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PUBLIC INFORMATION SYSTEMS: A WEAK PROPOSAL AND TEST OF A CONTINGENCY THEORY IN CALIFORNIA CITIES

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I. INTRODUCTION

The aim of this research is to formalize and summarize the theory of Information Systems — which to my knowledge has not been done before — and to propose and test a contingency theory relating the type of the information systems to the corresponding societal decision making model found to explain the behavior of public organizations in regard to public policies enactment.

It is my basic assumption that the problematic of information systems is based on the following paradox or apparent contradiction:

> *Information Paradox (IP): To define the relevant information to a decision situation, it is necessary to know what decisions should be made; to define what decisions should be made it is necessary to have relevant information on the decision situation.*

According to the way the solution to the IP was presented, information and information systems were defined and implemented in the great majority of organizations throughout the world, using computers as a technological base. We will discuss below the paradigms behind the present IS's and to extend the contingency theory to propose a new IS paradigm.

1. Data Processing Theory

Historically this was the first paradigm introduced. The IP is solved partially by accumulating all possible data related to the decision situation, and later, processing this data to produce the information necessary for a given problem.

In this paradigm information is the processing of data to provide information; data are raw facts. "An IS is ... a systematic, formal assemblage of components that perform data processing (a) to meet legal and transactional data processing requirements, (b) to provide information to management for support of planning, controlling, and decision-making activities, and (c) to provide a variety of reports, as required, to external constituents" (Burch and Strater, 1974, p. 71).

Without considering the ambiguity of the terms used, and the circularity of the categories used, let us consider three implicit assumptions of this paradigm and the consequences derived from them:

a) It is feasible to accumulate data on all the facts related to the decision situation.

b) It is possible to know how to process any given data to produce knowledge of all the users.

c) The users know their information needs and the designer should ask them.

These assumptions are misleading because, in the first case, facts are not things. They depend upon the view of the world of the one who is supposed to identify them, as well as upon the one who is going to collect them as data. Furthermore, what is the meaning of the phrase "all the facts"? Should the full reality be recorded? "Reality consists of an infinitely divisible profusion. Even if we should focus upon one particular element of reality, we find it partakes of this infinity" (Giddens, 1971, p. 138). The consequence of this assumption was, and still is, the construction of large, all embracing, and very expensive data banks. The second assumption, if not fulfilled, would generate two possible consequences (a) either not all data captured will be processed to produce information, or (b) non-information will be produced from the captured data and provided to a recipient. There is enough evidence in the practice that both are taking place, the so-called, computer under-utilization and information overload. Also the concept that the data collected can be used for all kinds of problems contradicts ideas developed by Anthony (1965) and Gorry and Scott-Morton (1970): there are different levels of decisions — strategic, tactic, and operational — for which different types of information and data are required. The third assumption is, in fact, the transfer of the IP problem to the users. In this circumstance "the manager(s) who does not fully understand the phenomenon that he controls plays it 'safe' and wants as much information as he can get ... The result is an increase in the overload of irrelevant information" (Ackoff, 1970, p. 116). Therefore, the third assumption reenforces the second and the organizations are immersed in lengthy reports.

The components of an IS are seen to be: (a) data and information flows, (b) data processing operations, (c) management and operational interfaces, and (d) external users interfaces. The data and information flows correspond to the routines that assure that the "source documents" arrive at the data processing center and that the "output reports" are distributed throughout the organization. The "interfaces" with internal and external users provide the logic to transform source documents into output reports. The data processing function performs data manipulation and computations in order to implement this logic.

2. Decision Analysis Theory

The IP is solved through identification of the decision hierarchy — strategic, tactic and operational — and determination of relevant information for each of these levels. Emphasis is placed on the definition of the organizations' environment, strategies and objectives, from which "key decisions" are identified in terms of their contribution to the objectives. They are then classified according to the level of commitment of the organization in terms of the time, resources, and threats to survival involved in each one of these decisions. This solution to the IP is the reverse of the previous one. Instead of starting from information to reach a decision, we study decisions to identify information. This is the prevailing paradigm today because of its logical and emotional appeal to managers or bureaucrats — the decision, policy-makers — bringing IS into their jurisdiction.

