, and motivations. If management desires to design a creative and adaptive system, it must not try to program it in the computer sense.²⁰

Simon views computerization as a new horizon, he maintains that decision-making and systems design are separable and independent.

Nowdays, with the advent of computers, we can think of information as something almost tangible; strings of symbols which, like strips of steel or plastic

¹⁹March and Simon, Organizations (New York: John Wiley & Sons, Inc., 1958), p. 3.

²⁰Jack A. Morton, "A Systems Approach to the Innovation Process," Business Horizons (Summer, 1967), pp. 57-58.

ribbers, can be processed--changed from one form to another. We can think of white-collar organizations as factories for processing information. The executive is the factory manager, with all the usual responsibilities for maintaining the factory operation; getting it back into operation when it breaks down, and proposing and carrying through improvements in its design.

There is no reason to expect that a man who has acquired a fairly high level of personal skill in decision making activity will have a correspondingly high skill in designing efficient decision making systems. To imagine that there is such a connection is like supposing that a man who is a good weight lifter can therefore design cranes.²¹

Although Simon discusses the inability of the individual users to design an efficient decision-making system, he lends no real rationale that the user cannot "define" the information elements in the system which are essential to his functioning in the integrated structure.

The individual user, as a decision-maker, has projected himself through the hierarchy structure to a lower level of abstraction. He has defined through his time-span capacity,²² the ability to perceive information criteria from a high stratum to a lower stratum in the performance of real work. He has "defined" through his discretionary ability the design of the system.

²¹Herbert A. Simon, The Shape of Automation for Men and Management (New York: Harper and Row, 1965), p. 21.

²²Elliott Jacques and Wilfred Brown, Glacier Project Papers (London: Heinemann Educational Books, Ltd., 1965), pp. 102-3.

"The phrase, 'time span capacity,' is purely descriptive, signifying nothing more than the capacity to carry levels of work as measured in time span."

Anything that consists of parts which are connected together can be called a system. Begeed-Dov couches the definition of a system in a different manner: "Stripped to its essentials a system is a collection of cells which are interconnected by various channels of communication and control for the attainment of clearly perceived goals."²³

Control of the internal environment is essential to the systems design, ensuring that its component parts work in conjunction with one another. Design of the overall system can provide greater effectiveness than the sum of the individual parts. This concept has been recognized recently and sometimes defined as "Synergistic Management."²⁴ J. A. Morton also considers systems engineering analogous to this concept. He states:

The Systems Engineering method recognizes each system as an integrated whole even though composed of diverse, specialized structures and subfunctions. It further recognizes that any system has a number of objectives and that the balance between them may differ widely from system to system. The methods seek to optimize the over-all system functions according to the weighted objectives and to achieve maximum compatibility of its parts.²⁵

²³Aharon G. Begeed-Dov, "An Overview of Management Science and Information Systems," Management Science, Vol. XIII, No. 12 (August, 1967), p. B-817.

²⁴William L. Williams, "Undergrowth in the Management Theory Jungle," Business Horizons (February, 1969),

²⁵J. A. Morton, "Integration of Systems Engineering with Component Development," Electrical Manufacturing, Vol. LVIV (August, 1959).

It is a reality that management tools are utilized in order to aid management in reaching its goals. Although these tools possess certain characteristics when applied to solve certain defined tasks, they cannot be applicable when the organizational goals are stated in vague terms.

The design should be conceived to aid management in securing these goals. There is a possibility that a system could be designed utilizing a piecemeal integration of existing reporting procedures. It is unlikely that a significant impact would be optimum in relationship to the organizational goals. However, one cannot say that information which was previously requested by the users was not originally conceived to aid in the decision-making process with respect to organizational goals.

A new design format should be viewed independently to examine the organizational requirements for information of the existing system. Understanding can only be achieved by systematically sifting organizational requirements that are identifiable and realistic. This entails the users' understanding of organizational objectives and their relationship to those objectives for the success of the organization or institution.

In a world of changing economic environment, objectives vacillate in organizations whose products or goals change. To meet the users' needs for quantity and timeliness of goal-oriented information, a realistic aspect to

design criteria must meet today's needs as well as tomorrow's. Staging of information phases in total overall design is becoming a "fact" instead of the antiquated approach of the total systems concept, a priori.

Staging of phases in the total management system places a new prospectus on "meeting the needs" of today's decision-making. The inability to maintain adequate service for the users during the course of organizational decision-making while concurrently developing a master system plan, will eventually cause sub-optimization and organizational disparity. Due to the discord among users, degradation will solidify and impair total systems innovation. Only harmony and users' involvement can bridge the systems approach to design criteria.

Systems Analyst in the MIS Design

The systems analyst is often viewed as being essentially a problem-solver and his solution to the problem is the resulting design. In addition, he recognizes the facts and defines the methodology for examining the process of problem-solving. Quade states about his ability: ". . . to help a decision maker identify a preferred course of action from among possible alternatives which are compatible."²⁶ Corrigan and Kaufman suggest that the systems

²⁶E. S. Quade, Some Problems Associated with Systems Analysis, in the Rand Collection (Santa Monica, Calif.: The Rand Corporation, June, 1966), p. 21.

analyst role in systems analyses emphasizes what is necessary to state mission objectives including the performance limits--the operational and design constraints under which the system operates.²⁷

The user or the systems analyst establishes the specifications of the performance level. This operational level can vary from the maximum to the minimum performance restrictions and is utilized in carrying out the sub-functions of the operation. The operational constraints are those restrictions established by the user or the systems analyst in the operation of the total system for specific objectives in the operation of the total system design and implementation. The design constraint consists of the user or systems analyst establishing the material requirement that is utilized for the operational standards, equipping, etc., and insuring optimum system performance within the design criteria.²⁸

What Corrigan and Kaufman suggest about characteristics of systems analyses would be to assume that a specialist, such as systems analysts, can provide a magnitude of decision-making capacity equal to that of the user. To be realistic, such a magnitude is highly unlikely.

²⁷Robert Corrigan and Roger Kaufman, Why System Engineering (Palo Alto, California: Fearon Publishers, 1966), p. 71.

²⁸Ibid., pp. 72-73.

Simon advocates that for a decision-maker to have the ability to be a good systems designer is highly improbable.²⁹ The writer rejected this concept on the basis that the decision-maker has the time-span capacity to define through his discretionary ability and level of abstraction the design of the management information system.³⁰ However, it seems more likely, in view of Simon's observation, that the systems designer (analyst) would not possess the ability to be a decision-maker.

In light of the systems analyses concept, the systems analyst's function has become analogous to the user in the decision-making role for the design of the management information system. But what deterrent or void has caused this shifting of authority toward the systems analyst in lieu of the user as a decision-maker? Barnard's general opinion is:

The necessity of the assent of the individual to establish authority for him is inescapable. A person can and will accept a communication as authoritative only when four conditions simultaneously obtain: (a) he can and does understand the communication; (b) at the time of his decision he believes that it is not inconsistent with the purpose of the organization; (c) at the time of his decision he believes it to be compatible with his personal interest as a whole; and (d) he is able mentally and physically to comply with it.³¹

There is no reason to doubt that an organization has decision-makers who do not understand the organizational

²⁹Simon, Automation for Men and Management, p. 21.

³⁰See chapter ii, supra, p. 16, for further substantiation.

³¹Barnard, Function of the Executive, p. 165.

objectives in relation to their function. For example, the decision-maker as a user is not always able to state his objectives clearly and precisely. Therefore it may be necessary to restate them many times before the objectives are clear. In some cases the objectives are never stated. The inability of the decision-maker as a user to define and communicate his objectives has caused serious repercussions in the user-system-analyst relationship. Barnard suggests:

A communication that cannot be understood can have no authority. An order issued, for example, in a language not intelligible to the recipient is no order at all--no one would so regard it. Now, many orders are exceedingly difficult to understand. They are often necessarily stated in general terms, and the person who issued them could not themselves apply them under many conditions. Until interpreted they have no meaning. The recipient either must disregard them or merely do anything in the hope that that is compliance.³²

In an effort to discharge his duties the systems analyst has usurped the authority of the user. The user unknowingly has abdicated his authority but not his responsibility for the information he needs to fulfill his duty as a decision-maker in the organization. Champanis argues that ". . . the systems analyst is not always concerned with the question of which two or more possible components is the best for a particular function, but which of the two components is adequate to do the job."³³

³²Ibid.

³³Alphonse Champanis, "On the Allocation of Function between Men and Machines," Occupational Psychology, Vol. XXXIX (January, 1965), pp. 1-11.

Thus, to complete the design concept, there has been a compromise of information without management's knowledge or consent from the user. In order for the systems analyst to perform his function, he must assume complete authority and select those elements of information which he thinks are adequate.

Rothery stipulates that the systems analyst has no limits in his role.³⁴ This is not by design but a miscarriage of the formulation of his job definition. Due to the lack of solidification, he has encompassed a broad range of duties. The initial concept of the systems analyst's job description was very unique. Rothery demonstrates:

We find that, generally, the operation and method specialists concentrate on the "things" that are used in systems, human and inanimate, whereas the systems analyst tends to concentrate on forms and on their interface with a computer.³⁵

The operation and method specialists look at the organization and distribution of people, officers, etc., while the systems analyst has assumed this as part of his function --an unchangeable fact of life.³⁶

Outwardly, the systems analyst's role cannot and in many cases does not suffer from limits set by management. His bounds of authority are an illusion; it contracts and

³⁴Brian Rothery, "The Limits of Systems Analyses," Data Processing Magazine, January, 1967, pp. 38-39.

³⁵Ibid., p. 37.

³⁶Ibid., p. 38.

expands at the inability of the users to define the information that is needed in respect to organizational objectives. It becomes more apparent that a user who cannot assess his information needs, and define them in terms of organizational objectives, has abdicated his authority. The user's inability to communicate his objectives in terms of information documentation has allowed the systems analyst to usurp his authority. The user's needs are then defined on the basis of the systems analyst's subjective judgment. The systems analyst perceives this dilemma and dictates to the user his information needs through a pseudo-shield called "delegation of authority and responsibility."

Information a Reality in the Decision-Making Process

Decision-making is a process in which management must use its knowledge and human judgment in relation to the organizational objectives. Dale states:

Management itself is sometimes defined simply as decision making, for the manager must choose among various courses of action in performing each of the management functions. He must choose, for example, among different possibilities in formulating plans, in developing his organization and staffing it, and in his day-to-day direction of the work. And certainly nothing in the way of innovations can be introduced unless a manager decides to go ahead with a new course of action.³⁷

The role of management has increasingly been interpreted as one of problem-solving and decision-making. There

³⁷Ernest Dale, Readings in Management (New York: McGraw Hill, 1965), p. 370.

are management theorists who advocate that this be kept in mind when the work of management is planned within the organization. Peter Drucker has observed:

For the organization of highly educated people, authority and responsibility may well be the wrong principles of organization. It may well be that we will learn to organize not a system of authority and responsibility--a system of command--but an information and decision system --a system of judgment, knowledge and expectation.³⁸

Along similar thoughts, Simon suggests:

The executive's job involves not only making decisions himself, but also seeing that the organization, or part of an organization that he directs makes decisions effectively. The vast bulk of decision making activities for which he is responsible is not his personal activity, but the activity of his subordinates.³⁹

In view of the decision-making process, the general conception seems to be clouded by the total function of the decision-making process. There is no reason to doubt that the total process contains many facets. Duncan concludes

that the whole complex process, of which the decision is only part, should be broken down into five stages: (1) formulation of the objective or aim; (2) analysis aimed at increase of knowledge; (3) listing of alternative possibilities of action; (4) decision; (5) implementation by planning.⁴⁰

³⁸Peter F. Drucker, "Managing the Educated," Management's Missions in a New Society, ed. by Don H. Fenn (New York: McGraw-Hill, 1956), pp. 163-78.

³⁹Simon, Automation for Men and Management, p. 57.

⁴⁰Dale, Readings in Management, pp. 387-88.
A. R. C. Duncan, "Techniques of Decision-Making," from a lecture given to the Executive Development Group, Queen's University, Kingston, Ontario, Canada, June, 1964.

Although Duncan has broken down the complex process into five definite stages, the abstention of information dependency must be recognized as the vehicle which links the decision-maker to reality.

The capacity of an organization to maintain a highly sophisticated interdependent pattern of activity is limited in some cases to its capacity to handle the information of its organization. The inability of management to perform without adequate information, limits or constrains the decision-making process. Decision-making requires information that is accurate and has value to make the best or optimum decision. Value in most cases can only be determined by human judgment in relation to the organizational objectives. No longer is it a question of quantity of information, but of quality and timeliness.

Users' consideration in design criteria must take precedence to insure that management receives the information which it needs and requires to perform the decision-making process. Only then can management be assured that the information for decision-making has been placed in a realistic frame of reference in which a greater degree of accuracy and timeliness can prevail.

CHAPTER III

MANAGEMENT INFORMATION SYSTEMS OVERVIEW, OPTIMIZATION, AND COST-EFFECTIVENESS

What is a Management Information System?

A management information system can be described as a system which provides information that is required at each level of management which has been carefully determined in advance of its needs and is produced from an integrated system at predetermined times. It must be in a form suitable for strategic planning, such as, setting basic goals, selecting major activities in which organizations engage, formulating basic policies, and allocating gross resources. It should include lower level "tactical" planning which is required in order to implement higher level decisions and "operational" activities at the lowest level in the organization.⁴¹

Such a system must provide the information that management needs to understand, plan, operate, and control

⁴¹Robert N. Anthony, Planning and Control Systems: A Framework for Analysis (Massachusetts: Harvard University, 1965), pp. 28-68.

the organization.⁴² In other words, a management information system's primary purpose is to aid managers to manage better by improving their decision-making capabilities and by placing them in a position to effectively implement those decisions.

Data Base, an Integrated Concept

Management information systems have existed in fact long before modern computers were developed. Today the computer plays the central role and provides direction for the management information systems.

The prescription of the "third generation" computer design manifests the current view that scientific and data processing computers have many common requirements. The important distinction differs largely in the source data. Scientific computation tends to rely on ad hoc data collections. Data is collected, read into the processor, and, upon completion, the results are printed out. Even when computations are repeated frequently, each new run is independent from the previous.⁴³ Emery terms such computations as "self contained."⁴⁴

⁴²Ridley Rhind, "Management Information Systems," Business Horizons (June, 1968), pp. 37-40.

⁴³J. C. Emery, "Management Information Systems," Progress in Operation Research, Vol. III, No. 16 (1968), p. 493.

⁴⁴Ibid.

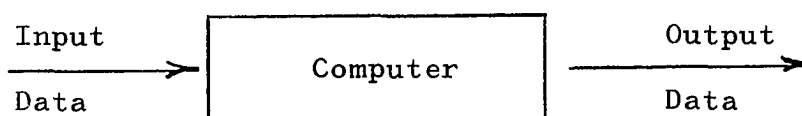


Fig. 3.--Self-Contained

The "data base computation" relies heavily upon data processing. It serves as a central bank of files in which information is stored by the various input documents. Upon recall, the stored information elements can be manipulated into any form or fashion in which the user stipulates.

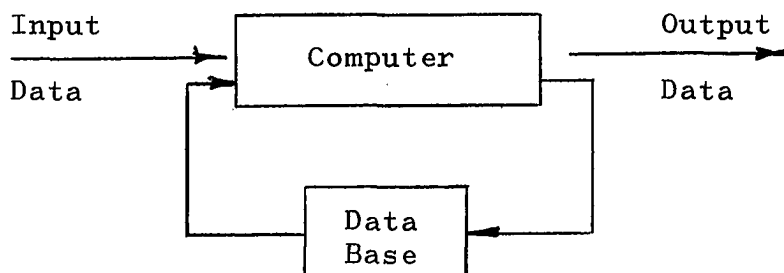


Fig. 4.--Data-Base Computation

In past years computer systems dealt only with the processing of information for accounting purposes and clerical levels.⁴⁵ Similar to "self-contained" computations, their features are independent from one run to the next. The prevalent notion of this system is somewhat routine and highly repetitive.

By utilizing an integrated data base, the same information could be used in different and more imaginative ways.

⁴⁵G. W. Dickson, "Management Information-Decision Systems," Business Horizons (December, 1968), p. 18.

This involves, for one thing, the use of information for management control purposes.⁴⁶ Here the emphasis is not on historical record-keeping, but on the processing of information for decision-making.

In order to utilize an integrated data base, two notions of organization design must first be reviewed. They are: horizontal and vertical integration.

There are basically three distinguishable levels in the horizontal hierarchy to be considered in the organization. They are: (1) Transaction Detail, (2) Operation Management, (3) Policy Management.⁴⁷ The pyramiding effect of the horizontal hierarchy concept shows three basic functional levels (Fig. 5).

There is a combined need to maintain detail customer accounts, etc., and this information will continue to be an important part in the development of the integrated data base. But operations managers do not need all these details, only some portion of them. At the top, policy management needs still another facet of the overall data base.

Vertical structuring in the organization (Fig. 6) points out that the different functions in the organizational hierarchy have departmental information prevalent to them from the lowest level of the hierarchy to the

⁴⁶Anthony, Planning and Control Systems, p. 41.

⁴⁷Robert V. Head, "Management Information Systems: A Critical Appraisal," Datamation (May, 1967), p. 24; Rosove, Computer-Based Information Systems, p. 9.

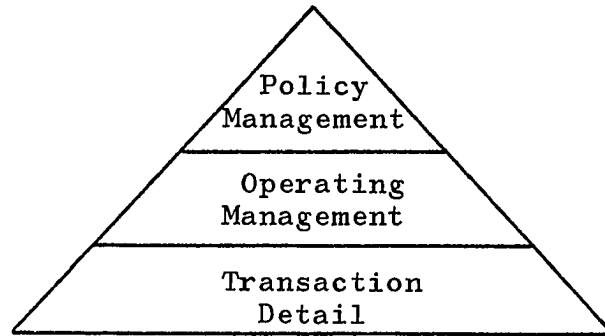


Fig. 5.--Horizontal Integration

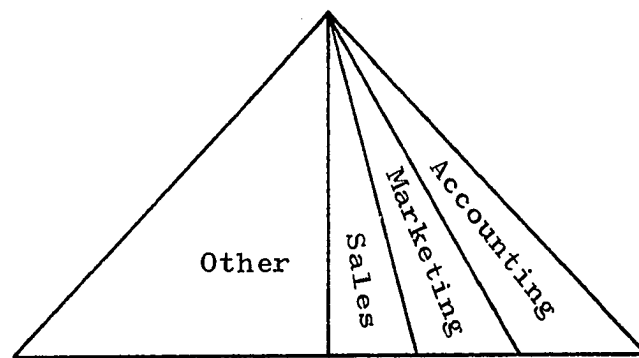


Fig. 6.--Vertical Integration

highest in their particular function.⁴⁸ These departments can be considered as specialized functions and maintain a vertical pyramiding effect within the organizational structure. The total sum of all vertical specialized functions or departments is equivalent to the sum total of the organizational pyramid. In view of the two separate and distinct, two-dimensional array, horizontal and vertical integration must be accomplished to enable the usage of a single integrated data base.

⁴⁸Ronald Daniel, "Management Information Crisis," Harvard Business Review (May, 1961), p. 112.

But how can this be done? An integrated data base bridges the gap by changing dimensions of the horizontal levels to laterally incorporate different functions at the same organizational level and vertically incorporate different levels of the organizational hierarchy. These functions are then able to share in the same common data base.

Essentially, with the integrated data base, the management information system vertically cuts across all levels of the organizational hierarchy from functions to specialization; thus resulting in a three-dimensional, integrated data base (Fig. 7).

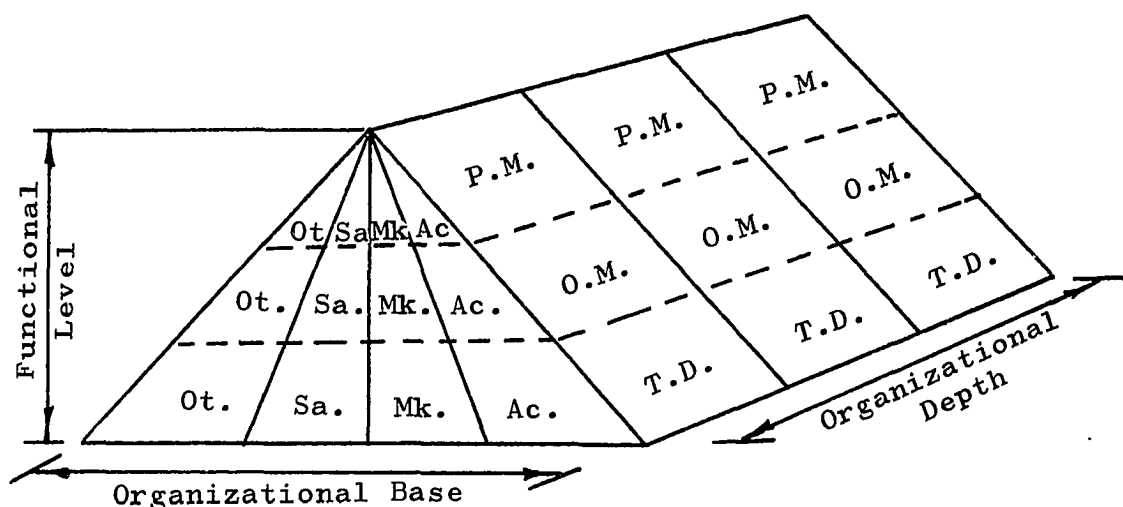


Fig. 7.--Integrated Data Base

This concept is synonymous to "matrix management," utilizing the information through all levels of the hierarchy of the organization.⁴⁹ When integration and orientation are toward providing information to be used in management decision-

⁴⁹Williams, "Management Theory Jungle," p. 56.

making, then the transition has been made from a clerical level to a management information system.