Information is "data that has been processed into a form that is meaningful to the recipient and is of real or perceived value in current or prospective decisions," while "data, the raw material for information, is defined as groups of non-random symbols which represent quantities, actions, things, etc." (Davis, 1974, pp. 32-33). An IS "is defined as a federation of functional subsystems, each of which is divided into four major information processing sections: transaction processing, operations information systems support, managerial control information systems support, and strategic planning information systems support" (Davis, 1974, p. 219).

The components of an IS are seen to be: (a) functional-hierarchical information processing sub-systems, (b) a data base sub-system, (c) common applications software, and (d) a model base. The first component comprises "application programs written especially for the sub-systems, ..."; while the model base is comprised of "many analytical and decision models ... that can be used by many applications" (Davis, 1974, p. 219). Finally, the data base consists of the different data necessary to generate information for the information processing sub-systems.

The assumptions of this paradigm and its consequences are:

a) It is feasible to know how to process any given data to produce knowledge for all decision-makers.

b) It is possible to perceive beforehand what information will be valuable for any given decision.

c) The users — decision-makers — know what kind of decisions should be made before they occur.

The first assumption was reviewed previously in the Data Processing paradigm and leads to computer under-utilization and information overload. The second assumption is true "ceteris paribus," the structure of the decisions that are modelled are the ones that are, or were, relevant in a given point in time. If no conditions change in the environment, the value system within the organization, or the like, then this same structure would be valid in the future, but unfortunately, this is not the case. For this reason information systems developed to the operational level can be reasonably well defined by this paradigm, but cannot be in the case of tactic systems and definitely not in the case of strategic systems. The third assumption, the transfer or the IP problem to the users, generates the same consequences pointed out before in the DP paradigm. In fact, Munro and Davis (1977, pp. 55-67) observed "that use of the two (paradigms) seemed to result in similar interviews, no difference in practice between methods." This is so because, in my view, the solution provided by the two paradigms is partial — starting from information or decision — and relies on the user to define "a priori" the kind of knowledge he will need and the type of problem with which he will be confronted.

3. Inquiry Systems Theory

The IP is solved through the simultaneous selection of information and the decision to be considered by an inquirer through a dialogue process. The function of the designer becomes to "learn to design and structure the debate underlying a measure (data) so that the richest set of possibilities is generated and the best synthesis is shifted to the characteristics of wicked problems and the possible ways to define or tame a social problem in order to "solve" it.

Information "is knowledge for the purpose of taking effective action" (Mason and Mitroff, 1973, p. 475), and is an internal process that takes place in the inquirer, while "datum (is) a statement given or taken as 'true' for the purpose of inquiry" (Swanson, 1976, p. 12), or 'facts' about the real world, taken to be true" (Mason and Swanson, 1977, pp. 31-32). The guarantors of the data are given by the epistemological method of generating it. An information system is defined as:

> *... an information system consists of at least one PERSON of a certain PSYCHOLOGICAL TYPE who faces a PROBLEM within some ORGANIZATIONAL CONTEXT for which he needs EVIDENCE to arrive at a solution ... and that the evidence is made available to him through some MODE OF PRESENTATION ... A program of research should seek to explore the differing characteristics of an MIS by manipulating these variables systematically (Mason and Mitroff, p. 475).*

The components of an IS are seen to be: (a) a data gathering subsystem, (b) a data processing subsystem, and (c) an inguiring and deciding subsystem. The first subsystem converts primary sensations of the real world into data and includes such processes as sensing, observation, recording and data entry. The data processing function maintains and updates a data base from which it generates reports, evidence of the reality. The inquiring and deciding function converts the reports it receives from queries into information to be used in a decision. The queries — requests for measurement data from the data processing function — direct the search for data from the real world and define the type of report required by the inquirer.

The assumptions of this paradigm and its consequences are:

a) To select a problem is also to choose a solution.
b) The decision problems are wicked and need to be tamed in order to be given a temporacy resolution.
c) The users have a sufficiently defined view of the world.

The first assumption is based in Rittel's arguments: "The information needed to understand the problem dependes upon one's idea for solving it. That is to say: in order to describe a wicked-problem in sufficient detail, one has to develop an exhaustive inventory of all conceivable solutions ahead of time" (1973, p. 161). This is so because to understand a problem we must encounter a set of causes that generates it, and when we do so, we are in fact constraining the problem to the solutions feasible to the causes identified. If we include or exclude new variables and relationships, different solutions will be involved. Although the first assumption is quite straightforward, the second one is not of the same kind because it assumes that we can solve a social problem by successive iterations and "the planner terminates work on wicked problem for considerations that are external to the problem: he runs out of time, or money, or patience" (Rittel, 1973, p. 162). I am not quite sure that the dominance of a programatic criteria — we tame because we need to solve the problem now — is a good reason to prescribe it. Finally, the third assumption requires that users, the inquirers, possess an ideology in order to choose the problem and data to be considered in the IS. It seems to me that the prevailing ideology in the society in which the inquirer was socialized will be present in the user, inquirer, and therefore this assumption is reasonable.

4. Contingency Theory

The IS structure to be evolved in an organization depends upon the type of decision-making process taking place in the given organization. Therefore, given a decision-making type, one theory will explain better than the others the type of IS involved. For the purpose of this research the IS contingency theory is proposed. All three types of information systems theories preceding will be considered as possible explanations, depending upon the following decision-making types:

(a) Data Analysis if the decision model is ecological,
(b) Decision Analysis if the decision model is analytical, and
(c) Inquiry Sytems if the decision model is bureaucratic.

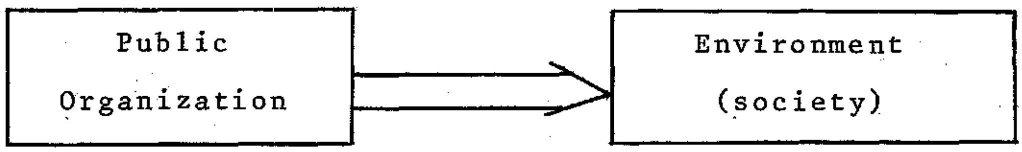
To verify and "prove" an IS contingency theory requires a test of the following conditions:

> *Necessary: There are at least two different models of information systems, in that model i has superior explanatory power over model j in the decision-making process i, and model j has superior explanatory power over model i in the decision-making process j.*
>
> *Sufficient: There are at least two types of decision models that imply different types of information systems, in that over model j in explaining the IS type i, and model j has superior explanatory power over model i in explaining the IS type j.*

This research will test both conditions. It will study through a survey instrument the necessary condition by examining the existing IS types in local government agencies based upon the perception of local agencies' officials of their IS's elements and structure. The sufficient condition will be studied based on a previous work of Bento (1980) on societal decision making. First we are going to use the taxonomy of decision models presented below, extracted from Bento. Then, we will proceed to test the relationships between IS and decision models.

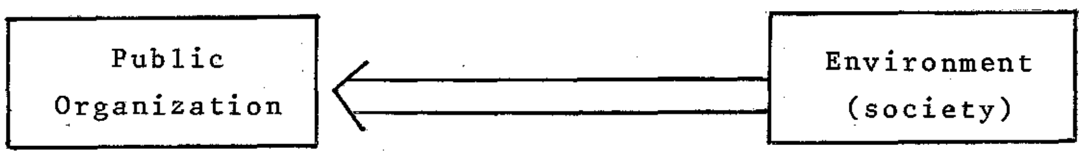
There are at least four theories explaining the process of societal decision-making: (a) bureaucratic theory, (b) ecological theory, (c) analytical or sinoptic theory, and (d) contingency theory.

Bureaucratic Theory: Decision-making in public organizations affects the invironment but is remotely affected by it. Decision-making is internal to the bureaucratic, relying on the dynamics of the organizational life and on the cognitive and informational constraints existing in the turbulent society we live in.



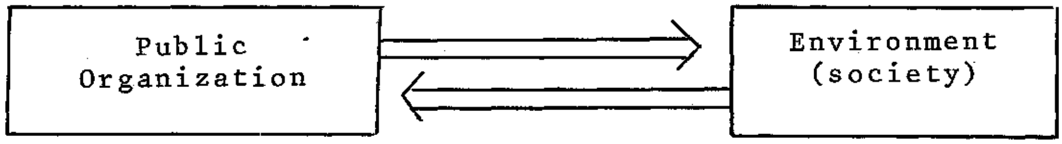
The "Politics of bureaucracy" is the best explanation of public policies being enacted by public organizations.

Ecological Theory: Decision-making in the environment affects public organizations but is remotely affected by them. Decision-making is external to public organizations, and public policies and services reflect the socio-economic characteristics of the environment, the society.