Optimization and Allocation Models

In the design of management information systems, the term optimization is consistently appearing in management literature. It appears not only in the systems design area, but in other fields as well. However, the questions still remain: What increasing role does optimization play in the information systems design? What action does it recommend? What are its values?

Pun states, "Optimization can be generally defined as getting the best of something under given conditions."⁵⁰ Wilde defines it, ". . . finding the best way to do things."⁵¹ Wilde goes on to say:

. . . it is obviously of interest in the practical world of production, trade, and politics, where small changes in efficiency can spell the difference between success or disaster for any enterprise, be it neighborhood store, mammoth industrial complex, or governing political party. Today, as always, many important decisions are made simply by describing the system under study as precisely and quantitatively as possible, selecting some measure of systems effectiveness, and then seeking the state of the system which gives the most desirable value of this criteria.⁵²

⁵⁰ Lucas Pun, Introduction to Optimization Practice (New York: John Wiley and Sons, Inc., 1969), p. 1.

⁵¹ Douglass J. Wilde, Optimum Seeking Methods (New Jersey: Prentice-Hall, Inc., 1964), p. vii.

⁵² Ibid.

Optimization principles are of undisputed importance in modern design and systems operations. Over the past few decades there has been a steady shift in applied optimization from the state of an art to that of a scientific discipline.

With the advent of advanced computer technology, mathematical modeling has come into its own science. Pierre believes that

to a large degree this trend has been fostered by the development of high speed computers with which large-scale problems can be solved with an exactness that previously was unapproachable. Computer availability has given rise to new optimization techniques and has enhanced previously developed ones.⁵³

Presently, optimization is being applied to computer programs and systems in business and institutional organizations. Usually there are many programs, each performing a single modular function. In all likelihood they are major candidates for optimization. Stuart refers to optimization in a computer program sense as:

Any given computer program can be modified to run faster, do more work and thus save time per dollars. Effort directed toward reaching the same, or an expanded, program objectives with any one of these happy results.⁵⁴

Systems planners, recognizing the need for better and more economical services, have continued to develop

⁵³Donald A. Pierre, Optimization Theory with an Application (New York: John Wiley and Sons, Inc., 1969), p. v.

⁵⁴Senter Stuart, "Optimization--It Can Pay Off," Business Automation (March, 1966), p. 46.

means in which services for the decision-maker can be improved. This has led many diverse organizations to study the question of centralizing some of their information functions for better resource allocation.

Brown indicates that an interuniversity information network, called EDUCOM, was organized to allow sharing of resources such as library facilities, machines, etc., among libraries in the country.⁵⁵ Bryant points out that acquisition decisions are made on serials or individual documents by means of a model that stresses economic trade off.⁵⁶ Acquisition decisions are made either by acquiring and maintaining documents prior to need or by borrowing them from an external source. Acquisition decisions are based on frequency of use, costs, and response time.

Kent advocates that optimization models should be used to determine the degree of decentralization for acquisition, search, and surrogation.⁵⁷ The determination for the number of locations necessary for storing documents

⁵⁵George Brown, "An Interuniversity Information Network," Electronic Handling of Information; Testing and Evaluation, ed. by Kent, Taulbee, Belzer, Goldstein (London: Academic Press, 1967), pp. 269-78.

⁵⁶Edward Bryant, "Modeling in Document Handling," Electronic Handling of Information; Testing and Evaluation, ed. by Kent, Taulbee, Belzer, Goldstein (London: Academic Press, 1967), pp. 163-73.

⁵⁷Allen Kent, "Centralization, Decentralization, and Specialization--A Problem in Resource Allocation," Electronic Handling of Information; Testing and Evaluation, ed. by Kent, Taulbee, Belzer, Goldstein (London: Academic Press, 1967), pp. 25-40.

depends on costs and frequency of overtime use. He also approaches the degree of search centralization in terms of batch processing which reflects the number of search installations that should be based on delay time created by queries of each facility. Meise agrees that the benefits of automation could be accessible to many more libraries on a larger scale if a centralized approach were followed.⁵⁸

Kent suspects that a document could be analyzed from many points of view. He formulates an allocation model based on elementary relationships, such as costs being a function of analysis and location number.⁵⁹ Day associates the allocation problem with a degree of centralization and stresses the need for cooperation among agencies and other organizations that make source material available.⁵⁹

Planning-Programming-Budgeting System (PPBS) is an allocation concept which is presently being used for long-range planning by the federal government for budgetary purposes. Early in the budget cycle (Fig. 8) each executive department is given loose financial and program guidelines that reflect the relative priorities assigned to the

⁵⁸Norman Meise, "Analysis of Selected Operations Problems in an Automated Library System," Bulletin of the Operations Research Society of America, Vol. XV, Supplement 1 (Spring, 1967), p. B55.

⁵⁹Kent, "Centralization, Decentralization, and Specialization," pp. 25-40.

⁶⁰Melvin Day, "Factors in Building an Operational Information Program," Journal of Chemical Documents (May, 1967), pp. 107-9.

different national goals. These are then translated into more detailed budget variables. The department also proposes incremental programs that show the allocation of additional funds made available. The Executive Department and Congress therefore have some knowledge of the marginal benefits that can be obtained for a marginal expenditure.⁶¹

An iterative planning cycle as discussed, induces lower level managers to behave in a way that contributes to the overall effectiveness of the system. Emery states:

The requirement for iterations in the planning process is an inherent implication of the limited information available at the time a high-level plan is formulated. Failure to adjust higher-level plans through an iterative process will almost inevitably mean that these plans will be less satisfactory than otherwise would be. To be sure, iterations add to the cost of planning and introduce delays. In some cases, the incremental value of a more perfect plan cannot justify the added cost or delay in searching for it.⁶²

PPBS utilizes cost-effectiveness and incremental analysis in the allocation of resources for long-term planning. As Emery emphasized, there is a possibility that the marginal value of a long-range plan cannot justify the added costs for additional iterations and systems analyses.

David Novick professes that PPBS sounds like a broad charter, but it has limitations that must be recognized.

⁶¹David Novick, Program Budgeting (Cambridge: Harvard University Press, 1965), pp. 52-78; Verne B. Lewis, "Toward a Theory of Budgeting," Planning Programming Budgeting (Chicago: Markham Publishing Company, 1967), pp. 117-30.

⁶²Emery, "Management Information Systems," p. 505.

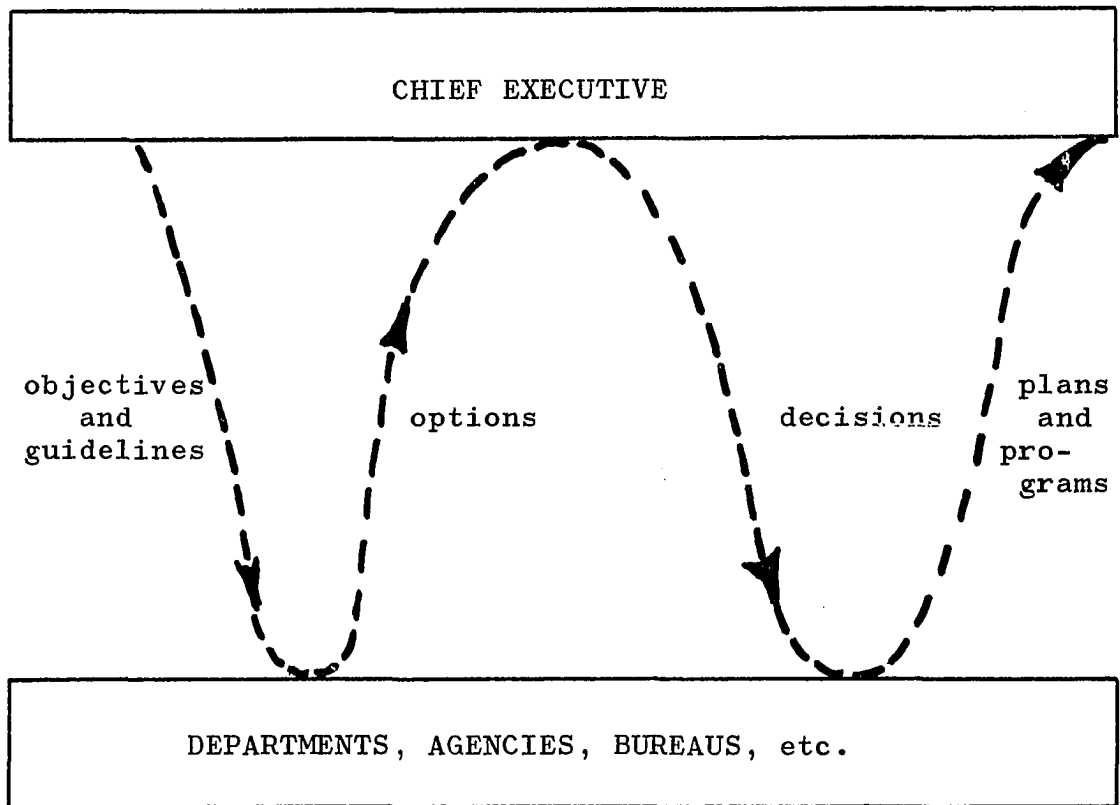


Fig. 8.--Planning-Programming-Budgeting System Cycle⁶³

⁶³Harry P. Hatry and John F. Cotton, "Program Planning for State, County, City," State-Local Finances Project (Washington, D.C.: The George Washington University, January, 1967), p. 38.

Even though these limitations are sometimes not adhered to,

it should be borne in mind that PPBS does not do a number of important things. As it is discussed here, PPBS is an instrument for over-all planning that utilizes existing systems for directing and controlling operations and therefore does not necessitate change in either the existing organization or methods of administration. In addition, PPBS is specifically designed for long-range planning and budgeting; it is not primarily a tool for conducting the annual budgeting-accounting cycle, although next year's budget must be included in its purview, last although PPBS stresses the use of quantitative analytical methods and, in some cases, a rather extensive use of modern computer technology, it does not attempt to quantify every part of the problem or to computerize the decision making process.⁶⁴

Novick advocates that the essence of PPBS philosophy is a truism, but one must recognize that "planning, not forecasting, is the purpose of the Planning-Programming-Budgeting System."⁶⁵

PPBS, a systems approach in long-range planning for budgetary purposes, is the most advanced state of resource allocation. But PPBS by definition, is not a forecasting tool; it does not change or affect present existing systems already implemented, and it does not attempt to quantify every part of the optimization problem. PPBS is a philosophy, not a panacea. But nevertheless, each application for the allocation of resources follows a pattern of cost-effectiveness and incremental analysis.

⁶⁴David Novick, "Long Range Planning Through Program Budgeting," Business Horizons (February, 1969), p. 62.

⁶⁵Ibid.

Cost-Effectiveness and Justification

Thus far, the discussion has been on some key notions of the philosophical concept of the management information system and optimization. In an attempt to set the stage for the necessity of an optimum cost-effectiveness model, some additional deterrents should be discussed now in order to present cost-effectiveness in a different frame of reference.

Since the advent of the third-generation computers, today's organizations, that maintain some form of an information system, are being confronted with new and non-dimensional problems. One of the most immediate problems of this kind centers around the fact that management information systems cost more than their predecessor systems. If management were to study their systems' costs, they would discover that the equipment and software necessary to support a management information system, costs considerably more than management has invested in the past. Head states:

It is undeniable that there is a higher price tag associated with management information systems than the already considerable cost burden that companies have been carrying for data processing technology. Despite the fact that unit costs have been declining, e.g., cost per bit stored, cost per item processed, hardware and software costs are both rising in an absolute sense, reflecting the more ambitious objectives of today's information system design.⁶⁶

From this point of view, management is now taking a closer look at new proposals for equipment, brick, mortar,

⁶⁶Head, "Management Information Systems," p. 26.

personnel, and is challenging each new systems project more vigorously. Coupled with the problem of rising developmental and operating costs is that of systems justification in view of management objectives. Even though a new proposed information system is very costly, an enlightened management may well support it if the proponents of the system can demonstrate what the benefits are going to be and that the maximum information is obtained at the minimum cost.

In the past, when data processing equipment was installed for repetitive and clerical level tasks, there were invariably demonstrable savings resulting from clerical displacement. This was a tangible cost-justification, but this antiquated concept is no longer appropriate. With additional systems presently proposed, management has already obtained the cost benefits by means of the existing, installed system. Now, the question is not what it is worth, but rather, what is its worth?

It could, for example, provide a university dean with a cathode ray tube display device to aid in advising a new student in academic matters. This is a benefit that in the past would be considered trivial or intangible. But most of the benefits of management information systems are of this intangible nature. Still, the problem exists, how do you rank, weight, and evaluate the intangible benefits that are goal-oriented toward management objectives? What kind or type of systems approach will perform this task?

Cost-effectiveness is a necessity in a systems approach. It provides a quantitative basis for evaluating a systems performance in light of both its costs and effectiveness. Fields advocates:

. . . it shows how alternative design decisions are related to system costs as a function of system effectiveness. In doing so, it identifies the value of the variable characteristics that should be considered in designing the system, enabling the system designer to evaluate candidate systems systematically and choose the one with the preferred characteristics. While this improves the efficiency of the decision maker, it is extremely important to note that it should not be regarded as a substitute for his experienced judgment.⁶⁷

In most cases, efficiency is too often defined in such narrow terms as computer capacity requirements and the cost of systems implementation, rather than by means of a broader definition that includes the value of information to the user. This narrow concept unfortunately biases the design alternatives in favor of an inflexible system that falls short of satisfying the decision-maker's needs.

Value in a qualitative sense is based upon users' judgment, and judgment in most cases is the one essential quality that aids in the decision-making process. The ability of a user to be a good decision-maker also depends upon the quality and timeliness of information. His success or failure as a decision-maker depends not only on the validity

⁶⁷David S. Fields, "Cost/Effectiveness Analysis," Operation Research, Vol. XIV, No. 3 (May-June, 1966), p. 515.

of the information but on his intuitive judgment as to the value of information as it relates to the organizational goals.

Moreover, the value of any decision is no better than the validity of the information that is used to make the decision. If information is being requested because the user thinks it's nice to know, but not a necessity, he has in essence increased the information flow. His span of information consumption in all likelihood has reached a point of diminishing returns which acts as a deterrent to his decision-making ability.

Through cost-effectiveness the total information resources that the user receives can be optimized, and the measure of performance will be formulated in terms of information value based upon the user's judgment as he relates it to the objectives of the organization.

CHAPTER IV

TOTAL SYSTEMS APPROACH AND MODEL FORMULATION

This chapter provides a mathematical approach for the determination of the optimum cost-effectiveness of a management information system. It combines a realistic systems approach with a methodology that is not only theoretical but pragmatic in nature.

The systems approach combines the use of a modified "Delphi" technique to obtain the relative worth of each information source. This is accomplished through a consensus of users' opinions and integer programming to determine the optimum cost-effectiveness of those resources.

Development of the Total Systems Approach

In designing a total systems approach, the objective is to determine through a systematic procedure the various inputs that will be required for the development of an optimum cost-effectiveness model. The formulation of such a model will require two basic categories of data which are essential for its existence. They are: (1) all costs (c_j) which are tangible and/or intangible that relate to each information source in the system, and (2) the relative

worth (w_j) of each information source in relation to its cost (c_j). To insure this information, a total systems approach must be developed to capture that data for the input into the model.

Such an approach is set forth in a flow diagram (Fig. 9), and shows the sequence of events that are to take place. The systems methodology in the flow diagram not only defines, determines, and optimizes the solution for the cost-effectiveness model, but also introduces an effective feedback mechanism.

The feed-back mechanism serves to insure the quality of information that determines the reality of the optimum cost-effectiveness. The results are evaluated in light of the organizational objectives and if additional information is introduced in the system, the system is then re-cycled.

Group Selection

To perform a cost-effectiveness study in an organization whose objectives are of a profit or even a non-profit nature, the selection of group participants will be chosen from the users or decision-makers at the upper echelon. Selection of the participants will be made with the agreement of top management. All participants will be selected on the basis of their ability, experience, and functional relationship to the organization. Personalities should not be considered in the selection, in any case.

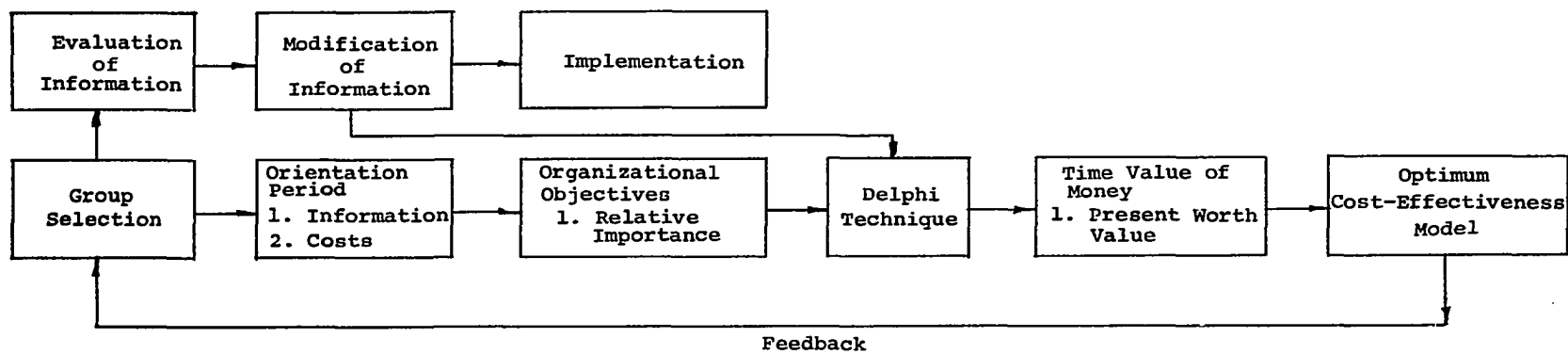


Fig. 9.--Total Systems Approach (Flow Diagram)

When it becomes evident that a decision-maker of a high status does not have the capabilities to perform at the minimum capacity of the job description, this individual should be excluded from the panel if at all possible. However, maximum effort should be made to include that information which is necessary for the decision-making responsibilities of the particular function.

Caution must be taken in the selection of group participants, because some decision-makers become very aware that "stacking" the panel with subordinates or related thinking peers can influence the studies' outcome, favorable to their means. But in most cases this warning can be disregarded.

Orientation, Information, and Costs

After the selection of the participants, an orientation period must be provided to interview each individual, reviewing with him the organizational objectives and information that he requires to perform his decision-making role. Each participant is required to state in three or four lines the purpose of each source of information that he requires. This information, combined with that of the other participants, becomes the composite input for the cost-effectiveness study.

If management feels that the composite of the information resources are too large and there exists in the composite some insignificant sources of information, editing

of the resources should be performed by top management. This not only holds true for the information resources, but likewise for the list of organizational objectives.

After the list of information sources has been edited, the systems personnel must determine, with the help of the users, the tangible and intangible costs of each source of information that is required by management. All costs must be determined in order to be certified as accurate input into the cost-effectiveness model.

Organizational Objectives

The list of objectives that was edited should be reviewed with the administrative staff in order to determine the relative importance (RI_i) of each objective as it relates to the overall success of the organization. Such a method to determine the relative importance (RI_i) is described by Churchman, Ackoff, and Arnoff:

1. Rank the outcomes in their order of value. Let O_1 represent the most valued, O_2 the next most important, . . . and O_m the least important.
2. Assign the value 1.00 to O_1 (i.e., $v_1 = 1.00$) and assign values that appear suitable to each of the other outcomes.
3. Compare O_1 versus $O_2 + O_3 + \dots + O_m$.
 - 3.1. If O_1 is preferable to $O_2 + O_3 + \dots + O_m$, adjust (if necessary) the value of v_1 so that $v_1 > v_2 + v_3 + \dots + v_m$. In this adjustment, as in all others, attempt to keep the relative values of the adjusted group (v_2, v_3 , etc.) invariant. Proceed to step 4.
 - 3.2. If $O_1 + O_2 + O_3 + \dots + O_m$ are equally preferred, adjust (if necessary) the value of v_1 so that $v_1 = v_2 + v_3 + \dots + v_m$. Proceed to step 4.
 - 3.3. If O_1 is preferred less than $O_2 + O_3 + \dots + O_m$, adjust (if necessary) the value of v_1 so that $v_1 < v_2 + v_3 + \dots + v_m$.

- 3.3.1. Compare O_1 versus $O_2 + O_3 + \dots + O_{m-1}$.
- 3.3.1.1. If O_1 is preferred, adjust (if necessary) the values so that $v_1 > v_2 + v_3 + \dots + v_{m-1}$. Proceed to step 4.
- 3.3.1.2. If O_1 is equally preferred, adjust (if necessary) the values so that $v_1 = v_2 + v_3 + \dots + v_{m-1}$. Proceed to step 4.
- 3.3.1.3. If O_1 is preferred less, adjust (if necessary) the values so that $v_1 < v_2 + \dots + v_3 + \dots + v_{m-1}$.
- 3.3.1.3.1. Compare O_1 versus $O_2 + O_3 + \dots + O_{m-2}$, until either O_1 is preferred or is equal to the rest then proceed to step 4, or until the comparison of O_1 versus $O_2 + O_3$ is completed, then proceed to step 4.
4. Compare O_2 versus $O_3 + O_4 + \dots + O_m$ and proceed as in step 3.
5. Continue until the comparison of O_{m-2} versus $O_{m-1} + O_m$ is completed.
6. Convert each v_j into a normalized value v_j , dividing it by $\sum v_j$. Then $\sum v_j$ should be equal to 1.00.⁶⁸

With the list of objectives weighted in terms of relative importance (RI_i), the efficiency can be weighted for each course of action for each objective. The sum of the weighted efficiencies (WE_i)--efficiency x relative importance, of any course of action that is determined--can be measured in terms of total expected value (TEV),

where

$$TEV = \sum_{i=1}^n (RI_i) \cdot (WE_i)$$

$$i = 1, 2, 3, \dots, n.$$

"Delphi," A Consensus of Users' Opinion

To determine the relative worth (w_i) of an information source, the "Delphi" technique has proven to be an

⁶⁸C. West Churchman, Russel L. Ackoff and E. Leonard Arnoff, Introduction to Operations Research (New York: John Wiley and Sons, Inc., 1957), pp. 142-43.

effective means in the converging of users' opinions in value areas. This approach, developed at the Rand Corporation, has enabled users and/or experts to exercise their combined judgment and intuition in a well-defined manner as a single opinion on value questions. Helmer states:

There are many cases, however, where decisions have to be based, not on the results of theoretical analysis, but on the intuitive judgment of what ever experts on the particular issue are at hand. This may be so simple because no satisfactory theory has as yet been devised; it may also be because judgment must be sought as a matter of principle, because the issue under consideration may involve moral in addition to factual aspects, and thus preferences in addition to data.