The demand for services and "consumer" satisfaction is the best explanation of public policies which reflect the satisfaction of societal needs by public services and goods.

Analytical Theory: The decision-making process of public organizations affects and is affected by the environment. The decision-making is internal but based on externally determined problems and issues of the society.



The rational analysis of societal problems — the definition of "public interest" or a societal "welfate function," — and the definition of alternatives to cope with them, are the best explanation of public policies.

Contingency Theory: The type of relationship between the public organization and society in the decision-making process depends upon the characteristics of the society in which the organization is immersed. There is no such thing as the best explanation; one theory will explain the relationship of organization-environment to each set of circumstances better than others. For the purpose of this research the contingency theory is also proposed. It will use all of the above theories as possible explanations, depending upon the characteristics of the environment as follows (Emery & Trist, 1965, 1972): (a) bureaucratic theory in turbulent environments, (b) ecological theory in reactive environments, and (c) analytical theory in disturbed-reactive environments.

As a medium-scale exploratory study, this work crosses many untouched lands, combines different trends in social research, and reinterprets many of the previous works. It is an effort to draw attention to IS Theory and research as well as to generate new questions and possibilities for understanding IS.

II. PAST RESEARCH

A survey of theories, frameworks and empirical research in IS is presented in this section. We will concentrate first on past works in theory, and later we will introduce corresponding empirical ones.

Theories and Frameworks

Simon (1960), Anthony (1965), Churchman (1971), and to a lesser extent, Rittel (1972) introduced the basic concepts in this area. Simon developed a framework for the decision-making process — intelligence, design and choice; a framework for decision types — programmed and nonprogrammed; and human cognitive limitations in the processing of information and decision-making, as well as recently a model of man as a "Human Information Processor."

Anthony developed a framework for organizational decision-making based on the level of commitment of organizational resources to a decision and the time-horizon of the consequences of a decision — strategic planning, management control and operational control — and the relationships among these various levels of decision.

Churchman developed a framework for purposeful systems — the nine conditions to something S be conceived as a system; a framework for Inquiry Systems — Lockean, Leibnitzian, Kantian and Singerian; and a framework for social measures — suggestive, predictive, decision and systemic.

Finally, Rittel developed a framework for problem definition — tame and wicked problems; distinguished among different types of knowledge — factual, deontic, explanatory, instrumental and conceptual knowledge; and proposed a "second generation" systems analysis approach — the so-called "conspiracy model". Pervasive in his writings is the notion that to define a problem is also to select a solution to the problem; both are chosen together.

From these thinkers three main currents of thought evolved through time: Inquiry Systems, Decision-Support Systems and Human Information Processing Systems.

The critical works of Hoos (1971, 1972), the evolving papers of Mason (1969), Mason and Mitroff (1973), and Mason and Swanson (1977) represent the trend towards the definition and design of Inquiry Systems based on measurement: a synthesis where Churchman's influence predominates.

The works of Gorry and Scott Morton (1970), Keen (1976) and Carlson (1977) represent the trends towards the definition of information support systems for decision-making — Decision-Support Systems (DSS) — based on decision analysis and modeling — a synthesis where Anthony's influence predominates.

The works of Schroder, Driver and Streufert (1967), and Newell and Simon (1972), among others, represent the trends towards the definition and design of information systems to cope with the human information process characteristics: a synthesis where Simons' influence predominates.

From other fields, such as Economics, Psychology and Sociology, new approaches are also emerging. Marshak (1967, 1969) and Emery (1969) discuss the value of information, based on the economic evaluation of uncertainty reduction. Argyris (1971) argues for the consequences of rationality on organizational life if IS were fully implemented. Allen and Cohen (1969) discuss the dissemination of information using organizational communications theory — the importance of "gate-keepers" and "stars" in the process. Caldwell (1975) and Goerl (1975) argue for "Knowledge Management" — the information production and dissemination — in the public sector as the new role of public administrators, as a policy matter and as the basis for the "social construction of reality."

The area is in a pre-paradigm stage, where overall synthesis is yet to be done, where comprehensive theories and contributions toward this aim are much needed. Figure 1 shows the above trends in IS theory.

Empirical Research

The existing research work reflects the stage of the theory in the area: it is fragmentary, and does not always represent in volume the importance of the arguments for each existing trend — Inquiry Systems, Decision Support, HIP, etc. Using my world view again, let us review some of these works, whose selection is based on a criteria of availability (due to the time constraints imposed on this work) but which are, to a certain extent, also representative of the thrust of the existing research.