Once we have recognized that reliance on expert opinion at times is unavoidable, we need to give some thought to the question of how to obtain such opinions most efficiently and most reliably.

The method I want to report on very briefly is a systematic procedure for obtaining the opinions and, if possible a consensus from a panel of experts on a particular issue. It was first designed many years ago here at Rand and has since aroused a good deal of interest both in this country and abroad and has been applied in universities as well as in government and industry. This method has become known, some what inadvertently, as the Delphi Technique. Like the ancient oracle, it has been employed to obtain opinions on what the future holds. But its scope is more general, in that it can be used in any context where it is appropriate to seek a consensus of opinions among experts on a particular subject.⁶⁹

"Delphi" Procedure

The "Delphi" procedure can be stated as a process for the controlled elicitation of group opinion by an iterative

⁶⁹Olaf Helmer, Systematic Use of Expert Opinion, in the Rand Collection (Santa Monica, Calif.: The Rand Corporation, November, 1967), pp. 1-2.

use of questionnaires. Each iteration is accompanied with a selective feedback of the previous group response as an informative input. This information is used for reference by the group members on the succeeding iteration.⁷⁰

The "Delphi" procedure has been designed to reduce the effect of those undesirable aspects of group interaction. The procedure has three distinctive characteristics:⁷¹

1. Anonymity.
2. Controlled feedback.
3. Statistical "group response."

Anonymity is a device to reduce the effect of the socially dominant individual. It is maintained by eliciting separate and private answers to prepared questions which are listed on a written questionnaire.

Controlled feedback is a device to reduce noise--that is, irrelevant or redundant material that obscures the directly relevant material offered by the participants. A "Delphi" exercise will consist of several iterations where the results of the previous iteration are "fed back" to the respondents, normally in summary form.

As a representative of the group opinion, some form of a statistical index is reported. For cases where the

⁷⁰Nicholas Rescher, Delphi and Values, in the Rand Collection (Santa Monica, Calif.: The Rand Corporation, September, 1969), p. 1.

⁷¹Norman C. Dalkey, Delphi, in the Rand Collection (Santa Monica, Calif.: The Rand Corporation, October, 1967), pp. 3-4.

group task is to estimate a numerical quantity, the median (m_i) of individual estimates turns out to be the most useful index tried to date. Thus, there is no particular attempt to arrive at unanimity among the respondents, and a spread of opinions on the final round is the normal outcome. This is a further device to reduce group pressure toward conformity.

The typical procedure consists of four rounds of questionnaires which ask for estimates of a set of numerical quantities. The results of the first round are summarized and the respondents are informed of the previous response distribution. This is done in terms of the median (m_i) and its so-called interquartile range ($Q_1 - Q_3$) --the interval containing the middle 50 percent of the response.

In round two, if a respondent's revised answer falls outside the interquartile range ($Q_1 - Q_3$), he is required to state briefly why he thought the event or value would occur that much earlier or less (or that much later or more) than the majority seemed to think. The effect of this places the individual in a position to justify relatively extreme opinions. Experiments in the past have shown those without strong convictions tend to move their estimates closer to the median (m_i), while those who felt they had a good argument for a divergent opinion tended to retain their original estimate and defend it.

In the third round the respondents are given a concise summary of reasons in support of extreme positions. They are asked to base any revision of their estimates on these reasons (after due consideration), giving them whatever weight they think is justified. Moreover, if a respondent's revised answer falls outside the new interquartile range ($Q_1 - Q_3$), he is further required to state again why his estimate falls outside the interval.

The fourth round is treated similarly, feeding these counter-arguments back to the entire group. This gives rise to one last change for re-estimating the value of the numerical quantity.⁷²

To insure the success of the "Delphi" technique, two critical factors must be recognized in order to obtain an acceptable measurement. They are: (1) the choice of experts to serve on the panel, and (2) the way in which the technique is implemented.⁷³ For these reasons, the top users in the organization will be selected for the panel of experts. Who else, except the user, has the best knowledge on what the value of information is worth to the organization, in view of its objectives, than the user himself? Quade concludes that:

⁷²Helmer, Use of Expert Opinion, pp. 3-4.

⁷³Robert M. Campbell and David Hitchin, "The Delphi Technique: Implementation in the Corporate Environment," Management Services (September - October, 1968), pp. 38-39.

For complex questions, intuition and judgment must continue to supplement systematic analysis, and as the questions get broader, this must happen to an increasing extent. To make such judgment and intuition most effective, a greater use of systematic techniques for the direct involvement of experts, in particular techniques like the Delphi process and its extension, seems inevitable.⁷⁴

Time Value of Money

After the information worth (w_j) has been determined through the consensus of users' opinion, both cost (c_j) and relative worth (w_j) of each information source can then be converted for the expected number of operational years and expected rate of return. This can be accomplished through the time valuation of money. By establishing the present worth value of the monies (c_j and w_j), at different rates of interest and years of operation, comparison of the optimum cost-effectiveness per year will indicate the operating levels of the information activities. The following equations that will perform this task are:

$$P(c_j) = c_j \left[\frac{1}{(1+i)^n} \right] \quad \text{and} \quad P(w_j) = w_j \left[\frac{1}{(1+i)^n} \right]$$

where

i = interest rate per interest period.

n = number of interest periods (months-years).

⁷⁴E. S. Quade, Cost-Effectiveness: Some Trends in Analysis, in the Rand Collection (Santa Monica, Calif.: The Rand Corporation, March, 1967), p. 18.

c_j = information source cost, n interest periods from present date that is equivalent to $P(c_j)$ with interest (i).

w_j = relative worth of the information source, n interest periods from present date that is equivalent to $P(w_j)$ with interest (i).

$P(c_j)$ = principal cost at a time regarded to be the present.

$P(w_j)$ = principal worth at a time regarded to be the present.⁷⁵

The rate of return and years of operation are predicted on management discretion to project their confidence of the information source. Based upon their knowledge and intuitive judgment, management must determine both factors --interest rate and years of information service--for the determination of the measure of performance.

Optimum Cost-Effectiveness Model

Our purpose is to develop a mathematical model that will ascertain the optimum cost-effectiveness for a given amount of information resource. Equation (1) will define the cost-effectiveness model, so that

$$(1) \quad V = f(c_j, w_j).$$

where V = the measure of performance or accomplishment that we seek to optimize.

c_j = the relative cost of the information source.

w_j = the relative worth of the information source

$j = 1, 2, 3, \dots, n.$

⁷⁵H. G. Thuesen, Engineering Economy (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1959), p. 55.

Thus far we have determined, through the total systems approach, the relative worth (w_j) and its information cost (c_j) per source (j). In order to solve for the measure of performance (V), the relative value (u_j) of source (j) must be determined. By definition, the relative value (u_j) is the value of the information source (j) as it relates to the relative worth (w_j) and its cost (c_j). The relationship is shown by equation (2), such that,

$$(2) \quad u_j = (w_j - c_j).$$

Hence, solving for the measure of performance (V), information source (j) will equal zero (0) when it has not been chosen for the optimum solution. But, if it has been selected as a candidate for the optimum solution, information source (j) will then be equal to (u_j). Therefore, to maximize (V), it is equivalent to optimizing X_0 . So that,

$$\text{Maximize } X_0 = \sum_{j=1}^n u_j x_j = u_1 x_1 + u_2 x_2 + u_3 x_3 + \dots + u_n x_n.$$

Subject to M constraints,

$$\sum_{j=1}^n a_{ij} x_j = b_i \text{ for } i = 1, 2, 3, \dots, m$$

and $x_j = 0$ or 1 for all j .

Where a_{ij} = amount of resource (i) used by the i^{th} information source.

b_i = amount of i^{th} resource available.

x_j = decision variable corresponding to information source no. 1, information source no. 2, etc.

The measure of performance (V) that we seek to optimize in the cost-effectiveness model can be obtained by varying the various resources available (b_i) in the optimization model. For example, the object is to vary (b_i) per fixed dollar unit starting from zero (0) cost of information to the cumulative amount of the total information resource costs. By varying resource (b_i) per optimization cycle, the optimum (z_i) per allocated dollars will be determined.

Performing the optimization cycle for a series of allocated monies, each cycle will yield an optimum point (z_i). Plotting the combined total of these optimum points on a graph, z_i versus b_i , a curve of a definite nature will form. Through incremental or marginal analysis a point will be determined that yields the measure of performance that is sought and defines those sources of information that are in the optimum solution.

Evaluation and Modification of Information

Upon completion of the optimization procedure, the information output is summarized in a tableau accompanied with the appropriate cost-effectiveness curves. These results are presented to management, recommending the optimum level of information activity. Management must assume the responsibility to evaluate the recommendation in light of its objectives before implementation.

If management feels that additional sources of information should be included in the study, then those new items of information must be evaluated by the "Delphi" technique to establish their relative worth. As soon as the relative worth and costs are determined for each source of information, this additional information is added to the original list and the cycle starts through the sequence of events.

If management decides to operate at a less efficient level with a lower rate of return, this is management's prerogative. But this level should be determined with the help of a systems analyst. If more than one alternative is being considered then a "Pay off" matrix in determining the total expected value will aid in selecting the alternative course of action.

It should be pointed out that the systems approach, to investigate the optimum cost-effectiveness, is basically a management tool. It is a device to add value to the user's decision-making ability and it should not be intended to replace his decision-making responsibility. Its ultimate goal is to aid the user in making a better decision.

Operation Code

In order to optimize the list of information resources that management requires for decision-making, integer programming was chosen as the optimizing technique after a

thorough investigation. The basis for this decision was predicated on the realization that, to optimize a set of information resources, either an information resource (e.g., a line of information or document) would entirely be in the optimum solution or it would be completely left out. When optimization occurs without placing an integer constraint on the decision variables ($x_j = 0$ or 1), any decision variable in the objective function could be less than one (1). Being pragmatic, less than a full line of information or even part of a document would hardly be in any practical sense an optimum solution.

In reviewing IBM's Program Information Library (SHARE) for an integer linear programming code whose variables are restricted to values of zero (0) or one (1), B. D. Holcomb's operational code was selected.⁷⁶ This code utilizes the well-known additive concept of Egon Balas and backtracking scheme of F. Glover. In addition, a group of user-selected heuristic test options are included in the design to speed solution time. Holcomb's code as compared to Lemke and Spielberg in a standard test problem showed a significant reduction in operational running time.⁷⁷

⁷⁶B. D. Holcomb, Zero-One Integer Programming with Heuristics, IBM Contributed Program Library (SHARE) (Published by IBM for users reference, IBM Corp. No. 360D-15.2.011, Dec., 1968), pp. 1-13.

⁷⁷B. D. Holcomb, An Implementation of a Zero-One Integer Programming Algorithm (Union Carbide Corporation Nuclear Division, No. CTC-3, Sep. 6, 1968), pp. 1-21.

In a test situation Lemke's code--Spielberg's code was involved--proved to be superior to the codes of F. Balas, Haldi, and W. Arcuri of IBM.⁷⁸ These test results compared more factual and up-to-date problems than the research done by Trauth and Woalsey.⁷⁹

⁷⁸Lemke and Spielberg, Direct Search Zero-One Integer Programming 1-DZipl, IBM Contributed Program Library (SHARE) (Published by IBM for users reference, IBM Corp. No. 360D-15.2.001, May, 1966), pp. 1-36.

⁷⁹Trauth and Woalsey, Practical Aspects of Integer Linear Programming (Sandia Corporation, Monograph SC-R-66-925, August, 1966), pp. 1-15.

CHAPTER V

MODEL APPLICATION AND EVALUATION

In order to determine the validity of the cost-effectiveness model, a real-world application was chosen. This was done inasmuch as it would render a challenge and reinforce the feasibility of the total systems approach.

Upon recommendation from the dissertation committee, Mercy Hospital at Oklahoma City, Oklahoma, was chosen as a prime candidate for the cost-effectiveness study. Mercy's administrators approved the request and were elated about the proposed research study. Their cooperation and understanding has added unprecedented research value in the development and application of a total systems methodology for investigating the optimum cost-effectiveness of a management information system.

Establishing the Objectives for the Cost-Effectiveness Study

In reviewing the objectives of this cost-effectiveness study with Mercy's top management, the Executive Director felt that it could best serve Mercy by examining the information utilized by the Executive Committee. This committee

functions at the executive level and is comprised of the top echelons of management (Fig. 10). The Executive Committee's primary function is to serve as a decision-making body for Mercy, and its secondary function serves for general information.

In order for the committee to perform at its optimum level, all of its members must be cognizant of certain types of information which are utilized by all of its members. This information is vital for each member so as to enable him to carry out his decision-making role. For this reason, the Executive Director preferred that the panel members selected for the cost-effectiveness study consist of the members on the Executive Committee.

Discussing with the Administrator and Associate Administrator some of their information problems, a general opinion seemed to prevail. This opinion was augmented by the fact that as management becomes more sophisticated its needs for more and different kinds of information become evident. Moreover it was expressed that some of the information documents actually have no real value to them as compared to other documents which they feel assist them explicitly in their decision-making.

The Associate Administrator viewed his opinion by advocating that too much information was being circulated over his desk and this was a deterrent in performing his job. In discussing the criteria for the cost-effectiveness

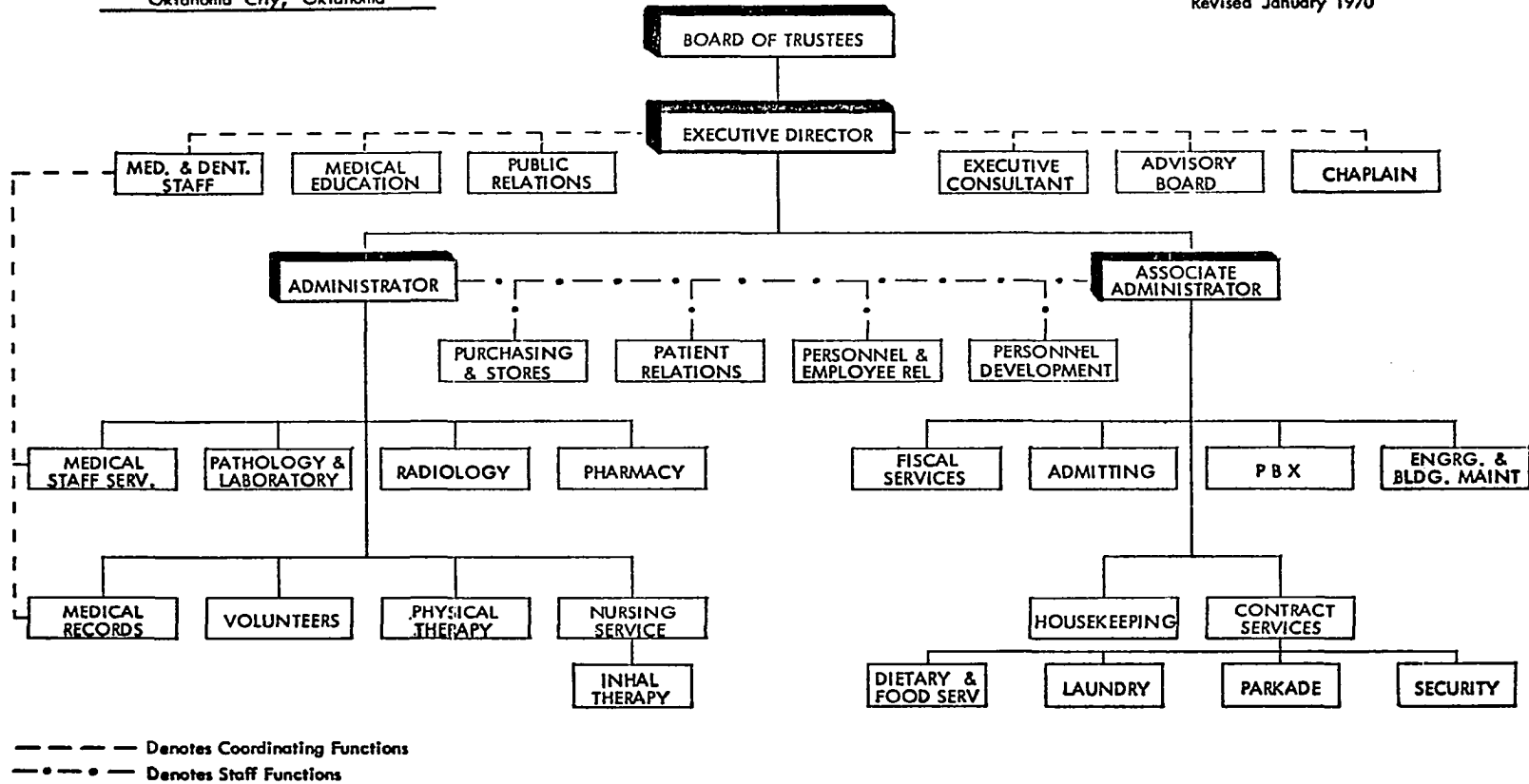


Fig. 10.--Mercy Hospital Organizational Chart.

study, the Associate Administrator requested that the objective of the study be to determine a break-even point which depicts the maximum information documents that are in the optimum solution and those that are not. Agreeing to the ground rules, the study commenced.

Orientation Period

To gain a better insight into the hospital operations, two weeks were spent in discussing and evaluating the fifty-six information documents that were essential for each panel member in their decision-making role. A majority of this information was collected over the past year by a group of industrial engineers who were performing systems studies. The information collected on each source document was comprised of: the recipient of the information, data source or where it was generated, and the frequency of use. The one item that was not obtained, though pertinent to the study, was the purpose for each information source as it related to the user's function.

Each panel member who was selected by the Executive Director was interviewed for a brief period of time. He was asked to write down in no more than two sentences the purpose of each information document as it relates to his job. In some cases the purpose had no meaning to the individual and in other cases the panel member was not even cognizant of the document.

Each panel member was than asked to write down the objectives of Mercy and attach to it his definition as to the purpose of each information document. This information was picked up after it had been completed. Each member was cautioned not to use his department sub-objectives --but the overall objectives of Mercy. In most cases each panel member already had an updated objective list which he removed from his files and presented to the writer. It was very enlightening to see that Mercy's objectives had been established and put down in writing. The next phase of the study was to discuss the ranking and determination of the relative importance for each objective with the Executive Administrators.

Organizational Objectives

In order to rank and determine the relative importance for each objective, a group was chosen comprised of the Executive Director, Administrator, and Associate Administrator. While reviewing the objectives with the three administrators it became quite evident that the Hospital's philosophy was included in the objectives. For a brief time the philosophy and objectives were discussed and an agreement to remove the philosophy was then advised. The objectives were then ranked in order of preference (Appendix I) by the Executive Director. The following day, the same group was assembled in order to determine the relative importance of each objective. The procedure specified by

Churchman (Appendix I) shows the results of this effort. Objective one dominates approximately 57 percent of the relative importance of the total percentage weight. Although objective one has three sub-groups, the administrators did not want to distinguish between these three. They felt that all three sub-groups made up the total sum of objective one.

Objective three's position in the ranked order proved to be inconsistent, viewed from its relative importance of 17.9 percent, to objective two's 14.7 percent. This one factor proved the value of a group response in the determination of the relative importance as compared to the ranking of one individual.

The sum total of percentage weights for objectives 2, 3, and 4, depicts less importance than objective one, but their values are still pertinent to the overall goals of the Hospital.

"Delphi" Application

The next phase in the cost-effectiveness study was to determine the relative worth for each information document in terms of dollars per year on the executive level. This information was placed on a questionnaire which consisted of a total of seventy-two documents in a question and answer format. Of the seventy-two documents, fifty-six existed in the present management information system and sixteen new documents were added for consideration.

Each panel member was notified as to the time and date he would receive a Part I package and the significance of his role in the information study (Appendix II). When each panel member received his Part I package, which consisted of instructions, objectives, and a Part I questionnaire, he was asked to read the instructions and inquire about any questions that he did not understand. On page two at the bottom of the instruction sheet a list of the start and completion dates were listed and as soon as he understood the instructions he was to begin. The following morning after each panel member had completed his questions, each questionnaire was picked up. This was the precedent that was established for the remaining three parts of the study.

As soon as the Part I questionnaire was picked up the statistics were generated from the available data. The relative worth for each document was calculated and arranged on a statistical work sheet listed in order of low quartile, median, and high quartile. The feedback was attached to a Part II package (Appendix II) and presented that afternoon to each panel member. This time the instructions stated that if any revised answer fell outside the quartile range to list its relative worth on a separate sheet of paper, with its reason in no more than two sentences. The second morning, the Part II questionnaire was picked up and the statistics were calculated as before. The Part III package

(Appendix II) now consisted of an instruction sheet, objectives, combined comment sheet, a statistical work sheet, and the Part III questionnaire. The same procedure was maintained for Part IV package (Appendix II) until the completion of the study.