Gingras (1975), Danziger and Dutton (1977), Swanson and Cooper (1978) and Bento (1978) works fall in the tradition of Inquiry Systems. Gingras, following Mason and Mitroff and Argyris, studied the difference of psychological types between the designer and the users of information systems. Danziger and Dutton made systemic questions on CBIS usage in local governments, in for example, its relation to other technological innovations, types of "information processing tasks," relationships to the environment, and the like. Swanson and Cooper reviewed the state of the art of MIR — Management Information Requirements — proposed an "Activity Sequence" framework for information analysis, and summarized the applicable theories, methods and "moderating factors." Bento, following Mason and Mitroff and Emery and Trist, studied a contingency theory for decision-making models with regard to the environment types for local government, as a first step to relating information systems types to organizational decision-making and environment types.

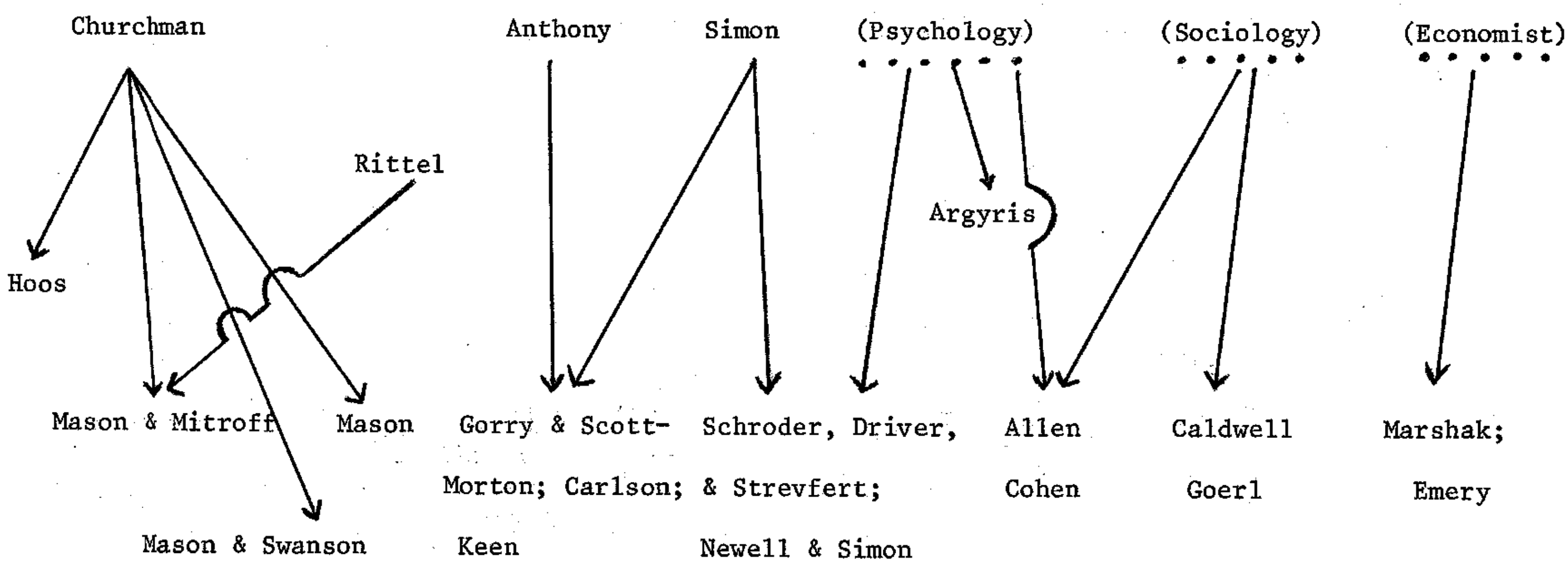


Figure 1
Contributions to IS Theory

Munro and Davis (1977) and Lucas (1978) are representative works in the tradition of Decision Support Systems. Munro and Davis studied decision analysis and data analysis methods to design information systems, measuring the value of information generated by each method and differentiating between structured (programmed) and unstructured (non-programmed) decisions. Lucas, following Gorry and Scott Morton and his own previous works, proposed and conducted an experiment, using the case method, of a so-called "evolutionary design" for IS, emphasizing the importance of implementation: "A ... system which remains unused provides no benefits for an organization and cannot be considered successful."