The "Delphi" procedure consisted of four completed cycles of questionnaires with controlled feedback, anonymity, and statistical group response.

Costs Determination

Concurrent to the "Delphi" procedure being administered, all costs per document were being explored for both tangible and intangible considerations. To some extent, all costs were based on actual numbers and the Associate Administrator's best guess. The method of arriving at a composite cost figure per document was by no means exact and could have some definite skewing effects on the outcome of the study. But these estimates were the best cost figures that the Mercy administrators had at their disposal. In addition to the existing documents the same method for cost determination was applied for the sixteen new source documents that were being considered in the study (Appendix IV gives cost per document).

Application of the Optimum Cost-Effectiveness Model

In order to determine the optimum cost-effectiveness of the seventy-two documents in Mercy's management information

system, a mathematical model was formulated in chapter IV and expressed by the general equation:

$$(1) \quad V = f(c_j, w_j)$$

where V = the measure of performance or accomplishment that we seek to maximize.

c_j = the cost of the information document.

w_j = the relative worth of the information document.

$j = 1, 2, 3, \dots, n.$

Using the "Delphi" technique as the vehicle to obtain the relative worth for each of the information documents and concurrently determining their costs, the relative value (u_j) per information document can be calculated. The general relationship is expressed by equation (2):

such that

$$(2) \quad u_j = (w_j - c_j).$$

The calculations for determining the relative value for each of the seventy-two documents that are listed on the Part IV questionnaire are shown in Appendix IV. These values are the resultant of the expressed equation (2).

Therefore, to solve for the measure of performance (V) that is to be maximized is equivalent to optimizing X_0 (Fig. 11). The applied optimization equation depicts seventy-two different information documents that are potential candidates for the optimum solution. Each candidate is judged by the optimization equation on its cost and relative value relationship, but with a 0-1 constraint.

Maximize

$$x_0 = \sum_{j=1}^{72} u_j x_j = 207x_1 + 340x_2 + 185x_3 + 100x_4 + 30x_5 + 58x_6 + 26x_7 + 64x_8 + 26x_9 + 155x_{10} + 6x_{11} + 37x_{12} + 24x_{13} + 50x_{14} + 90x_{15} + 50x_{16} + 10x_{17} + 52x_{18} + 0x_{19} + 44x_{20} + 60x_{21} + 20x_{22} + 40x_{23} + 9x_{24} + 40x_{25} + 370x_{26} + 180x_{27} + 250x_{28} + 250x_{29} + 30x_{30} + 20x_{31} + 20x_{32} + 10x_{33} + 40x_{34} + 5x_{35} + 45x_{36} + 10x_{37} + 40x_{38} + 40x_{39} + 40x_{40} + 60x_{41} + 500x_{42} + 30x_{43} + 40x_{44} + 22x_{45} + 42x_{46} + 6x_{47} + 10x_{48} + 157x_{49} + 400x_{50} + 70x_{51} + 90x_{52} + 38x_{53} + 88x_{54} + 38x_{55} + 20x_{56} + 70x_{57} + 109x_{58} + 500x_{59} + 70x_{60} + 9x_{61} + 40x_{62} + 40x_{63} + 9x_{64} + 9x_{65} + 89x_{66} + 90x_{67} + 64x_{68} + 3x_{69} + 45x_{70} + 24x_{71} + 15x_{72}$$

Subject To:

$$150x_1 + 250x_2 + 100x_3 + 50x_4 + 20x_5 + 12x_6 + 4x_7 + 6x_8 + 4x_9 + 60x_{10} + 4x_{11} + 3x_{12} + 6x_{13} + 50x_{14} + 10x_{15} + 100x_{16} + 6x_{17} + 8x_{18} + 100x_{19} + 6x_{20} + 40x_{21} + 10x_{22} + 10x_{23} + 1x_{24} + 10x_{25} + 30x_{26} + 100x_{27} + 50x_{28} + 150x_{29} + 20x_{30} + 10x_{31} + 10x_{32} + 40x_{33} + 60x_{34} + 5x_{35} + 5x_{36} + 20x_{37} + 60x_{38} + 10x_{39} + 60x_{40} + 10x_{41} + 300x_{42} + 20x_{43} + 60x_{44} + 8x_{45} + 8x_{46} + 4x_{47} + 40x_{48} + 60x_{49} + 300x_{50} + 30x_{51} + 10x_{52} + 12x_{53} + 12x_{54} + 12x_{55} + 10x_{56} + 10x_{57} + 10x_{58} + 300x_{59} + 10x_{60} + 1x_{61} + 10x_{62} + 10x_{63} + 1x_{64} + 1x_{65} + 11x_{66} + 10x_{67} + 6x_{68} + 6x_{69} + 5x_{70} + 6x_{71} + 5x_{72} = b_i$$

For $i = 50, 100, 200, \dots, 2950$ And $x_j = 0$ or 1 for all j .

Note: All constants must be multiplied by (1×10^2) .

Fig. 11.--Applied Optimization Equation

Utilizing a 0-1 integer linear constraint the decision variable (x_j) is either in the optimum solution or completely out of solution.

The objective of the Mercy Hospital Study, set by the administrators, was to determine a break-even point --a point that predicates the total amount of resource dollars that render a dollar relative value for a dollar allocated and the maximum documents that are in the optimum solution. In an attempt to isolate this point, the allocated resource (b_i) has been varied from 0 to \$295,000 --the maximum range--to ascertain the break-even point. In varying the allocated resource (b_i) at \$1,000 increments, a composite of optimization points were obtained. Plotting these points on a graph, optimum relative value (z_i) versus allocated dollars (b_i), a curve was formed (Fig. 12).

Examining this curve, it became quite evident that a conventional break-even analysis was not applicable since the dollar resource per cycle allocated is returning at least 200 percent in relative value. The approach that was used to bridge this gap was incremental analysis. For this reason the criteria for the break-even point was re-defined as the point in which the delta change in allocated dollar resource per cycle (Δb_i) divided by the delta change in the optimum relative value (Δz_i) was equal to one. In essence, when a dollar change in the allocated resource equals a

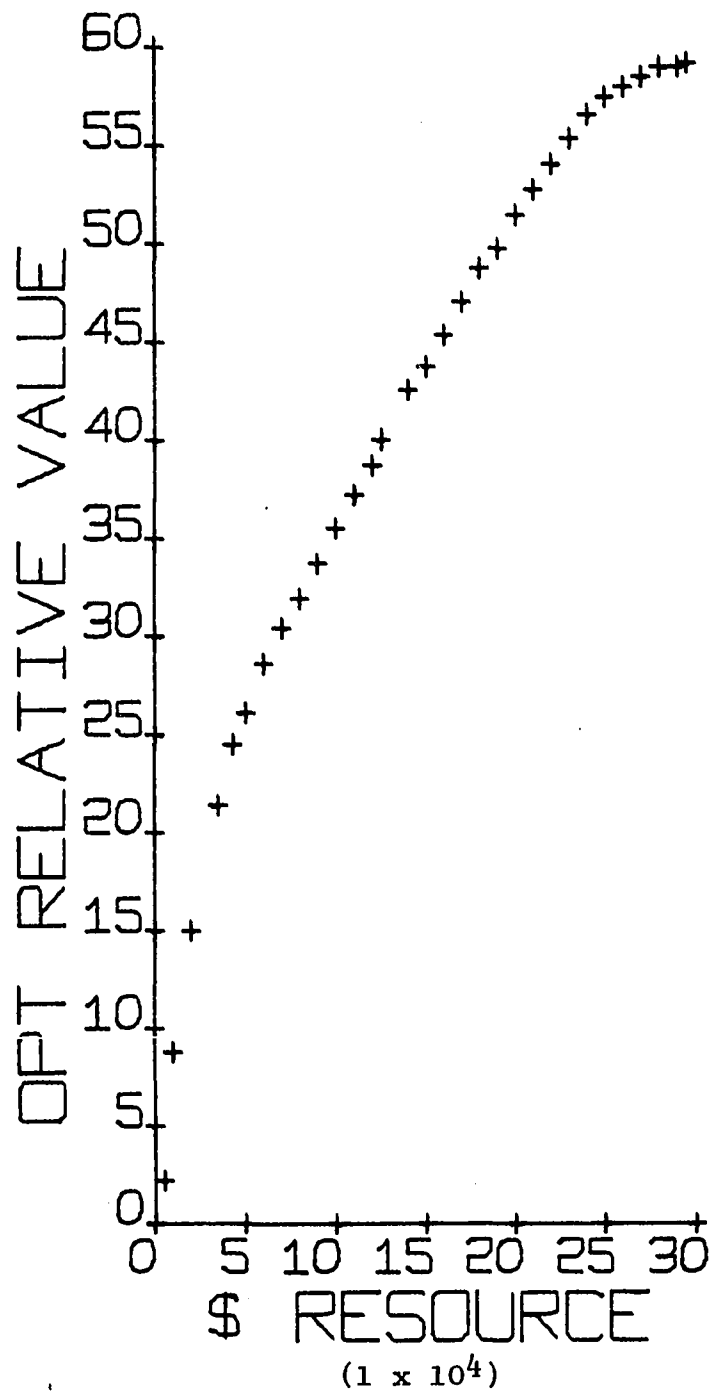


Fig. 12.--Optimum Relative Value Versus Dollar Resource

dollar change in the optimum relative value, we have determined a break-even point and the measure of performance (V) that we seek for the cost-effectiveness model.

In order to ascertain the upper and lower limits that the break-even point falls within, the allocated dollar resource per cycle (b_i) was listed in a descending order from \$295,000 to \$190,000. Table 1 depicts the incremental analysis approach and column (5) shows the method of arriving at the break-even point.

Viewing column (5) we see that the break-even point (by re-definition, the break-even point equals one: $\frac{\Delta b_i}{\Delta z_i} = 1$) falls within \$240,000 and \$230,000. To ascertain the break-even point, a step down analysis between these two dollar figures can be determined. By varying each allocated dollar resource per cycle (b_i) from \$234,000 to \$240,000 as shown in Table 2, we are able to view the break-even point in column (5). The break-even point can either be \$238,500 or \$239,000 depending upon management discretion. The reason for either of the two allocated resources (b_i) to be considered as the break-even point is because of document thirty-five (Appendix IV). Document thirty-five adds an equal amount of cost (\$500) as relative value (\$500) which basically neutralizes its effect on the solution. The delta change is not effected by this equal amount but only adds additional resource dollars per cycle.

TABLE 1

DETERMINATION OF THE UPPER AND LOWER

LIMITS FOR b_i , WHERE $\frac{\Delta b_i}{\Delta z_i} = 1$

(1) Allocated dollar resource per cycle *	(2) Delta change in dollar resource *	(3) Optimum relative value per cycle *	(4) Delta change in relative value *	(5) Delta change in (2) per delta change in (4)
b_i	Δb_i	z_i	Δz_i	$\Delta b_i/\Delta z_i$
2950	50	5908	19	2.67
2900	100	5889	0	∞
2800	100	5889	50	2.00
2700	100	5839	50	2.00
2600	110	5789	71	1.55
2490	90	5718	70	1.29
----- 2400	----- 100	----- 5648	----- 119	----- .84
----- 2300	----- 100	----- 5529	----- 127	----- .78
2200	100	5402	133	.75
2100	100	5269	140	.72
2000	100	5129	167	.65
1900		4962		

*multiply by (1x10²)

TABLE 2

DETERMINATION OF b_i , WHERE $\frac{\Delta b_i}{\Delta z_i} = 1$

(1) Allocated dollar resource per cycle *	(2) Delta change in dollar resource *	(3) Optimum relative value per cycle *	(4) Delta change in relative value *	(5) Delta change in (2) per delta change in (4)
b_i	Δb_i	z_i	Δz_i	$\Delta b_i/\Delta z_i$
2400		5648		
----- 2390	----- 10	----- 5639	----- 9	----- 1.11
2385	5	5634	5	1.00
----- 2380	----- 5	----- 5629	----- 5	----- 1.00
2370	10	5618	11	.91
2340	30	5584	34	.74

*multiply by (1×10^2)

In reviewing the objective of this study, the break-even point was to include the maximum number of documents in the optimum solution thus determining \$239,000 as the measure of performance of the cost-effectiveness study. The cost-effectiveness model also has determined the documents that are in the optimum solution and those that are not. This information has been listed in Appendix V as a matter of convenience. In addition to the break-even point and its optimum solution, the optimum relative value (z_i) for the allocated resource (b_i) per cycle ranging from \$190,000 to \$295,000 are included with their optimum solution. A sample of the computer printout for one optimization point has been placed in Appendix VI, for convenience.

Evaluation of Results

Prior to presenting the results of the cost-effectiveness study to Mercy's administrators, the Associate Administrator was asked to rank the information documents in order of importance from 1 to 72. This was requested primarily to serve as a yardstick for evaluation of the study's results. Although this information was not obtained by group opinion it still served as an informal yardstick. Table 3 shows the results of this effort by depicting the rank order of the information documents and those that are not in the optimum solution.

Discussing the results of the study with the Mercy administrators, the documents not in solution were compared

TABLE 3

RANKED ORDER OF THE INFORMATION DOCUMENTS

Document	Rank	Document	Rank	Document	Rank
1	11	31	14	61	41
2	10	32	14	62	41
3	12	*33	14	63	39
4	15	*34	14	64	40
5	16	35	33	65	40
6	16	36	14	66	40
7	16	*37	20	67	40
8	16	*38	17	68	40
9	16	39	17	*69	40
10	9	*40	17	70	40
11	33	41	17	71	40
12	33	42	2	72	40
13	29	43	28		
14	23	*44	27		
15	25	45	34		
*16	22	46	34		
17	30	*47	36		
18	30	*48	31		
*19	30	49	8		
20	30	50	5		
21	24	51	6		
22	42	52	32		
23	35	53	21		
24	43	54	21		
25	19	55	21		
26	18	*56	21		
27	13	57	37		
28	3	58	7		
29	4	59	1		
30	26	60	38		

*not in the optimum solution for the break-even point.

with their ranking as shown in Table 3. Document thirty-three, Room Availability, and document thirty-four, Daily Occupancy Report, were ranked in order of 14, but they were not in the optimum solution. It was discussed that the reason for this was due to the timing of the two documents. These reports are the result of a 12:00 A.M. data processing run. When these reports arrive in the Administrator's office they are approximately eight to ten hours old. It was felt that this area should be reviewed and recommended for a systems study.

Document forty-eight, "HAS" comparative study, also was out of solution, and the general finding concluded that this information is nice to know, but it does not tell the administration why its hospital has different cost figures than others in the same area. The Associate Administrator felt that this outside service could be dropped or utilized every six months.

A feeling of indecision was expressed about the other documents that were out of solution and existed in the present management information system. But these comments would be held until additional studies could be made for corrective action.

The results of the new documents were not surprising --all but document sixty-nine were found in the optimum solution. These results showed that the need for new and additional types of information are required by the

progressiveness of Mercy's management. From this study the results positively showed that Mercy's management needs new and additional types of information to function optimally.

The question was raised about time value of money being applicable to the information value and cost. The Associate Administrator felt that due to their dynamic restructuring in their management hierarchy that the validity of this information would only be good for a short period of time.

In general, the finding of this study seemed to parallel certain basic opinions that Mercy's management already surmised on certain basic documents but were not cognizant of the group opinion. To this extent the evaluation of the study was considered a success. Although the findings are still being reviewed by Mercy's administrators, some administrators are still asking themselves, why is this document in the optimum solution and this one is not? The only real or valid answer falls within the subjectiveness of each of the panel members. Based upon their knowledge, experience, and ability as managers, the composite of their group opinion has predicated the outcome of the Mercy Hospital Study.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

This dissertation has demonstrated that a methodology to investigate the optimum cost-effectiveness of a management information system can be meaningfully formulated. Basically, this formulation provides a design that will not only aid management in making better decisions that are goal-oriented, but it also will serve as a tool to investigate long-term capital commitment a priori. In addition to its predictability, the cost-effectiveness design has the ability to determine the optimum amount of information that can be obtained within an allocated amount of resource and those information sources that are in the optimal solution. Its versatility has been depicted in the Mercy Hospital Study, in which the methodology of the design criteria was applied not only to an a priori management information system but an ab priori as well.

This methodology has combined the most modern management techniques and operation research tools found in the latest research literature. For example: the "Delphi" technique, used for many years in determining the consensus

of group opinion, integer linear programming to ascertain the optimum solution constrained by limited capital, and incremental analysis to determine the cost-effectiveness or break-even point. These are the composite inputs that are the basic building blocks that make this approach so meaningful.

This concept is new and adds a fresh approach to value judgment in determining the user's needs in the management information system. The writer feels that this is a first step in a new era--an era of value judgment, the decision-maker as the designer, the decision-maker fulfilling his decision-making role, and the decision-maker controlling the vehicle for his own destiny.

In performing the cost-effectiveness study, there are several recommendations that should be adhered to for future research in this area. One of the most essential criteria is to select individuals for the "Delphi" procedure who are competent and knowledgeable to serve as panel members. This in itself seems to be very difficult. A screening method or testing procedure should be devised to ascertain those individuals whose qualifications or credentials appear to be best suited for panel membership. The writer can not stress this point enough since it is so important to the success of the panel study.

To avoid skewing of the study's outcome, information costs should be the second most important consideration.

The difficulty lies in the fact that in order to apply the methodology of the cost-effectiveness model, costs are the responsibility of management. If management's costing technique is outdated, then the responsibility should be shared with the systems analyst to determine the tangible and intangible cost considerations. It is, therefore, pertinent to apply future research in the cost-determination area.

Upon reviewing the computer output, it became apparent that certain documents in the optimum solution had identical costs and relative values. A more intense survey pointed out that documents 24, 61, 64, and 65 had the same relationship. This relationship had no apparent effect since all documents were in the optimum solution. While in this study there was not a negative reaction due to this oversight, it is, however, recommended that a priority numbering procedure be established for all documents whose costs and relative values are identical. In this manner the operation code will select documents in a priority sequence instead of a first-come-first-serve basis.

To evaluate the results of a cost-effectiveness study, a method of ranking should be implemented. Although in this study one individual did rank the documents from 1 to 72, this only served as an informal yardstick and was by no means the group opinion of the document's rank. It is, therefore, recommended that future investigation should incorporate into the cost-effectiveness model, a procedure for ranking to insure a method of evaluation.

Information which is the essence of today's decision-making process is a resource that possesses utility. Each user's utility function vacillates with the information that is goal-oriented for managerial decision-making. The ability of management to predict, a priori, the worth of this information in respect to costs will enable it to ascertain the optimum information per allocated dollar prior to capital commitment. Simon states in his book, that

the accuracy of our prediction will depend less upon forecasting exactly the course of change than upon assessing correctly which factors are the unmoved movers and which the equally unmoved invariants. The growth in human knowledge is the primary factor that will give the system its direction--in particular, that will fix the boundaries of the technologically feasible. The growth in real capital is the major secondary factor in change--within the realm of what is technologically feasible, it will determine what is economical.⁸⁰

There is no question that with man's inherent ability to assess the boundaries of the unknown, with desire, and with capital resources, he will move the unmoved and ascend to what is "technologically feasible."

⁸⁰ Simon, Automation for Men and Management, p. 29.

SELECTED BIBLIOGRAPHY

Books

- Allen, C. L. The Framework of Price Theory. Belmont: Wadsworth Publishing Company, 1967.
- Anthony, Robert N. Planning and Control Systems: A Framework for Analysis. Cambridge, Mass.: Harvard University Press, 1965.
- Arnoff, Leonard E. and Sankar, Sengupa. "Mathematical Programming." Vol. I: Progress in Operations Research. New York: John Wiley and Sons, Inc., 1961.
- Barnard, Chester R. The Function of the Executive. Cambridge, Mass.: Harvard University Press, 1938.
- _____. Organization and Management. Cambridge, Mass.: Harvard University Press, 1948.
- Bellman, R. E. Dynamic Programming. Princeton: Princeton University Press, 1957.
- Bellman, R. E. and Dreyfus, S. E. Applied Dynamic Programming. Princeton: Princeton University Press, 1962.
- Bellman, R. E. and Kalaba, Robert. Dynamic Programming and Modern Control Theory. New York: Academic Press, 1965.
- Brown, George. "An Interuniversity Information Network." Electronic Handling of Information; Testing and Evaluating. London: Academic Press, 1967.
- Brown, Wilfred. Exploration in Management. New York: John Wiley and Sons, Inc., 1960.
- Bryant, Edward. "Modeling in Document Handling." Electronic Handling of Information; Testing and Evaluating. London: Academic Press, 1967.

- Chorafas, Dimitris N. Control Systems Functions and Programming Approaches. New York: Academic Press, 1966.
- Churchman, C. West; Ackoff, Russel L.; and Arnoff, E. Leonard. Introduction to Operations Research. New York: John Wiley and Sons, Inc., 1957.
- Corrigan, Robert and Kaufman, Roger. Why Systems Engineering. Palo Alto, Calif.: Fearon Publishers, 1966.
- Dale, Ernest. Reading in Management. New York: McGraw-Hill, 1965.
- Dantzig, G. B. Linear Programming and Extensions. Princeton: Princeton University Press, 1963.
- Dean, Burton V.; Sasieni, Maurice W.; and Gupta, Shiv K. Mathematics for Modern Management. New York: John Wiley and Sons, Inc., 1963.
- Dreyfus, Stuart. "Dynamic Programming." Progress in Operation Research. New York: John Wiley and Sons, Inc., 1961.
- Drucker, Peter F. "Managing the Educated." Management's Missions in a New Society. New York: McGraw-Hill, 1965.
- Fayol, Henri. General and Industrial Management. Translated by Constance Storrs. London: Sir Isaac Pitman and Sons, Ltd., 1949.
- Jaques, Elliott and Brown, Wilfred. Glacier Project Papers. London: Heinemann Educational Books, Ltd., 1965.
- Kent, Allen. "Centralization, Decentralization and Specialization--A Problem of Resource Allocation." Electronic Handling of Information; Testing and Evaluating. London: Academic Press, 1967.
- Lavi, Abraham and Vogl, Thomas P. Decent Advances in Optimization Technique. New York: John Wiley and Sons, Inc., 1966.
- Lewis, Verne B. "Toward A Theory of Budgeting." Planning Programming Budgeting. Chicago: Markham Publishing Company, 1967.
- March and Simon. Organization. New York: John Wiley and Sons, Inc., 1958.

- Mertin, Robert K. A Reader in Bureaucracy. New York: The Free Press of Glencoe, 1952.
- Nemhauser, George L. Introduction to Dynamic Programming. New York: John Wiley and Sons, Inc., 1966.
- Novick, David. Program Budgeting. Cambridge: Harvard University Press, 1965.
- Pierre, Donald A. Optimization Theory with an Application. New York: John Wiley and Sons, Inc., 1969.
- Pun, Lucas. Introduction to Optimization Practice. New York: John Wiley and Sons, Inc., 1969.
- Rosove, Perry E. Developing Computer-Based Information Systems. New York: John Wiley and Sons, Inc., 1967.
- Sasieni, Maurice; Yaspan, Arthur; and Friedman, Lawrence. Operation Research--Methods and Problems. New York: John Wiley and Sons, Inc., 1961.
- Simon, Herbert A. The Shape of Automation for Men and Management. New York: Harper and Row, 1965.
- Thuesen, H. G. Engineering Economy. Englewood Cliffs, N.J.: Prentice-Hall, 1959.
- Urwick, Luther. The Elements of Administration. New York: Harper and Brothers Publishers, 1943.
- Vickery, B. C. On Retrieval System Theory. London: Archon Books, 1965.
- Weber, Max. The Essentials of Bureaucratic Organization: An Ideal-Type Construction. New York: Free Press of Glencoe, 1952.
- Wilde, Douglass J. Optimum Seeking Methods. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1964.

Journals

- Beged-Dov, Aharon G. "An Overview of Management Science and Information Systems." Management Science, Vol. XIII, No. 12 (August, 1967), p. B-817.
- Campbell, Robert M. and Hitchin, David. "The Delphi Technique: Implementation in the Corporate Environment." Management Services (September-October, 1968), pp. 38-39.

- Champanis, Alphonse. "On the Allocation of Function Between Men and Machines." Occupational Psychology, XXXIX (January, 1965), 1-11.
- Day, Melvin. "Factors in Building an Operations Information Program." Journal of Chemical Documents (May, 1967), pp. 107-9.
- Daniel, Ronald. "Management Information Crisis." Harvard Business Review (May, 1961), p. 112.
- Dickson, G. W. "Management Information-Decision Systems." Business Horizons (December, 1968), p. 18.
- Emery, J. C. "Management Information Systems." Progress in Operation Research, Vol. III, No. 16 (1968), p. 493.
- Fields, David S. "Cost/Effectiveness Analysis." Operation Research, Vol. XIV, No. 3 (May-June, 1966), p. 515.
- Gulick, Luther and Lyndall. "Papers on the Science of Administration." Institute of Public Administration, p. 137.
- Head, Robert V. "Management Information Systems. A Critical Appraisal." Datamation (May, 1967), p. 24.
- Hirsch, Rudolph B. "The Value of Information." The Journal of Accountancy (June, 1968), pp. 41-45.
- Morton, Jack A. "A System Approach to the Innovation Process." Business Horizons (Summer, 1967), pp. 157-58.
- Novick, David. "Long-Range Planning Through Program Budgeting." Business Horizons (February, 1969), p. 62.
- Optner, Stanford. "System Analysis for Business and Industrial Problem Solving." Prentice-Hall International Series in Industrial and Management Science (1966), p. 116.
- Rhind, Ridley. "Management Information Systems." Business Horizons (June, 1968), pp. 37-40.
- Rothery, Brian. "The Limits of Systems Analyses." Data Processing Magazine (January, 1967), pp. 38-39.
- Simmons, W. W. "The Keystone of the Management Systems." Long Range Planning (September, 1968), pp. 2-8.

- Stuart, Senter. "Optimization--It Can Pay Off." Business Automation (March, 1966), p. 46.
- Temmer, Harold. "Topless Management or the Anatomy of Data Systems." College and University, Vol. XLIV, No. 3 (Spring, 1969), p. 213.
- Tucci, Valerie A. and Horrocks, Norman. "User-Oriented Information System." American Documentation (July, 1969), pp. 279-80.
- Williams, William L. "Undergrowth in the Management Theory Jungle." Business Horizons (February, 1969), p. 56.

Bulletins and Pamphlets

Miscellaneous

- Dalkey, Norman C. Delphi. Rand Collection. Santa Monica, Calif.: The Rand Corporation, October, 1967.
- Hatry, Harry P. and Cotton, John F. "Program Planning for State, County, City." State-Local Finances Project. Washington, D.C.: The George Washington University (January, 1967), p. 38.
- Helmer, Olaf. Systematic Use of Expert Opinion. Rand Collection. Santa Monica, Calif.: The Rand Corporation, November, 1967.
- Holcomb, B. D. Zero-One Integer Programming with Heuristics. IBM Contributed Program Library (SHARE). Published by IBM for users reference, IBM Corp. No. 360D-15.2.011, December, 1968.
- . An Implementation of a Zero-One Integer Programming Algorithm. Union Carbide Corporation Nuclear Division, No. CTC-3, September 6, 1968.
- Lemke and Spielberg. Direct Search Zero-One Integer Programming 1-DZipl. IBM Contributed Program Library (SHARE). Published by IBM for users reference, IBM Corp. No. 360D-15.2.001, May, 1966.
- Meise, Norman. "Analysis of Selected Operations Problems in a Library System." Bulletin of the Operations Research Society of America, Vol. XV, Supplement 1 (Spring, 1967), p. B55.

- Novick, David. The Role of Quantitative Analysis and the Computer in Program Budgeting. Rand Collection. Santa Monica, Calif.: The Rand Corporation, October, 1967.
- Quade, E. S. Some Problems Associated with Systems Analysis. Rand Collection. Santa Monica, Calif.: The Rand Corporation, June, 1966.
- _____. Cost-Effectiveness: Some Trends in Analysis. Rand Collection. Santa Monica, Calif.: The Rand Corporation, March, 1967.
- Rescher, Nicholas. Delphi and Values. Rand Collection. Santa Monica, Calif.: The Rand Corporation, September, 1969.
- Trauth and Woalsey. Practical Aspects of Integer Linear Programming. Sandia Corporation, Monograph SC-R-66-925, August, 1966.
- Watson, R. D. "Management Centralization-Decentralization Syndrome." Unpublished paper (April, 1968).

APPENDIX I

DETERMINATION OF THE RANK AND RELATIVE IMPORTANCE OF MERCY HOSPITAL OBJECTIVES

Listed below is the final rank of the hospital objectives in accordance with the management of Mercy Hospital. Subsequently, the ranked objectives were utilized to calculate the relative importance of each objective.

Ranked Objectives

1. To optimize total cost per day for maximum patient care, at a quality level of performance.
 - a. To provide an atmosphere or climate for the inducement of doctors to utilize hospital facilities.
 - b. To provide a work environment which will enable the employee to perform assigned duties at his highest level of efficiency and effectiveness.
 - c. To provide educational programs whereby employees may improve job skills and develop their potential.
2. To cooperate with institutions of higher learning providing facilities for the education of physicians and allied health professionals.
3. To cooperate with community agencies in community wide planning.
4. To participate in research, in the promotion of health, and in the prevention of disease according to available resources.

Relative Importance Calculations

Objectives in Rank Order

	Tentative Value	Value Change by Decision No. 4	Value Change by Decision No. 5	Value Change by Decision No. 6	Normalized
$O_1 = v_1 = 1.0$		1.3	1.6	1.6	$1.6/2.8 = .57$
$O_2 = v_2 = .7$.7	.7	.4	$.4/2.8 = .147$
$O_3 = v_3 = .5$.5	.5	.5	$.5/2.8 = .179$
$O_4 = v_4 = .3$.6	.2	.3	$.3/2.8 = .104$
				Total 2.8	

<u>Decision No.</u>	<u>Comparison</u>	<u>Decision Yes-No</u>		<u>Majority Decision</u>
1.	$O_1 > O_2$	3	0	Yes
2.	$O_1 > O_3$	3	0	Yes
3.	$O_1 > O_4$	3	0	Yes
4.	$O_1 > O_2 + O_3$	2	1	Yes
5.	$O_1 > O_2 + O_3 + O_4$	2	1	Yes
6.	$O_2 > O_3$	1	2	No
7.	$O_2 > O_4$	3	0	Yes
8.	$O_3 > O_4$	3	0	Yes

Value of Relative Importance in %

$$V_1 = 57.0\%$$

$$V_2 = 14.7\%$$

$$V_3 = 17.9\%$$

$$V_4 = 10.4\%$$

APPENDIX II

DETERMINATION OF INFORMATION WORTH

MERCY HOSPITAL

Introduction

Objective:

The objective of this study is to determine the relative worth of certain items of information as they relate to the goals or objectives of Mercy Hospital. Information that is essential to the functioning and operations of the hospital has a definite cost attached to it and this same information has a worth that can be expressed in dollars.

This worth, in terms of dollars, is what the oncoming study will attempt to determine with your help and diligence.

General Instructions:

This study is to be performed in the privacy of your office or home. Do not discuss the questions or the study with any of your colleagues. Do not write your name on any of the questionnaires.

Mr. Watson will administer this study and any questions concerning it should be directed to him. He will distribute and pick up the questionnaires on predetermined dates. If you need to contact him, he can be reached in Norman, Oklahoma, telephone 325-6344.

This study is composed of four separate parts. Each part is attached to its instruction sheet. Read it carefully and ask any questions that you feel are pertinent to insure your understanding of the procedure. But only write down your answers in the privacy of your office.

The scheduled dates for the study are as follows:

	<u>Part I</u>	<u>Part II</u>	<u>Part III</u>	<u>Part IV</u>
Start, Afternoon:	May 18	May 19	May 20	May 21
Finish, Morning:	May 19	May 20	May 21	May 22

DETERMINATION OF INFORMATION WORTH

MERCY HOSPITAL

Part I

Instructions:

The study in which you are taking part in today is Part I in a four part series to determine the relative worth (dollar value) of information as it relates to the objectives of Mercy Hospital. Attached to these instructions is a list of objectives set forth by the hospital administrators. Each objective has been assigned a weighted value along a scale from 0 to 1 (e.g., reduce maximum cost per bed patient = .5). The weight given to the objective must be considered in your estimate of the relative worth of the information source.

The information you and your staff receive to operate your department has a cost, in terms of dollars, attached to it. Your primary task will be to answer the seventy-two questions found on the attached questionnaire. Each question is an information source that is currently being used in one form or another which has been extracted from its original source or document. In conjunction with new information sources requested, a brief summary on the purpose is included.

Your job will be to examine each question and write down a dollar value in the box based upon your best guess what the relative worth of the information is in relationship

to the hospital objectives. It is not expected that you know the exact answer to any of the questions. However, for most of them you will have some general knowledge that will enable you to make as good an estimate--an informed guess--of the answer as is expected of you. But in any case, answer every question as best as you can. You are required to give your answers in whole numbers and the last digit in the number is a multiple of 5 (e.g., 555, 40, 75, 095).

There has been no time limit assigned, but spend no more than a few minutes per question.

When you have completed answering all the questions, remove the second copy for future reference and give the original copy to Mr. Watson.

Note: If you have made calculations, save them for Part II.

MERCY HOSPITAL
OKLAHOMA CITY, OKLAHOMA

OBJECTIVES	RELATIVE IMPORTANCE
1. To optimize total cost per day for maximum patient care, at a quality level of performance.	57 %
a. To provide an atmosphere or climate for the inducement of doctors to utilize hospital facilities.	
b. To provide a work environment which will enable the employee to perform assigned duties at his highest level of efficiency and effectiveness.	
c. To provide educational programs whereby employees may improve job skills and develop their potential.	
2. To cooperate with institutions of higher learning providing facilities for the education of physicians and allied health professionals.	14.7%
3. To cooperate with community agencies in community wide planning.	17.9%
4. To participate in research, in the promotion of health and in the prevention of disease, according to available resources.	10.4%
	100 %

PART I

QUESTIONNAIRE

Instructions:

What is your best guess in terms of annual dollars the worth of each document or item of information as it relates to the overall objectives of Mercy Hospital?

Place your answers in the space provided.

Existing Information

Document Name	Recipient	Data Source	Frequency	Dollars/Year
1. Administrative Memos	Various Depts.	Misc.	As needed	
2. New or Revised Policies	Various Depts.	Misc.	As needed	
3. Procedures	Various Depts.	Misc.	As needed	
4. Incident Reports	All Depts. Nursing Service	Witnesses	As happen	
5. Security Reports	Security	Security Guard	Daily	
6. Laboratory Report	Laboratory	Daily Lab Requisition	Monthly	
7. Physical Therapy Report	Physical Therapy	Daily Treatment Book	Monthly	
8. X-Ray Reports	Radiology	Daily Ledger	Monthly	
9. Heart Station Report	Heart Station	Daily Log	Monthly	

Document Name	Recipient	Data Source	Frequency	Dollars/Year
10. Executive-Joint Conference Report	Medical Staff Service	Meeting	Monthly	
11. Graduate Education Committee Minutes	Medical Staff Service	Meeting	Monthly	
12. Patient Relations Committee	Medical Staff Service	Meeting	Monthly	
13. Operating Room Committee	Medical Staff Service	Meeting	Monthly	
14. Infection Control Meeting	Medical Staff Service	Meeting	Monthly	
15. Credentials Committee	Medical Staff Service	Meeting	Monthly	
16. Utilization Review	Medical Staff Service	Meeting	Monthly	
17. Ambulant Care Committee	Medical Staff Service	Meeting	Monthly	
18. Tissue Committee	Medical Staff Service	Meeting	Monthly	
19. General Staff Meeting	Medical Staff Service	Meeting	Monthly	
20. Medical Care Appraisals Committee	Medical Staff Service	Meeting	Monthly	
21. Nominating Committee	Medical Staff Service	Meeting	Monthly	
22. OB Dept. Meeting	Medical Staff Service	Meeting	Monthly	

Document Name	Recipient	Data Source	Frequency	Dollars/Year
23. Pharmacy and Therapeutics Committee	Medical Staff Service	Meeting	Monthly	
24. Research Committee	Medical Staff Service	Meeting	Monthly	
25. Personnel Development Meeting	Medical Staff Service	Meeting	Monthly	
26. Advisory Board	Medical Staff Service	Meeting	Monthly	
27. Executive Council	Administration	Meeting	Monthly	
28. Board of Trustees	Executive Office	Meeting	Monthly	
29. Department Managers	Administration	Meeting	Monthly	
30. Auxiliary Meeting	Auxiliary	Meeting	Monthly	
31. Surgery Report	Surgery	Daily Schedule	Monthly	
32. Night Summary Report	PBX	Nsg. Service	Daily	
33. Room Availability Sheet	Admitting	Dismissals	Daily	
34. Daily Occupancy Report	Business Office	IBM	Daily	
35. Travel Vouchers	Various Depts.	Brochures, etc.	As needed	
36. Daily Admission Report	Admitting	Admissions	Daily	
37. Nsg. Serv. Report	Nsg. Serv. Ad.	Summary Reports	Monthly	

Document Name	Recipient	Data Source	Frequency	Dollars/Year
38. Overtime Analysis	Personnel	IBM Listing	Monthly	
39. Employee Benefits Cost Anal.	Personnel	IBM Listing	Monthly	
40. New Hire & Term.	Personnel	IBM Listing	Monthly	
41. Occupational Injury	Personnel	Incident Reports	Quarterly	
42. Budgets	IBM	Accounting	Monthly	
43. Doctors Data	Medical Staff Service	Misc.	Monthly	
44. Mercy "Progress"	Public Relations	Misc.	Monthly	
45. Memos	Various Depts.	Various	As needed	
46. Letters (cc)	Various Depts.	Various	As needed	
47. Nsg. Serv. Paint Sch.	Nsg. Serv. Ad.	Nsg. Serv. Ad.	As needed	
48. HAS Comparative Study	HAS (AHA)	Nationally Compiled	Monthly	
49. Dr. Admission by Fin. Class	IBM	Admission Census	Monthly	
50. Financial Statements	IBM	Various Areas	Monthly	
51. Monthly Statistic Report	Medical Records	Various Depts.	Monthly	
52. Annual Statistic Report	Medical Records	Various Depts.	Annual	
53. Executive Communications Minutes of Meetings	Various Depts.	Misc.	As needed	

Document Name	Recipient	Data Source	Frequency	Dollars/Year
54. Executive Communications Planning & Building Program	Various Depts.	Misc.	As needed	
55. Executive Communications, P.R. & Development Progress	Various Depts.	Misc.	As needed	
56. Executive Communications Community Agencies	Various Depts.	Misc.	As needed	

New Items of Information

Information Source	Dollars/Year
57. Including monthly HAS data in conjunction with monthly operating budgets to inform department managers how they compare with comparable hospitals in the state and nation.	
58. Expand the information being obtained on doctor's admissions by financial class to include total charges to patients and collections on their patient accounts.	
59. Instant recall of all financial information by cathode-ray tube. If this cannot be accomplished to receive a quarterly step down allocation, take into consideration the variables that affect the respective cost centers, e.g., change in sq. ft., number of employees.	
60. Monthly training reports prepared by our Personnel Development Department.	
61. Executive Communications: Conventions and Meetings for the week--(1) What, (2) Where, (3) When, (4) Those Attending.	

Information Source	Dollars/ Year
62. Executive Communications: Budget to Date (once a month).	
63. Executive Communications: Ideas for and changes in policies and procedures (made within broad policies set by Board).	
64. Executive Communications: Visitors expected during the week--architects, consultants, auditors, groups or individuals for any reason, JCAH, etc.	
65. Executive Communications: Any undue maintenance or repair problems and their costs.	
66. Executive Communications: Any problems that involve doctors, that might result in lawsuits, or poor public relations, pertain to hiring and/or firing of personnel, etc.	
67. Executive Communications: Ideas for increasing economy or efficiency of operation, for changing forms, etc.	
68. Executive Communications: Communications received which pertain to hospital function or trends: AHA, OHA, Medicare, OCCH, OCAHC, Chamber of Commerce, etc.	
69. Executive Communications: Report of progress on ongoing activities; National Hospital Week, construction of new hospital, bids on equipment, employment of key personnel, contracts, etc.	
70. Executive Communications: Recommendations made to administration by Medical Staff Committees.	
71. Executive Communications: New equipment or new kind of supplies purchased.	
72. Executive Communications: Feedback on problems that have been solved or activities that have been initiated.	

DETERMINATION OF INFORMATION WORTH
MERCY HOSPITAL

Part II

Instructions:

Your task today will be to reconsider your answers from Part I, this time taking into account the responses of the other participants on the preceding round. You have your record of your previous answers to compare.

Attached to the questionnaire is a statistical summary of the group's estimates per question, given in terms of the median (m_1) and the quartile interval ($Q_1 - Q_3$). The median is the middle response for the group's estimate of the worth and the quartile interval contains the middle 50 percent of the responses. The size gives you some indication of how widely the responses differed from one to another.

Taking this new information into account, you may revise your answers where you think it is called for. Think over each question in view of the hospital objectives and consider whether there were factors you might have overlooked or computations which might have contained a numerical mistake.

However, keep in mind that you are still being asked only for your best estimate based upon your intuitive judgment. After answering each question with your best guess, those estimates which fall outside the quartile interval

$(Q_1 - Q_3)$, explain on the attached comment sheet your reason and estimate. Your reason should not be more than a paragraph in length.

MERCY HOSPITAL
OKLAHOMA CITY, OKLAHOMA

OBJECTIVES	RELATIVE IMPORTANCE
1. To optimize total cost per day for maximum patient care, at a quality level of performance.	57 %
a. To provide an atmosphere or climate for the inducement of doctors to utilize hospital facilities.	
b. To provide a work environment which will enable the employee to perform assigned duties at his highest level of efficiency and effectiveness.	
c. To provide educational programs whereby employees may improve job skills and develop their potential.	
2. To cooperate with institutions of higher learning providing facilities for the education of physicians and allied health professionals.	14.7%
3. To cooperate with community agencies in community wide planning.	17.9%
4. To participate in research, in the promotion of health and in the prevention of disease, according to available resources.	10.4%
	100 %

PART I
STATISTICS

Listed below are the group statistics on the relative worth of each information document or source of information.