The works of Mason and Moskowitz (1972), Chervany and Dickson (1974), Driver and Mock (1975), Bariff and Lusk (1977), and Abdel-Khalik (1977) belong to the HIP tradition. Mason and Moskowitz studied "the possible sources and effects of conservatism in human information processing in a management information systems (MIS environment)." Chervany and Dickson studied summarization data and the extent to which this factor affected the information overload of decision-makers, using an experimental setting and students as surrogates. Driver and Mock (1979) using a similar methodology, defined four types of cognitive styles — Flexible, Decisive, Integrative, and Hierarchic — and tested hypothesis of different HIP behaviors for each of these types. Bariff and Lusk studied the relationships between cognitive styles and the choice of report format from an information system. Abdel-Khalik studied the effect of aggregation on the quality of decision-making, in a commercial bank lending decision environment.

Examples of research from other emerging traditions are Fellingham, Mock adn Vasarhelyi (1976) — economics of information, Zand and Sorensen (1975) and Schewe (1976) — psychology — and Pettgrew (1972) — sociology.

Although the quality of research in the area has improved — from mere case descriptions to sophisticated applications of statistical analysis — there is also a lack of standards and critical observations on the usage of certain types of experimental designs, for example, the proliferation of studies of "simulated" decision situations, with "simulated" managers, and "simulate" treatments, etc.

III. RESEARCH HYPOTHESIS

In this study both the necessary and sufficient conditions of an IS Contingency theory will be tested.

The data on the societal decision making models came from Bento (1980). Table 1 summarizes the results obtained in the classification of the cities studied by decision model found to explain the local departments/divisions behavior in regard to public policies enactment.

The information systems will be obtained through a survey instrument as described in the methodology section of this work.

The IS typology to be used is the one described in the introduction of this research: (a) data analysis, (b) decision analysis, and (c) inquiring systems. The dimension to be used to discriminate among these types is the solution to the Information Paradox, that is, how information is selected for the societal decision-making process. The overall model of information systems to be used here is shown in Figure 2 taken from Mason and Swanson (1977, p. 31).

Table II presents the main elements of an IS and their characteristics according to the three theories considered — Data Analysis, Decision Analysis, and Inquiring System.

The survey instrument was designed to present a description of the information system as applied to the budgetary process — the decision situation we are studying — in accordance with the three theories and their characteristics as shown in Table II. The instrument was divided into two sets of measures with regard to the type of information system (theory) implemented in the departments of local government organizations.

Table 1

Decision Models by City

Frequency

THEORY / CITY	BUREAUCRATIC	ECOLOGICAL	ANALYTICAL
Alameda	5	2	0
Alhambra	3	3	1
Berkeley	5	1	1
Compton	2	3	2
Long Beach	5	2	0
Los Angeles	3	2	2
Oakland	5	2	0
Sacramento	7	0	0
San Diego	4	2	1
San Francisco	4	3	0
San Jose	7	0	0
Santa Ana	1	4	2
Whittier	4	1	2
TOTAL	55	25	11
% of Total	60.4	27.5	12.1

Source: Bento (1980, p. 54)