Document Name or Information Source	Information Worth		
	Low Quartile (Q ₁)	Median	High Quartile (Q ₃)
1. Administrative Memos	7,500	20,000	100,000
2. New or Revised Policies	10,000	10,000	150,000
3. Procedures	6,000	30,000	150,000
4. Incident Reports	7,500	15,000	75,000
5. Security Reports	1,000	5,000	35,000
6. Laboratory Report	800	10,000	95,000
7. Physical Therapy Report	300	3,000	30,000
8. X-Ray Reports	800	10,000	60,000
9. Heart Station Report	300	3,000	55,000
10. Executive-Joint Conference Report	4,500	40,000	75,000
11. Graduate Education Committee Minutes	750	1,000	50,000
12. Patient Relations Committee	1,000	10,000	37,500
13. Operating Room Committee	1,000	10,000	30,000
14. Infection Control Meeting	3,000	10,000	50,000
15. Credentials Committee	2,500	5,000	75,000

Document Name or Information Source	Median		
	Low Quartile (Q ₁)		High Quartile (Q ₃)
16. Utilization Review	1,000	10,000	125,000
17. Ambulant Care Committee	750	1,000	50,000
18. Tissue Committee	2,750	10,000	50,000
19. General Staff Meeting	1,000	10,000	37,500
20. Medical Care Appraisals Committee	1,000	10,000	62,500
21. Nominating Committee	750	10,000	75,000
22. OB Dept. Meeting	300	10,000	37,500
23. Pharmacy and Therapeutics Committee	2,750	5,000	30,000
24. Research Committee	100	3,000	50,000
25. Personnel Development Meeting	1,250	5,000	30,000
26. Advisory Board	7,500	20,000	525,000
27. Executive Council	5,500	10,000	60,000
28. Board of Trustees	10,000	30,000	550,000
29. Department Managers	7,500	15,000	150,000
30. Auxiliary Meeting	3,000	5,000	260,000
31. Surgery Report	300	5,000	50,000
32. Night Summary Report	100	5,000	15,000
33. Room Availability Sheet	5,050	5,000	460,000
34. Daily Occupancy Report	1,000	5,000	105,000
35. Travel Vouchers	300	20,000	30,000

Document Name or Information Source	Median		
	Low Quartile (Q ₁)		High Quartile (Q ₃)
36. Daily Admission Report	550	5,000	30,000
37. Nsg. Serv. Report	550	10,000	30,000
38. Overtime Analysis	1,000	18,000	50,000
39. Employee Benefits Cost Analysis	500	10,000	35,000
40. New Hire & Term.	300	10,000	290,000
41. Occupational Injury	2,750	10,000	37,500
42. Budgets	7,500	50,000	300,000
43. Doctors Data	1,000	10,000	62,500
44. Mercy "Progress"	3,000	5,000	55,000
45. Memos	750	10,000	55,000
46. Letters (cc)	550	10,000	60,000
47. Nsg. Serv. Paint Sch.	100	10,000	30,000
48. HAS Comparative Study	1,000	50,000	75,000
49. Dr. Admission by Fin. Class	2,750	50,000	300,000
50. Financial Statements	7,500	20,000	350,000
51. Monthly Statistic Report	750	10,000	300,000
52. Annual Statistic Report	500	10,000	550,000
53. Executive Communications Minutes of Meetings	300	5,000	27,500
54. Executive Communications Planning & Bldg. Prog.	3,000	10,000	40,000

Document Name or Information Source	Median		
	Low Quartile (Q ₁)		High Quartile (Q ₃)
55. Executive Communi- cations P.R. & De- velopment Progress	750	10,000	30,000
56. Executive Communications Community Agencies	750	5,000	30,000
57. New Item of Information	5,500	10,000	100,000
58. New Item of Information	3,000	100,000	550,000
59. New Item of Information	7,500	30,000	350,000
60. New Item of Information	1,000	5,000	31,000
61. New Item of Information	100	5,000	10,000
62. New Item of Information	1,000	5,000	112,000
63. New Item of Information	1,000	10,000	75,000
64. New Item of Information	100	5,000	11,000
65. New Item of Information	350	36,000	62,500
66. New Item of Information	750	100,000	550,000
67. New Item of Information	3,000	24,000	250,000
68. New Item of Information	300	12,000	550,000
69. New Item of Information	150	12,000	75,000
70. New Item of Information	1,000	50,000	650,000
71. New Item of Information	100	10,000	75,000
72. New Item of Information	550	10,000	50,000

PART II

QUESTIONNAIRE

Instructions:

What is your best guess in terms of annual dollars the worth of each document or item of information as it relates to the overall objectives of Mercy Hospital?

Place your answers in the space provided.

Existing Information

Document Name	Recipient	Data Source	Frequency	Dollars/Year
1. Administrative Memos	Various Depts.	Misc.	As needed	
2. New or Revised Policies	Various Depts.	Misc.	As needed	
3. Procedures	Various Depts.	Misc.	As needed	
4. Incident Reports	All Depts. Nursing Service	Witnesses	As happen	
5. Security Reports	Security	Security Guard	Daily	
6. Laboratory Report	Laboratory	Daily Lab Requisition	Monthly	
7. Physical Therapy Report	Physical Therapy	Daily Treatment Book	Monthly	
8. X-Ray Reports	Radiology	Daily Ledger	Monthly	
9. Heart Station Report	Heart Station	Daily Log	Monthly	

Document Name	Recipient	Data Source	Frequency	Dollars/Year
10. Executive-Joint Conference Report	Medical Staff Service	Meeting	Monthly	
11. Graduate Education Committee Minutes	Medical Staff Service	Meeting	Monthly	
12. Patient Relations Committee	Medical Staff Service	Meeting	Monthly	
13. Operating Room Committee	Medical Staff Service	Meeting	Monthly	
14. Infection Control Meeting	Medical Staff Service	Meeting	Monthly	
15. Credentials Committee	Medical Staff Service	Meeting	Monthly	
16. Utilization Review	Medical Staff Service	Meeting	Monthly	
17. Ambulant Care Committee	Medical Staff Service	Meeting	Monthly	
18. Tissue Committee	Medical Staff Service	Meeting	Monthly	
19. General Staff Meeting	Medical Staff Service	Meeting	Monthly	
20. Medical Care Appraisals Committee	Medical Staff Service	Meeting	Monthly	
21. Nominating Committee	Medical Staff Service	Meeting	Monthly	
22. OB Dept. Meeting	Medical Staff Service	Meeting	Monthly	

Document Name	Recipient	Data Source	Frequency	Dollars/Year
23. Pharmacy and Therapeutics Committee	Medical Staff Service	Meeting	Monthly	
24. Research Committee	Medical Staff Service	Meeting	Monthly	
25. Personnel Development Meeting	Medical Staff Service	Meeting	Monthly	
26. Advisory Board	Medical Staff Service	Meeting	Monthly	
27. Executive Council	Administration	Meeting	Monthly	
28. Board of Trustees	Executive Office	Meeting	Monthly	
29. Department Managers	Administration	Meeting	Monthly	
30. Auxiliary Meeting	Auxiliary	Meeting	Monthly	
31. Surgery Report	Surgery	Daily Schedule	Monthly	
32. Night Summary Report	PBX	Nsg. Service	Daily	
33. Room Availability Sheet	Admitting	Dismissals	Daily	
34. Daily Occupancy Report	Business Office	IBM	Daily	
35. Travel Vouchers	Various Depts.	Brochures, etc.	As needed	
36. Daily Admission Report	Admitting	Admissions	Daily	
37. Nsg. Serv. Report	Nsg. Serv. Ad.	Summary Reports	Monthly	

Document Name	Recipient	Data Source	Frequency	Dollars/Year
38. Overtime Analysis	Personnel	IBM Listing	Monthly	
39. Employee Benefits Cost Anal.	Personnel	IBM Listing	Monthly	
40. New Hire & Term.	Personnel	IBM Listing	Monthly	
41. Occupational Injury	Personnel	Incident Reports	Quarterly	
42. Budgets	IBM	Accounting	Monthly	
43. Doctors Data	Medical Staff Service	Misc.	Monthly	
44. Mercy "Progress"	Public Relations	Misc.	Monthly	
45. Memos	Various Depts.	Various	As needed	
46. Letters (cc)	Various Depts.	Various	As needed	
47. Nsg. Serv. Paint Sch.	Nsg. Serv. Ad.	Nsg. Serv. Ad.	As needed	
48. HAS Comparative Study	HAS (AHA)	Nationally Compiled	Monthly	
49. Dr. Admission by Fin. Class	IBM	Admission Census	Monthly	
50. Financial Statements	IBM	Various Areas	Monthly	
51. Monthly Statistic Report	Medical Records	Various Depts.	Monthly	
52. Annual Statistic Report	Medical Records	Various Depts.	Annual	
53. Executive Communications Minutes of Meetings	Various Depts.	Misc.	As needed	

Document Name	Recipient	Data Source	Frequency	Dollars/Year
54. Executive Communications Planning & Building Program	Various Depts.	Misc.	As needed	
55. Executive Communications, P.R. & Development Progress	Various Depts.	Misc.	As needed	
56. Executive Communications Community Agencies	Various Depts.	Misc.	As needed	

New Items of Information

Information Source	Dollars/Year
57. Including monthly HAS data in conjunction with monthly operating budgets to inform department managers how they compare with comparable hospitals in the state and nation.	
58. Expand the information being obtained on doctor's admissions by financial class to include total charges to patients and collections on their patient accounts.	
59. Instant recall of all financial information by cathode-ray tube. If this cannot be accomplished to receive a quarterly step down allocation, take into consideration the variables that affect the respective cost centers, e.g., change in sq. ft., number of employees.	
60. Monthly training reports prepared by our Personnel Development Department.	
61. Executive Communications: Conventions and Meetings for the week--(1) What, (2) Where, (3) When, (4) Those Attending.	

Information Source	Dollars/ Year
62. Executive Communications: Budget to Date (once a month).	
63. Executive Communications: Ideas for and changes in policies and procedures (made within broad policies set by Board).	
64. Executive Communications: Visitors expected during the week--architects, consultants, auditors, groups or individuals for any reason, JCAH, etc.	
65. Executive Communications: Any undue maintenance or repair problems and their costs.	
66. Executive Communications: Any problems that involve doctors, that might result in lawsuits, or poor public relations, pertain to hiring and/or firing of personnel, etc.	
67. Executive Communications: Ideas for increasing economy or efficiency of operation, for changing forms, etc.	
68. Executive Communications: Communications received which pertain to hospital function or trends: AHA, OHA, Medicare, OCCH, OCAHC, Chamber of Commerce, etc.	
69. Executive Communications: Report of progress on ongoing activities; National Hospital Week, construction of new hospital, bids on equipment, employment of key personnel, contracts, etc.	
70. Executive Communications: Recommendations made to administration by Medical Staff Committees.	
71. Executive Communications: New equipment or new kind of supplies purchased.	
72. Executive Communications: Feedback on problems that have been solved or activities that have been initiated.	

DETERMINATION OF INFORMATION WORTH
MERCY HOSPITAL

Part III

Instructions:

In this round you are asked again to reconsider your answer to each question you gave in Part II.

Remove your carbon copies of Parts I and II from your files. Compare your Part II answers with the Part II group median (m_1) and the quartile interval ($Q_1 - Q_3$), middle 50 percent.

Attached to Part III is a copy of those reasons why participants in Part II did not choose \$ values within the quartile interval ($Q_1 - Q_3$) for a particular question.

You are asked to read the reasons for their actions in Part II before proceeding on to Part III. Taking this additional information into account, you may revise your answers where you think it is appropriate.

The same procedure applies to Part III as in Part I and II. Read over the hospital's objectives and record your best guess on the questionnaire for each question. If your answer falls outside of the quartile interval, state on the comment sheet your reasons and dollar estimate. Do this for each question where your answer falls outside of it.

When you are finished, remove the carbon copy from both comment and Part III questionnaire for your file. The original will be picked up by Mr. Watson.

Remember, fill in all blanks whether you change your estimate or not.

MERCY HOSPITAL
OKLAHOMA CITY, OKLAHOMA

OBJECTIVES	RELATIVE IMPORTANCE
1. To optimize total cost per day for maximum patient care, at a quality level of performance.	57 %
a. To provide an atmosphere or climate for the inducement of doctors to utilize hospital facilities.	
b. To provide a work environment which will enable the employee to perform assigned duties at his highest level of efficiency and effectiveness.	
c. To provide educational programs whereby employees may improve job skills and develop their potential.	
2. To cooperate with institutions of higher learning providing facilities for the education of physicians and allied health professionals.	14.7%
3. To cooperate with community agencies in community wide planning.	17.9%
4. To participate in research, in the promotion of health and in the prevention of disease, according to available resources.	10.4%
	100 %

PART II

STATISTICS

Listed below are the group statistics on the relative worth of each information document or source of information.

Document Name or Information Source	Information Worth		
	Low Quartile (Q ₁)	Median	High Quartile (Q ₃)
1. Administrative Memos	15,000	20,000	75,000
2. New or Revised Policies	10,000	80,000	100,000
3. Procedures	85,000	30,000	100,000
4. Incident Reports	10,750	15,000	62,500
5. Security Reports	1,000	5,000	27,500
6. Laboratory Report	900	10,000	92,500
7. Physical Therapy Report	400	3,000	17,500
8. X-Ray Reports	900	10,000	35,000
9. Heart Station Report	400	3,000	37,500
10. Executive-Joint Conference Report	7,000	30,000	37,500
11. Graduate Education Committee Minutes	875	1,000	30,000
12. Patient Relations Committee	1,000	10,000	25,000
13. Operating Room Committee	1,000	10,000	17,500
14. Infection Control Meeting	5,000	10,000	50,000
15. Credentials Committee	3,250	5,000	50,000

Document Name or Information Source	Median		
	Low Quartile (Q ₁)		High Quartile (Q ₃)
16. Utilization Review	1,250	10,000	112,500
17. Ambulant Care Committee	1,000	1,000	37,500
18. Tissue Committee	2,750	10,000	31,250
19. General Staff Meeting	3,000	10,000	25,000
20. Medical Care Appraisals Committee	1,000	10,000	43,750
21. Nominating Committee	4,250	10,000	50,000
22. OB Dept. Meeting	300	10,000	25,000
23. Pharmacy and Therapeutics Committee	2,750	5,000	17,500
24. Research Committee	300	3,000	30,000
25. Personnel Development Meeting	3,750	5,000	20,000
26. Advisory Board	6,250	15,000	510,000
27. Executive Council	300	10,000	400,000
28. Board of Trustees	25,000	30,000	325,000
29. Department Managers	10,000	15,000	85,000
30. Auxiliary Meeting	3,000	5,000	134,500
31. Surgery Report	400	5,000	15,000
32. Night Summary Report	750	5,000	12,500
33. Room Availability Sheet	3,000	5,000	102,500
34. Daily Occupancy Report	3,000	5,000	55,000
35. Travel Vouchers	650	5,000	27,500
36. Daily Admission Report	775	5,000	17,500

Document Name or Information Source	Median		
	Low Quartile (Q ₁)		High Quartile (Q ₃)
37. Nsg. Serv. Report	775	5,000	20,000
38. Overtime Analysis	3,000	10,000	21,500
39. Employee Benefits Cost Analysis	750	10,000	27,500
40. New Hire & Term.	500	10,000	107,800
41. Occupational Injury	3,375	10,000	22,500
42. Budgets	11,250	50,000	175,000
43. Doctors Data	3,000	10,000	17,500
44. Mercy "Progress"	4,000	50,000	37,500
45. Memos	875	10,000	37,500
46. Letters (cc)	775	10,000	40,000
47. Nsg. Serv. Paint Sch.	300	10,000	21,500
48. HAS Comparative Study	3,000	20,000	62,500
49. Dr. Admission by Fin. Class	3,900	30,000	200,000
50. Financial Statements	9,000	20,000	200,000
51. Monthly Statistic Report	3,000	10,000	160,000
52. Annual Statistic Report	4,000	10,000	285,000
53. Executive Communications Minutes of Meetings	500	5,000	15,000
54. Executive Communications Planning & Bldg. Prog.	4,000	5,000	35,000
55. Executive Communications P.R. & Develop- ment Progress	875	5,000	20,000

Document Name or Information Source	Median		
	Low Quartile (Q ₁)		High Quartile (Q ₃)
56. Executive Communications Community Agencies	875	5,000	17,500
57. New Item of Information	1,000	10,000	57,500
58. New Item of Information	4,000	20,000	325,000
59. New Item of Information	10,000	20,000	190,000
60. New Item of Information	1,000	2,000	18,500
61. New Item of Information	100	1,000	7,500
62. New Item of Information	1,000	10,000	62,000
63. New Item of Information	1,000	5,000	42,500
64. New Item of Information	100	2,000	11,000
65. New Item of Information	350	36,000	42,000
66. New Item of Information	1,000	100,000	300,000
67. New Item of Information	3,000	24,000	100,000
68. New Item of Information	400	10,000	181,000
69. New Item of Information	350	10,000	31,000
70. New Item of Information	1,000	10,000	50,000
71. New Item of Information	300	5,000	23,500
72. New Item of Information	775	10,000	17,500

INDIVIDUAL COMMENTS

<u>Questions</u>	<u>Relative Worth</u>	<u>Remarks</u>
6-9	\$ 300	These are statistical reports of the various departments and should have the same relative worth.
18	500	Pertains to medical staff only; the hospital is not liable.
22	100	From a financial standpoint this department should be closed. Therefore, reports are negatively received.
23	500	It is a none existent paper committee and has accomplished very little since its inception.
26	1,000,000	The Advisory Board is the prime factor in fund raising. Keeps the Executive Director, Administration, Medical Staff and employees apprised of the Board's activities which can be of an unestimable value.
27	1,000	This is used only for information and communication.
30	1,000	It serves only for information purposes.
33	1,000	The worth is not more than fifty times the night summary report.
57	1,000	Indicated how you compare with other hospitals but does not give enough details on how you differ from them (e.g., age of facility, design, equipment, etc.)
65	200	It is after the fact media, a negative report and a corrective tool.

<u>Questions</u>	<u>Relative Worth</u>	<u>Remarks</u>
67	\$ 1,000	It serves for ideas only and is good reading.

Information Research Study
May 20, 1970
Accumulated by Mr. Watson

PART III
QUESTIONNAIRE

Instructions:

What is your best guess in terms of annual dollars the worth of each document or item of information as it relates to the overall objectives of Mercy Hospital?

Place your answers in the space provided.

<u>Existing Information</u>				
Document Name	Recipient	Data Source	Frequency	Dollars/Year
1. Administrative Memos	Various Depts.	Misc.	As needed	
2. New or Revised Policies	Various Depts.	Misc.	As needed	
3. Procedures	Various Depts.	Misc.	As needed	
4. Incident Reports	All Depts. Nursing Service	Witnesses	As happen	
5. Security Reports	Security	Security Guard	Daily	
6. Laboratory Report	Laboratory	Daily Lab Requisition	Monthly	
7. Physical Therapy Report	Physical Therapy	Daily Treatment Book	Monthly	
8. X-Ray Reports	Radiology	Daily Ledger	Monthly	
9. Heart Station Report	Heart Station	Daily Log	Monthly	

Document Name	Recipient	Data Source	Frequency	Dollars/Year
10. Executive-Joint Conference Report	Medical Staff Service	Meeting	Monthly	
11. Graduate Education Committee Minutes	Medical Staff Service	Meeting	Monthly	
12. Patient Relations Committee	Medical Staff Service	Meeting	Monthly	
13. Operating Room Committee	Medical Staff Service	Meeting	Monthly	
14. Infection Control Meeting	Medical Staff Service	Meeting	Monthly	
15. Credentials Committee	Medical Staff Service	Meeting	Monthly	
16. Utilization Review	Medical Staff Service	Meeting	Monthly	
17. Ambulant Care Committee	Medical Staff Service	Meeting	Monthly	
18. Tissue Committee	Medical Staff Service	Meeting	Monthly	
19. General Staff Meeting	Medical Staff Service	Meeting	Monthly	
20. Medical Care Appraisals Committee	Medical Staff Service	Meeting	Monthly	
21. Nominating Committee	Medical Staff Service	Meeting	Monthly	
22. OB Dept. Meeting	Medical Staff Service	Meeting	Monthly	

Document Name	Recipient	Data Source	Frequency	Dollars/Year
23. Pharmacy and Therapeutics Committee	Medical Staff Service	Meeting	Monthly	
24. Research Committee	Medical Staff Service	Meeting	Monthly	
25. Personnel Development Meeting	Medical Staff Service	Meeting	Monthly	
26. Advisory Board	Medical Staff Service	Meeting	Monthly	
27. Executive Council	Administration	Meeting	Monthly	
28. Board of Trustees	Executive Office	Meeting	Monthly	
29. Department Managers	Administration	Meeting	Monthly	
30. Auxiliary Meeting	Auxiliary	Meeting	Monthly	
31. Surgery Report	Surgery	Daily Schedule	Monthly	
32. Night Summary Report	PBX	Nsg. Service	Daily	
33. Room Availability Sheet	Admitting	Dismissals	Daily	
34. Daily Occupancy Report	Business Office	IBM	Daily	
35. Travel Vouchers	Various Depts.	Brochures, etc.	As needed	
36. Daily Admission Report	Admitting	Admissions	Daily	
37. Nsg. Serv. Report	Nsg. Serv. Ad.	Summary Reports	Monthly	

Document Name	Recipient	Data Source	Frequency	Dollars/Year
38. Overtime Analysis	Personnel	IBM Listing	Monthly	
39. Employee Benefits Cost Anal.	Personnel	IBM Listing	Monthly	
40. New Hire & Term.	Personnel	IBM Listing	Monthly	
41. Occupational Injury	Personnel	Incident Reports	Quarterly	
42. Budgets	IBM	Accounting	Monthly	
43. Doctors Data	Medical Staff Service	Misc.	Monthly	
44. Mercy "Progress"	Public Relations	Misc.	Monthly	
45. Memos	Various Depts.	Various	As needed	
46. Letters (cc)	Various Depts.	Various	As needed	
47. Nsg. Serv. Paint Sch.	Nsg. Serv. Ad.	Nsg. Serv. Ad.	As needed	
48. HAS Comparative Study	HAS (AHA)	Nationally Compiled	Monthly	
49. Dr. Admission by Fin. Class	IBM	Admission Census	Monthly	
50. Financial Statements	IBM	Various Areas	Monthly	
51. Monthly Statistic Report	Medical Records	Various Depts.	Monthly	
52. Annual Statistic Report	Medical Records	Various Depts.	Annual	
53. Executive Communications Minutes of Meetings	Various Depts.	Misc.	As needed	

Document Name	Recipient	Data Source	Frequency	Dollars/Year
54. Executive Communications Planning & Building Program	Various Depts.	Misc.	As needed	
55. Executive Communications, P.R. & Development Progress	Various Depts.	Misc.	As needed	
56. Executive Communications Community Agencies	Various Depts.	Misc.	As needed	

New Items of Information

Information Source	Dollars/Year
57. Including monthly HAS data in conjunction with monthly operating budgets to inform department managers how they compare with comparable hospitals in the state and nation.	
58. Expand the information being obtained on doctor's admissions by financial class to include total charges to patients and collections on their patient accounts.	
59. Instant recall of all financial information by cathode-ray tube. If this cannot be accomplished to receive a quarterly step down allocation, take into consideration the variables that affect the respective cost centers, e.g., change in sq. ft., number of employees.	
60. Monthly training reports prepared by our Personnel Development Department.	
61. Executive Communications: Conventions and Meetings for the week--(1) What, (2) Where, (3) When, (4) Those Attending.	

Information Source	Dollars/ Year
62. Executive Communications: Budget to Date (once a month).	
63. Executive Communications: Ideas for and changes in policies and procedures (made within broad policies set by Board).	
64. Executive Communications: Visitors expected during the week--architects, consultants, auditors, groups or individuals for any reason, JCAH, etc.	
65. Executive Communications: Any undue maintenance or repair problems and their costs.	
66. Executive Communications: Any problems that involve doctors, that might result in lawsuits, or poor public relations, pertain to hiring and/or firing of personnel, etc.	
67. Executive Communications: Ideas for increasing economy or efficiency of operation, for changing forms, etc.	
68. Executive Communications: Communications received which pertain to hospital function or trends: AHA, OHA, Medicare, OCCH, OCAHC, Chamber of Commerce, etc.	
69. Executive Communications: Report of progress on ongoing activities; National Hospital Week, construction of new hospital, bids on equipment, employment of key personnel, contracts, etc.	
70. Executive Communications: Recommendations made to administration by Medical Staff Committees.	
71. Executive Communications: New equipment or new kind of supplies purchased.	
72. Executive Communications: Feedback on problems that have been solved or activities that have been initiated.	

DETERMINATION OF INFORMATION WORTH

MERCY HOSPITAL

Part IV

Instructions:

On this final round you are asked again to reconsider your answer to each question you gave in Part III.

Remove your carbon copy of Parts II and III from your files and compare your answers with the group median (m_i) and the quartile interval ($Q_1 - Q_3$), middle 50 percent.

Attached to Part IV is a copy of those reasons why participants in Part III did not choose \$ values within the quartile interval ($Q_1 - Q_3$) for a particular question.

You are asked to read the reasons for their actions in Part III before proceeding on to Part IV. Taking this additional information into account, you may revise your answers where you think it is appropriate.

The same procedure applies to Part IV as in Part I, II, and III. Read over the hospital's objectives and record your best guess on the questionnaire for each question. If your answer falls outside of the quartile interval, state on the comment sheet your reasons. Do this for each question where your answer falls outside of it.

When you are finished, remove the carbon copy from both comment and Part IV questionnaire for your files. The original copies will be picked up by Mr. Watson.

Remember, fill in all blanks whether you change your estimate or not.

MERCY HOSPITAL
OKLAHOMA CITY, OKLAHOMA

OBJECTIVES	RELATIVE IMPORTANCE
1. To optimize total cost per day for maximum patient care, at a quality level of performance.	57 %
a. To provide an atmosphere or climate for the inducement of doctors to utilize hospital facilities.	
b. To provide a work environment which will enable the employee to perform assigned duties at his highest level of efficiency and effectiveness.	
c. To provide educational programs whereby employees may improve job skills and develop their potential.	
2. To cooperate with institutions of higher learning providing facilities for the education of physicians and allied health professionals.	14.7%
3. To cooperate with community agencies in community wide planning.	17.9%
4. To participate in research, in the promotion of health and in the prevention of disease, according to available resources.	10.4%
	100 %

PART III
STATISTICS

Listed below are the group statistics on the relative worth of each information document or source of information.

Document Name or Information Source	Information Worth		
	Low Quartile (Q ₁)	Median	High Quartile (Q ₃)
1. Administrative Memos	17,500	25,000	62,500
2. New or Revised Policies	10,000	70,000	70,000
3. Procedures	10,000	40,000	75,000
4. Incident Reports	11,800	15,000	50,000
5. Security Reports	1,000	5,000	17,500
6. Laboratory Report	1,250	8,000	30,000
7. Physical Therapy Report	450	3,000	13,750
8. X-Ray Reports	1,200	5,000	15,000
9. Heart Station Report	450	3,000	22,500
10. Executive-Joint Conference Report	9,000	26,000	25,000
11. Graduate Education Committee Minutes	950	1,000	17,500
12. Patient Relations Committee	1,000	4,000	21,250
13. Operating Room Committee	1,000	3,000	20,000
14. Infection Control Meeting	5,000	10,000	30,500
15. Credentials Committee	3,625	5,000	37,500

Document Name or Information Source	Median		
	Low Quartile (Q ₁)		High Quartile (Q ₃)
16. Utilization Review	1,125	3,000	75,000
17. Ambulant Care Committee	1,000	1,000	31,250
18. Tissue Committee	2,750	10,000	27,500
19. General Staff Meeting	4,000	10,000	25,000
20. Medical Care Appraisals Committee	1,000	4,000	34,375
21. Nominating Committee	6,250	10,000	37,500
22. OB Dept. Meeting	650	5,000	25,000
23. Pharmacy and Therapeutics Committee	750	6,000	17,500
24. Research Committee	400	2,000	17,500
25. Personnel Development Meeting	4,375	5,000	14,000
26. Advisory Board	15,000	15,000	440,000
27. Executive Council	5,000	20,000	60,000
28. Board of Trustees	3,000	3,000	217,500
29. Department Managers	12,500	15,000	47,500
30. Auxiliary Meeting	4,000	5,000	72,000
31. Surgery Report	550	3,000	10,000
32. Night Summary Report	875	2,500	7,500
33. Room Availability Sheet	2,000	4,000	52,500
34. Daily Occupancy Report	2,000	4,000	32,500
35. Travel Vouchers	650	5,000	22,500
36. Daily Admission Report	750	4,000	13,250

Document Name or Information Source	Median		
	Low Quartile (Q ₁)		High Quartile (Q ₃)
37. Nsg. Serv. Report	750	5,000	15,000
38. Overtime Analysis	4,000	10,000	15,750
39. Employee Benefits Cost Analysis	875	3,000	17,500
40. New Hire & Term.	750	4,000	50,000
41. Occupational Injury	4,185	6,000	20,000
42. Budgets	17,000	50,000	125,000
43. Doctors Data	3,000	4,000	10,000
44. Mercy "Progress"	4,000	5,000	23,750
45. Memos	890	3,000	22,250
46. Letters (cc)	887	6,000	15,000
47. Nsg. Serv. Paint Sch.	400	1,000	7,000
48. HAS Comparative Study	4,000	5,000	20,000
49. Dr. Admission by Fin. Class	4,525	25,000	125,000
50. Financial Statements	17,500	20,000	75,000
51. Monthly Statistic Report	4,000	6,000	55,000
52. Annual Statistic Report	4,500	8,000	80,000
53. Executive Communications Minutes of Meetings	500	1,500	10,000
54. Executive Communications Planning & Bldg. Prog.	4,500	5,000	27,500
55. Executive Communications P.R. & Develop- ment Progress	950	3,000	17,500

Document Name or Information Source	Median		
	Low Quartile (Q ₁)		High Quartile (Q ₃)
56. Executive Communications Community Agencies	950	2,000	11,250
57. New Item of Information	1,000	3,000	30,000
58. New Item of Information	4,500	15,000	155,000
59. New Item of Information	12,500	20,000	90,000
60. New Item of Information	1,000	2,000	13,500
61. New Item of Information	100	1,000	5,000
62. New Item of Information	1,000	6,000	40,000
63. New Item of Information	1,000	5,000	33,250
64. New Item of Information	100	2,000	7,500
65. New Item of Information	350	3,000	30,000
66. New Item of Information	1,000	10,000	150,000
67. New Item of Information	3,000	5,000	61,000
68. New Item of Information	400	1,000	55,000
69. New Item of Information	350	1,000	20,000
70. New Item of Information	1,000	3,000	30,000
71. New Item of Information	300	1,000	15,000
72. New Item of Information	785	1,000	10,000

INDIVIDUAL COMMENTS

<u>Question</u>	<u>Relative Worth</u>	<u>Remarks</u>
18	\$ 500	Examination of tissue removed is a medical procedure; not hospital. The Pathologist is responsible for the findings and therefore is liable.
23	300	The committee has not functioned with objectives in mind. Their main functions are to approve drugs, new items utilized and assist the hospital by establishing a formulary where one drug is stocked per generic name to reduce inventory. This has not been accomplished, therefore the relative worth should reflect this.
33- 34	1,000	Too high in relationship to other reports.

Information Research Study
 May 21, 1970
 Page Two
 Prepared by Mr. Watson

PART IV

QUESTIONNAIRE

Instructions:

What is your best guess in terms of annual dollars the worth of each document or item of information as it relates to the overall objectives of Mercy Hospital?

Place your answers in the space provided.

Existing Information

Document Name	Recipient	Data Source	Frequency	Dollars/Year
1. Administrative Memos	Various Depts.	Misc.	As needed	
2. New or Revised Policies	Various Depts.	Misc.	As needed	
3. Procedures	Various Depts.	Misc.	As needed	
4. Incident Reports	All Depts. Nursing Service	Witnesses	As happen	
5. Security Reports	Security	Security Guard	Daily	
6. Laboratory Report	Laboratory	Daily Lab Requisition	Monthly	
7. Physical Therapy Report	Physical Therapy	Daily Treatment Book	Monthly	
8. X-Ray Reports	Radiology	Daily Ledger	Monthly	
9. Heart Station Report	Heart Station	Daily Log	Monthly	

Document Name	Recipient	Data Source	Frequency	Dollars/Year
10. Executive-Joint Conference Report	Medical Staff Service	Meeting	Monthly	
11. Graduate Education Committee Minutes	Medical Staff Service	Meeting	Monthly	
12. Patient Relations Committee	Medical Staff Service	Meeting	Monthly	
13. Operating Room Committee	Medical Staff Service	Meeting	Monthly	
14. Infection Control Meeting	Medical Staff Service	Meeting	Monthly	
15. Credentials Committee	Medical Staff Service	Meeting	Monthly	
16. Utilization Review	Medical Staff Service	Meeting	Monthly	
17. Ambulant Care Committee	Medical Staff Service	Meeting	Monthly	
18. Tissue Committee	Medical Staff Service	Meeting	Monthly	
19. General Staff Meeting	Medical Staff Service	Meeting	Monthly	
20. Medical Care Appraisals Committee	Medical Staff Service	Meeting	Monthly	
21. Nominating Committee	Medical Staff Service	Meeting	Monthly	
22. OB Dept. Meeting	Medical Staff Service	Meeting	Monthly	

Document Name	Recipient	Data Source	Frequency	Dollars/Year
23. Pharmacy and Therapeutics Committee	Medical Staff Service	Meeting	Monthly	
24. Research Committee	Medical Staff Service	Meeting	Monthly	
25. Personnel Development Meeting	Medical Staff Service	Meeting	Monthly	
26. Advisory Board	Medical Staff Service	Meeting	Monthly	
27. Executive Council	Administration	Meeting	Monthly	
28. Board of Trustees	Executive Office	Meeting	Monthly	
29. Department Managers	Administration	Meeting	Monthly	
30. Auxiliary Meeting	Auxiliary	Meeting	Monthly	
31. Surgery Report	Surgery	Daily Schedule	Monthly	
32. Night Summary Report	PBX	Nsg. Service	Daily	
33. Room Availability Sheet	Admitting	Dismissals	Daily	
34. Daily Occupancy Report	Business Office	IBM	Daily	
35. Travel Vouchers	Various Depts.	Brochures, etc.	As needed	
36. Daily Admission Report	Admitting	Admissions	Daily	
37. Nsg. Serv. Report	Nsg. Serv. Ad.	Summary Reports	Monthly	

Document Name	Recipient	Data Source	Frequency	Dollars/Year
38. Overtime Analysis	Personnel	IBM Listing	Monthly	
39. Employee Benefits Cost Anal.	Personnel	IBM Listing	Monthly	
40. New Hire & Term.	Personnel	IBM Listing	Monthly	
41. Occupational Injury	Personnel	Incident Reports	Quarterly	
42. Budgets	IBM	Accounting	Monthly	
43. Doctors Data	Medical Staff Service	Misc.	Monthly	
44. Mercy "Progress"	Public Relations	Misc.	Monthly	
45. Memos	Various Depts.	Various	As needed	
46. Letters (cc)	Various Depts.	Various	As needed	
47. Nsg. Serv. Paint Sch.	Nsg. Serv. Ad.	Nsg. Serv. Ad.	As needed	
48. HAS Comparative Study	HAS (AHA)	Nationally Compiled	Monthly	
49. Dr. Admission by Fin. Class	IBM	Admission Census	Monthly	
50. Financial Statements	IBM	Various Areas	Monthly	
51. Monthly Statistic Report	Medical Records	Various Depts.	Monthly	
52. Annual Statistic Report	Medical Records	Various Depts.	Annual	
53. Executive Communications Minutes of Meetings	Various Depts.	Misc.	As needed	

Document Name	Recipient	Data Source	Frequency	Dollars/Year
54. Executive Communications Planning & Building Program	Various Depts.	Misc.	As needed	
55. Executive Communications, P.R. & Development Progress	Various Depts.	Misc.	As needed	
56. Executive Communications Community Agencies	Various Depts.	Misc.	As needed	

New Items of Information

Information Source	Dollars/Year
57. Including monthly HAS data in conjunction with monthly operating budgets to inform department managers how they compare with comparable hospitals in the state and nation.	
58. Expand the information being obtained on doctor's admissions by financial class to include total charges to patients and collections on their patient accounts.	
59. Instant recall of all financial information by cathode-ray tube. If this cannot be accomplished to receive a quarterly step down allocation, take into consideration the variables that affect the respective cost centers, e.g., change in sq. ft., number of employees.	
60. Monthly training reports prepared by our Personnel Development Department.	
61. Executive Communications: Conventions and Meetings for the week--(1) What, (2) Where, (3) When, (4) Those Attending.	

Information Source	Dollars/ Year
62. Executive Communications: Budget to Date (once a month).	
63. Executive Communications: Ideas for and changes in policies and procedures (made within broad policies set by Board).	
64. Executive Communications: Visitors expected during the week--architects, consultants, auditors, groups or individuals for any reason, JCAH, etc.	
65. Executive Communications: Any undue maintenance or repair problems and their costs.	
66. Executive Communications: Any problems that involve doctors, that might result in lawsuits, or poor public relations, pertain to hiring and/or firing of personnel, etc.	
67. Executive Communications: Ideas for increasing economy or efficiency of operation, for changing forms, etc.	
68. Executive Communications: Communications received which pertain to hospital function or trends: AHA, OHA, Medicare, OCCH, OCAHC, Chamber of Commerce, etc.	
69. Executive Communications: Report of progress on ongoing activities; National Hospital Week, construction of new hospital, bids on equipment, employment of key personnel, contracts, etc.	
70. Executive Communications: Recommendations made to administration by Medical Staff Committees.	
71. Executive Communications: New equipment or new kind of supplies purchased.	
72. Executive Communications: Feedback on problems that have been solved or activities that have been initiated.	

PART IV

STATISTICS

Listed below are the group statistics on the relative worth of each information document or source of information

Document Name or Information Source	Information Worth		
	Low Quartile (Q ₁)	Median	High Quartile (Q ₃)
1. Administrative Memos	22,500	35,700	45,000
2. New or Revised Policies	19,000	59,000	55,000
3. Procedures	12,500	28,500	56,250
4. Incident Reports	13,500	15,000	40,000
5. Security Reports	3,500	5,000	13,750
6. Laboratory Report	1,750	7,000	25,000
7. Physical Therapy Report	750	3,000	13,875
8. X-Ray Reports	1,500	7,000	17,500
9. Heart Station Report	750	3,000	11,000
10. Executive-Joint Conference Report	8,500	21,500	20,000
11. Graduate Education Committee Minutes	1,000	1,000	10,000
12. Patient Relations Committee	2,000	4,000	15,000
13. Operating Room Committee	2,000	3,000	12,500
14. Infection Control Meeting	7,500	10,000	17,500
15. Credentials Committee	4,500	10,000	20,000

Document Name or Information Source	Median		
	Low Quartile (Q ₁)		High Quartile (Q ₃)
16. Utilization Review	7,500	15,000	68,750
17. Ambulant Care Committee	1,000	1,600	17,500
18. Tissue Committee	4,000	6,000	17,500
19. General Staff Meeting	7,500	10,000	20,000
20. Medical Care Appraisals Committee	2,000	5,000	15,000
21. Nominating Committee	8,500	10,000	23,750
22. OB Dept. Meeting	1,000	3,000	12,500
23. Pharmacy and Therapeutics Committee	1,375	5,000	10,000
24. Research Committee	500	1,000	7,500
25. Personnel Development Meeting	5,000	5,000	10,250
26. Advisory Board	15,000	40,000	520,000
27. Executive Council	5,000	28,000	40,000
28. Board of Trustees	3,000	30,000	150,000
29. Department Managers	15,000	40,000	40,000
30. Auxiliary Meeting	5,000	5,000	41,000
31. Surgery Report	1,000	3,000	7,500
32. Night Summary Report	2,000	3,000	5,000
33. Room Availability Sheet	3,000	5,000	30,000
34. Daily Occupancy Report	3,000	10,000	20,000
35. Travel Vouchers	925	1,000	6,500
36. Daily Admission Report	2,000	5,000	9,125

Document Name or Information Source	Median		
	Low Quartile (Q ₁)		High Quartile (Q ₃)
37. Nsg. Serv. Report	1,500	3,000	9,000
38. Overtime Analysis	8,500	10,000	13,375
39. Employee Benefits Cost Analysis	3,500	5,000	16,250
40. New Hire & Term.	3,000	10,000	32,500
41. Occupational Injury	5,000	7,000	12,575
42. Budgets	35,000	80,000	100,000
43. Doctors Data	4,000	5,000	7,750
44. Mercy "Progress"	4,000	10,000	15,000
45. Memos	1,000	3,000	13,750
46. Letters (cc)	1,000	5,000	12,500
47. Nsg. Serv. Paint Sch.	750	1,000	5,000
48. HAS Comparative Study	5,000	5,000	17,500
49. Dr. Admission by Fin. Class	5,000	21,700	87,500
50. Financial Statements	20,000	70,000	67,500
51. Monthly Statistic Report	5,000	10,000	30,000
52. Annual Statistic Report	7,500	10,000	47,500
53. Executive Communications Minutes of Meetings	1,500	5,000	7,500
54. Executive Communications Planning & Bldg. Prog.	5,000	10,000	20,000
55. Executive Communications P.R. & Develop- ment Progress	2,000	5,000	13,750

Document Name or Information Source	Median		
	Low Quartile (Q ₁)		High Quartile (Q ₃)
56. Executive Communications Community Agencies	1,500	3,000	7,500
57. New Item of Information	4,000	8,000	17,500
58. New Item of Information	5,000	11,900	90,000
59. New Item of Information	16,250	80,000	72,500
60. New Item of Information	1,500	8,000	10,000
61. New Item of Information	650	1,000	2,750
62. New Item of Information	3,500	5,000	25,000
63. New Item of Information	3,500	5,000	20,000
64. New Item of Information	500	1,000	5,000
65. New Item of Information	500	1,000	17,500
66. New Item of Information	6,000	10,000	75,000
67. New Item of Information	4,000	10,000	37,000
68. New Item of Information	5,000	7,000	30,000
69. New Item of Information	425	900	12,500
70. New Item of Information	1,000	5,000	17,500
71. New Item of Information	650	3,000	8,750
72. New Item of Information	835	2,000	7,500

APPENDIX III

INFORMATION WORTH (w_j) STATISTICS

Round 1-2-3-4 (Five Respondents)

<u>Document</u>	<u>Round</u>	<u>Low Quartile</u>	<u>Median</u>	<u>High Quartile</u>
1.	1	7,500	20,000	100,000
	2	15,000	20,000	75,000
	3	17,500	25,000	62,500
	4	22,500	35,700	45,000
2.	1	10,000	90,000	150,000
	2	10,000	80,000	100,000
	3	10,000	70,000	80,000
	4	19,000	59,000	70,000
3.	1	6,000	30,000	150,000
	2	8,500	30,000	100,000
	3	10,000	40,000	75,000
	4	12,500	28,500	56,250
4.	1	7,500	15,000	75,000
	2	10,750	15,000	62,500
	3	11,800	15,000	50,000
	4	13,500	15,000	40,000
5.	1	1,000	5,000	35,000
	2	1,000	5,000	27,800
	3	1,000	5,000	17,500
	4	3,500	5,000	13,750
6.	1	800	10,000	95,000
	2	900	10,000	92,500
	3	1,250	8,000	30,000
	4	1,750	7,000	25,000

<u>Document</u>	<u>Round</u>	<u>Low Quartile</u>	<u>Median</u>	<u>High Quartile</u>
7.	1	300	3,000	30,000
	2	400	3,000	17,500
	3	450	3,000	13,750
	4	750	3,000	13,875
8.	1	800	10,000	60,000
	2	900	10,000	35,000
	3	1,200	5,000	15,000
	4	1,500	7,000	17,500
9.	1	300	3,000	55,000
	2	400	3,000	37,500
	3	450	3,000	22,500
	4	750	3,000	11,000
10.	1	4,500	40,000	75,000
	2	7,000	30,000	37,500
	3	9,000	26,000	35,000
	4	8,500	21,500	25,000
11.	1	750	1,000	50,000
	2	875	1,000	30,000
	3	950	1,000	17,500
	4	1,000	1,000	10,000
12.	1	1,000	10,000	37,500
	2	1,000	10,000	25,000
	3	1,000	4,000	21,250
	4	2,000	4,000	15,000
13.	1	1,000	10,000	30,000
	2	1,000	10,000	17,500
	3	1,000	3,000	20,000
	4	2,000	3,000	12,500
14.	1	3,000	10,000	50,000
	2	5,000	10,000	50,000
	3	5,000	10,000	30,500
	4	7,500	10,000	17,500

<u>Document</u>	<u>Round</u>	<u>Low Quartile</u>	<u>Median</u>	<u>High Quartile</u>
15.	1	2,500	5,000	75,000
	2	3,250	5,000	50,000
	3	3,625	5,000	37,500
	4	4,500	10,000	20,000
16.	1	1,000	10,000	125,000
	2	1,250	10,000	112,500
	3	1,125	3,000	75,000
	4	7,500	15,000	68,000
17.	1	750	1,000	50,000
	2	1,000	1,000	37,500
	3	1,000	1,000	31,250
	4	1,000	1,600	17,500
18.	1	2,750	10,000	50,000
	2	2,750	10,000	31,250
	3	2,750	10,000	27,500
	4	4,000	6,000	17,500
19.	1	1,000	10,000	37,500
	2	3,000	10,000	25,000
	3	4,000	10,000	25,000
	4	7,500	10,000	20,000
20.	1	1,000	10,000	62,500
	2	1,000	10,000	43,750
	3	1,000	4,000	34,375
	4	2,000	5,000	15,000
21.	1	750	10,000	75,000
	2	4,250	10,000	50,000
	3	6,250	10,000	37,500
	4	8,500	10,000	23,750
22.	1	300	10,000	37,500
	2	300	10,000	25,000
	3	650	5,000	25,000
	4	1,000	3,000	12,500

<u>Document</u>	<u>Round</u>	<u>Low Quartile</u>	<u>Median</u>	<u>High Quartile</u>
23.	1	2,750	5,000	30,000
	2	2,750	5,000	17,500
	3	750	6,000	17,500
	4	1,375	5,000	10,000
24.	1	100	3,000	50,000
	2	300	3,000	30,000
	3	400	2,000	17,800
	4	500	1,000	7,500
25.	1	1,250	5,000	30,000
	2	3,750	5,000	20,000
	3	4,375	5,000	14,000
	4	5,000	5,000	10,250
26.	1	7,500	20,000	525,000
	2	6,250	15,000	510,000
	3	15,000	15,000	440,000
	4	15,000	40,000	420,000
27.	1	5,500	10,000	60,000
	2	300	10,000	400,000
	3	5,000	20,000	60,000
	4	5,000	28,000	40,000
28.	1	10,000	30,000	550,000
	2	25,000	30,000	325,000
	3	3,000	30,000	217,000
	4	3,000	30,000	150,000
29.	1	7,500	15,000	150,000
	2	10,000	15,000	85,000
	3	12,500	15,000	47,500
	4	15,000	40,000	47,500
30.	1	3,000	5,000	260,000
	2	3,000	5,000	134,500
	3	4,000	5,000	72,000
	4	5,000	5,000	41,000

<u>Document</u>	<u>Round</u>	<u>Low Quartile</u>	<u>Median</u>	<u>High Quartile</u>
31.	1	300	5,000	50,000
	2	400	5,000	15,000
	3	550	3,000	10,000
	4	1,000	3,000	75,000
32.	1	100	5,000	15,000
	2	750	5,000	12,500
	3	875	2,500	7,500
	4	2,000	3,000	5,000
33.	1	5,050	5,000	460,000
	2	3,000	5,000	102,500
	3	2,000	4,000	52,500
	4	3,000	5,000	30,000
34.	1	1,000	5,000	105,000
	2	3,000	5,000	55,000
	3	2,000	4,000	32,500
	4	3,000	10,000	20,000
35.	1	300	20,000	35,000
	2	650	5,000	27,500
	3	650	5,000	22,500
	4	925	1,000	6,500
36.	1	550	5,000	30,000
	2	775	5,000	17,500
	3	750	4,000	13,250
	4	2,000	5,000	9,125
37.	1	550	10,000	30,000
	2	750	5,000	15,000
	3	775	5,000	20,000
	4	1,500	3,000	9,000
38.	1	1,000	18,000	50,000
	2	3,000	10,000	21,500
	3	4,000	10,000	15,750
	4	8,500	10,000	13,375

<u>Document</u>	<u>Round</u>	<u>Low Quartile</u>	<u>Median</u>	<u>High Quartile</u>
39.	1	500	10,000	35,000
	2	750	10,000	27,500
	3	875	3,000	17,500
	4	3,500	5,000	16,250
40.	1	300	10,000	290,000
	2	500	10,000	107,800
	3	750	4,000	50,000
	4	3,000	10,000	32,500
41.	1	2,750	10,000	37,500
	2	3,375	10,000	22,500
	3	4,185	6,000	20,000
	4	5,000	7,000	12,575
42.	1	7,500	50,000	300,000
	2	11,250	50,000	175,000
	3	17,000	50,000	125,000
	4	35,000	80,000	100,000
43.	1	1,000	10,000	62,500
	2	3,000	10,000	17,500
	3	3,000	4,000	10,000
	4	4,000	5,000	12,500
44.	1	3,000	5,000	55,000
	2	4,000	5,000	37,500
	3	4,000	5,000	23,500
	4	4,000	10,000	15,000
45.	1	750	10,000	55,000
	2	875	10,000	37,500
	3	890	3,000	22,250
	4	1,000	3,000	13,750
46.	1	550	10,000	60,000
	2	775	10,000	40,000
	3	887	6,000	15,000
	4	1,000	5,000	12,500

<u>Document</u>	<u>Round</u>	<u>Low Quartile</u>	<u>Median</u>	<u>High Quartile</u>
47.	1	100	10,000	30,000
	2	300	10,000	21,500
	3	400	1,000	7,000
	4	750	1,000	5,000
48.	1	1,000	50,000	75,000
	2	3,000	20,000	62,500
	3	4,000	5,000	20,000
	4	5,000	5,000	17,500
49.	1	2,750	50,000	300,000
	2	3,900	30,000	200,000
	3	4,525	25,000	125,000
	4	5,000	21,700	87,500
50.	1	7,500	20,000	380,000
	2	9,000	20,000	200,000
	3	17,500	50,000	75,000
	4	20,000	70,000	75,000
51.	1	750	10,000	300,000
	2	3,000	10,000	160,000
	3	4,000	6,000	55,000
	4	5,000	10,000	30,000
52.	1	500	10,000	550,000
	2	4,000	10,000	285,000
	3	4,500	8,000	80,000
	4	7,500	10,000	47,500
53.	1	300	5,000	27,500
	2	500	5,000	15,000
	3	500	1,500	10,000
	4	1,500	5,000	75,000
54.	1	3,000	10,000	40,000
	2	4,000	5,000	35,000
	3	4,500	5,000	27,500
	4	5,000	10,000	20,000

<u>Document</u>	<u>Round</u>	<u>Low Quartile</u>	<u>Median</u>	<u>High Quartile</u>
55.	1	750	10,000	30,000
	2	875	5,000	20,000
	3	950	3,000	17,500
	4	2,000	5,000	13,750
56.	1	750	5,000	30,000
	2	875	5,000	17,500
	3	950	2,000	11,250
	4	1,500	3,000	7,500
57.	1	5,500	10,000	100,000
	2	1,000	10,000	57,500
	3	1,000	3,000	30,000
	4	4,000	8,000	17,500
58.	1	3,000	100,000	550,000
	2	4,000	20,000	325,000
	3	4,500	15,000	155,000
	4	5,000	10,900	90,000
59.	1	7,500	30,000	350,000
	2	10,000	20,000	190,000
	3	12,500	20,000	90,000
	4	16,250	80,000	90,000
60.	1	1,000	5,000	31,000
	2	1,000	2,000	18,500
	3	1,000	2,000	13,500
	4	1,500	8,000	10,000
61.	1	100	5,000	10,000
	2	100	1,000	7,500
	3	100	1,000	5,000
	4	650	1,000	2,750
62.	1	1,000	5,000	112,000
	2	1,000	10,000	62,000
	3	1,000	6,000	40,000
	4	3,800	5,000	25,000

<u>Document</u>	<u>Round</u>	<u>Low Quartile</u>	<u>Median</u>	<u>High Quartile</u>
63.	1	1,000	10,000	75,000
	2	1,000	5,000	42,500
	3	1,000	5,000	33,250
	4	3,500	5,000	20,000
64.	1	100	5,000	11,000
	2	100	2,000	11,000
	3	100	2,000	7,500
	4	500	1,000	5,000
65.	1	350	36,000	62,500
	2	350	36,000	42,000
	3	350	3,000	30,000
	4	500	1,000	17,500
66.	1	750	100,000	550,000
	2	1,000	100,000	300,000
	3	1,000	10,000	150,000
	4	6,000	10,000	75,000
67.	1	3,000	24,000	250,000
	2	3,000	24,000	100,000
	3	3,000	5,000	61,000
	4	4,000	10,000	37,000
68.	1	300	12,000	550,000
	2	400	10,000	181,000
	3	400	1,000	55,000
	4	5,000	7,000	30,000
69.	1	150	12,000	75,000
	2	350	10,000	31,000
	3	350	1,000	20,000
	4	425	900	12,500
70.	1	1,000	50,000	650,000
	2	1,000	10,000	50,000
	3	1,000	3,000	30,000
	4	1,000	5,000	17,500

<u>Document</u>	<u>Round</u>	<u>Low Quartile</u>	<u>Median</u>	<u>High Quartile</u>
71.	1	100	10,000	75,000
	2	300	5,000	23,500
	3	300	1,000	15,000
	4	650	3,000	8,750
<hr/>				
72.	1	550	10,000	50,000
	2	775	10,000	17,500
	3	785	1,000	10,000
	4	835	2,000	7,500
<hr/>				

APPENDIX IV

THE RELATIVE VALUE (u_j) CALCULATIONS

Where: $(u_j) = (w_j - c_j)$

<u>Document</u>	<u>(w_j)</u>	-	<u>(c_j)</u>	=	<u>(u_j)</u>
1.	35,700	-	15,000	=	20,700
2.	59,000	-	25,000	=	34,000
3.	28,500	-	10,000	=	18,500
4.	15,000	-	5,000	=	10,000
5.	5,000	-	2,000	=	3,000
6.	7,000	-	1,200	=	5,800
7.	3,000	-	400	=	2,600
8.	7,000	-	600	=	6,400
9.	3,000	-	400	=	2,600
10.	21,500	-	6,000	=	15,500
11.	1,000	-	400	=	600
12.	4,000	-	300	=	3,700
13.	3,000	-	600	=	2,400
14.	10,000	-	5,000	=	5,000
15.	10,000	-	1,000	=	9,000
16.	15,000	-	10,000	=	5,000
17.	1,600	-	600	=	1,000
18.	6,000	-	800	=	5,200
19.	10,000	-	10,000	=	0
20.	5,000	-	600	=	4,400
21.	10,000	-	4,000	=	6,000
22.	3,000	-	1,000	=	2,000
23.	5,000	-	1,000	=	4,000
24.	1,000	-	100	=	900
25.	5,000	-	1,000	=	4,000
26.	40,000	-	3,000	=	37,000
27.	28,000	-	10,000	=	18,000
28.	30,000	-	5,000	=	25,000
29.	40,000	-	15,000	=	25,000
30.	5,000	-	2,000	=	3,000
31.	3,000	-	1,000	=	2,000
32.	3,000	-	1,000	=	2,000
33.	5,000	-	4,000	=	1,000

<u>Document</u>	<u>(w_j)</u>	-	<u>(c_j)</u>	=	<u>(u_j)</u>
34.	10,000	-	6,000	=	4,000
35.	1,000	-	500	=	500
36.	5,000	-	500	=	4,500
37.	3,000	-	2,000	=	1,000
38.	10,000	-	6,000	=	4,000
39.	5,000	-	1,000	=	4,000
40.	10,000	-	6,000	=	4,000
41.	7,000	-	1,000	=	6,000
42.	80,000	-	30,000	=	50,000
43.	5,000	-	2,000	=	3,000
44.	10,000	-	6,000	=	4,000
45.	3,000	-	800	=	2,200
46.	5,000	-	800	=	4,200
47.	1,000	-	400	=	600
48.	5,000	-	4,000	=	1,000
49.	21,700	-	6,000	=	15,700
50.	70,000	-	30,000	=	40,000
51.	10,000	-	3,000	=	7,000
52.	10,000	-	1,000	=	9,000
53.	5,000	-	1,200	=	3,800
54.	10,000	-	1,200	=	8,800
55.	5,000	-	1,200	=	3,800
56.	3,000	-	1,000	=	2,000
57.	8,000	-	1,000	=	7,000
58.	11,900	-	1,000	=	10,900
59.	80,000	-	30,000	=	50,000
60.	8,000	-	1,000	=	7,000
61.	1,000	-	100	=	900
62.	5,000	-	1,000	=	4,000
63.	5,000	-	1,000	=	4,000
64.	1,000	-	100	=	900
65.	1,000	-	100	=	900
66.	10,000	-	1,100	=	8,900
67.	10,000	-	1,000	=	9,000
68.	7,000	-	600	=	6,400
69.	900	-	600	=	300
70.	5,000	-	500	=	4,500
71.	3,000	-	600	=	2,400
72.	2,000	-	500	=	1,500

APPENDIX

OPTIMUM SOLUTION PER ALLOCATED RESOURCE

Allocated Dollar Resource	Relative Value	Documents in Optimum Solution	Documents Not in Optimum Solution
2950	5908	All	None
2900	5889	1,2,3,4,5,6,7,8,9,10,11,12,13, 14,15,16,17,18,19,20,21,22,23, 24,25,26,27,28,29,30,31,32,33, 34,35,36,37,38,39,40,41,42,43, 44,45,46,49,50,51,52,53,54,55, 56,57,58,59,60,61,62,63,64,65, 66,67,68,70,71,72	47,48,69
2800	5889	1,2,3,4,5,6,7,8,9,10,11,12,13, 14,15,16,17,18,20,21,22,23,24, 25,26,27,28,29,30,31,32,33,34, 35,36,37,38,39,40,41,42,43,44, 45,46,49,50,51,52,53,54,55,56, 57,58,59,60,61,62,63,64,65,66, 67,68,70,71,72	19,47,48,69

Allocated Dollar Resource	Relative Value	Documents in Optimum Solution	Documents Not in Optimum Solution
2700	5839	1,2,3,4,5,6,7,8,9,10,11,12,13, 14,15,17,18,20,21,22,23,24,25, 26,27,28,29,30,31,32,33,34,35, 36,37,38,39,40,41,42,43,44,45, 46,49,50,51,52,53,54,55,56,57, 58,59,60,61,62,63,64,65,66,67, 68,70,71,72.	16,19,47,48,69
2600	5789	1,2,3,4,5,6,7,8,9,10,11,12,13, 14,15,17,18,20,21,22,23,24,25, 26,27,28,29,30,31,32,35,36,37, 38,39,40,41,42,43,45,46,50,51, 52,53,54,55,56,57,58,59,60,61, 62,63,64,65,66,67,68,70,71,72	16,19,33,34,44, 47,48,49,69
2490	5718	1,2,3,4,5,6,7,8,9,10,11,12,13, 14,15,17,18,20,21,22,23,24,25, 26,27,28,29,30,31,32,34,35,36, 37,39,41,42,43,45,46,47,49,50, 51,52,53,54,55,56,57,58,59,60, 61,62,63,64,65,66,67,68,69,70, 71,72	16,19,33,38,40 44,48

Allocated Dollar Resource	Relative Value	Documents in Optimum Solution	Documents Not in Optimum Solution
2400	5648	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 35, 36, 39, 41, 42, 43, 45, 46, 47, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72	16, 19, 33, 34, 37, 38, 40, 44, 48
2390	5639	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 35, 36, 39, 41, 42, 43, 45, 46, 49, 50, 51, 52, 53, 54, 55, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 70, 71, 72	16, 19, 33, 34, 37, 38, 40, 44, 47, 48, 56, 69
2385	5634	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 36, 39, 41, 42, 43, 45, 46, 49, 50, 51, 52, 53, 54, 55, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 70, 71, 72	16, 19, 33, 34, 35, 37, 38, 40, 44, 47, 48, 56, 69
2380	5629	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 35, 36, 39, 41, 42, 45, 46, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 70, 71, 72	16, 19, 33, 34, 37, 38, 40, 43, 44, 47, 48, 69

Allocated Dollar Resource	Relative Value	Documents in Optimum Solution	Documents Not in Optimum Solution
2370	5618	1,2,3,4,5,6,7,8,9,10,11,12,13, 15,17,18,20,21,22,23,24,25,26, 27,28,29,30,31,32,35,36,37,39, 41,42,43,45,46,49,50,51,52,53, 54,55,56,57,58,59,60,61,62,63, 64,65,66,67,68,70,71,72	14,16,19,33,34, 38,40,44,47,48, 69
2340	5584	1,2,3,4,5,6,7,8,9,10,11,12,13, 15,17,18,20,21,22,23,24,25,26, 27,28,29,30,31,32,35,36,39,41, 42,43,45,46,49,50,51,52,53,54, 55,57,58,59,60,61,62,63,64,65, 66,67,68,70,71,72	14,16,19,33,34, 37,38,40,44,47, 48,56,69
2300	5529	1,2,3,4,5,6,7,8,9,10,11,12,13, 15,17,18,20,22,23,24,25,26,27, 28,29,30,31,32,35,36,39,41,42, 43,45,46,49,50,51,52,53,54,55, 57,58,59,60,61,62,63,64,65,66, 67,68,70,71,72	14,16,19,21,33, 34,37,38,40,44, 47,48,56,69
2200	5402	2,3,4,5,6,7,8,9,10,11,12,13,15, 17,18,20,21,22,23,24,25,26,27, 28,29,30,31,32,35,36,39,41,42, 43,45,46,49,50,51,52,53,54,55, 56,57,58,59,60,61,62,63,64,65, 66,67,68,70,71,72	1,14,16,19,33, 34,37,38,40,44, 47,48,69

Allocated Dollar Resource	Relative Value	Documents in Optimum Solution	Documents Not in Optimum Solution
2100	5269	1,3,4,5,6,7,8,9,10,11,12,13, 15,17,18,20,21,22,23,24,25,26, 27,28,29,30,31,32,35,36,39,41, 42,43,45,46,49,50,51,52,53,54, 55,56,57,58,59,60,61,62,63,64, 65,66,67,68,70,71,72	2,14,16,19,33, 34,37,38,40,44, 47,48,69
2000	5129	1,2,3,4,5,6,7,8,9,10,11,12,13, 15,17,18,20,22,23,24,25,26,27, 28,29,30,31,32,35,36,39,41,42, 43,45,46,49,51,52,53,54,55,57, 58,59,60,61,62,63,64,65,66,67, 68,70,71,72	14,16,19,21,33, 34,37,38,40,44, 47,48,50,56,69
1900	4962	2,3,4,5,6,7,8,9,10,11,12,13, 15,17,18,20,21,22,23,24,25,26, 27,28,29,30,31,32,35,36,39,41, 42,43,45,46,49,51,52,53,54,55, 56,57,58,59,60,61,62,63,64,65, 66,67,68,70,71,72	1,14,16,19,33, 34,37,38,40,44, 47,48,50,69

APPENDIX VI

SIMULATION

NO. OF CONSTRAINTS =	2
NO. OF VARIABLES =	72
INITIAL VALUE OF Z =	0
TIME LIMIT IS 55 MINUTES	

OPTIONS SELECTED HAVE A POSITIVE VALUE

NR1 = 0	NR2 = 0	NF1 = 0	NF2 = 1	NS1 = 1	NH1 = 0
---------	---------	---------	---------	---------	---------

C(J)	-247	-340	-195	-100	-30	-58	-26	-64	-26	-155	-4	-37	-24	-50	-90
	-50	-10	-52	0	-44	-50	-20	-40	-9	-40	-370	-180	-250	-250	-30
	-20	-20	-10	-40	-5	-45	-10	-40	-40	-40	-60	-500	-30	-40	-22
	-42	-6	-10	-157	-400	-70	-90	-38	-88	-38	-20	-70	-109	-500	-70
	-9	-40	-40	-9	-9	-89	-90	-64	-3	-45	-24	-15			

MATRIX OF CONSTRAINTS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	-150	-250	-100	-50	-20	-12	-4	-6	-4	-60	-6	-3	-6	-50	-10
2	150	250	100	50	20	12	4	6	4	60	6	3	6	50	10
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	-100	-6	-8	-100	-6	-40	-10	-10	-1	-10	-30	-100	-50	-150	-20
2	100	6	8	100	6	40	10	10	1	10	30	100	50	150	20
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
1	-10	-10	-40	-60	-5	-5	-20	-60	-10	-60	-10	-300	-20	-60	-8
2	10	10	40	60	5	5	20	60	10	60	10	300	20	60	8
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
1	-8	-4	-40	-60	-300	-30	-10	-12	-12	-12	-10	-10	-10	-300	-10
2	8	4	40	60	300	30	10	12	12	12	10	10	10	300	10
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	61	62	63	64	65	66	67	68	69	70	71	72	73		
1	-1	-10	-10	-1	-1	-11	-10	-6	-6	-6	-6	-5	-2600		
2	1	10	10	1	1	11	10	6	6	6	6	5	2600		
3	0	0	0	0	0	0	0	0	0	0	0	0	0		