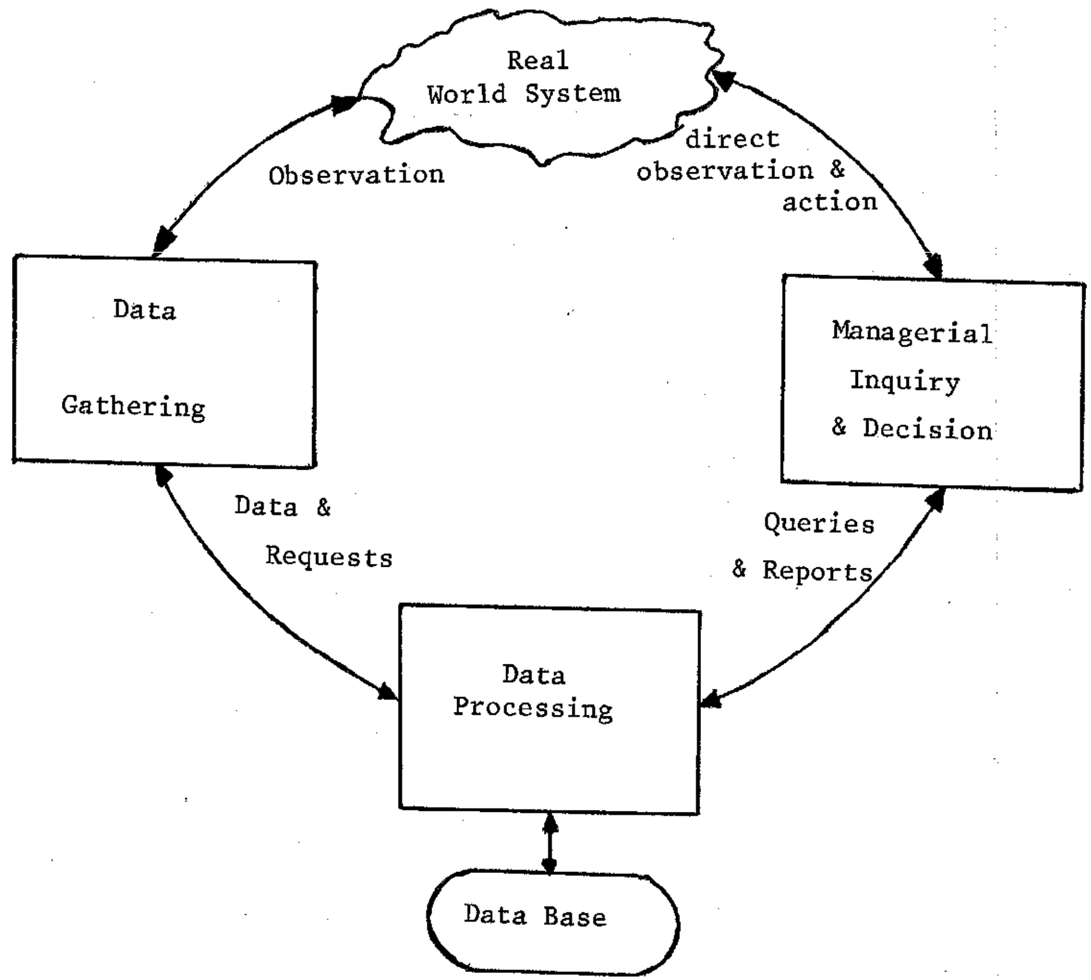


Figure 2 - IS Model

Table II

Theories and Elements of an IS

Theory	Overall Description	Data Gathering	Processing	Reports & Queries
Data Analysis	All data related to the organization decision space is collected, and reports are prepared based on queries.	observations are made of all data related to the decision space.	data oriented processing: combinations of existing data.	selection of decision space data to meet the needs of given decision points in this space.
Decision Analysis	All data relevant to an organization point and reports are prepared based upon a decision model.	observations are made of necessary/relevant data for a decision point.	model oriented processing: procedures and computations of analytical variables.	results of computations and procedures, derived from an a priori schema of the decision-making process.
Inquiring Systems	Data is collected and reports are prepared one taking the other in consideration, in successive "tamings" of the problem situation.	observations are made part of data related to the decision space, and part of data relevant for a decision point.	taming oriented processing: search for a decision schema and data that can produce a resolution of a problem.	part of selections of decision space data and part of results of computations and procedures defined a priori and during the process.

Four intermediate variables were defined in the first set of measures: data, report, processing, and modification. The three first variables refer to the elements of the IS, and the fourth refers to the feed-back mechanism adjusting the preliminary results obtained in the solution of the budget problem; it refers to the way the three previous variables are repeated in order to make corrections to the results. It is important to note that these four variables measure the <u>same dimension</u> of an IS: the solution to the information paradox. By averaging these variables, the first index to classify information systems types is obtained — I_{1i}. The four intermediate variables can assume values between 1 and 3 — Data Analysis to Inquiring Systems — as well as the resulting information system index.

The second set of measures of information system type produce an aggregate index for the existing implementation — I_{2i}. Here, three full descriptions of the IS, in light of the competing theories, are presented. The budgetary information system is described from the point of view of the three theories and the respondents were asked to choose the one closest to their situation.

Finally, a final IS type index is obtained by averaging the two partial and similar, indexes so that: $I_i = (I_{1i} + I_{2i}) /2$. Again, this index is defined in the interval 1 to 3, corresponding to the three types of information systems hypothesized.

Here, again, we assume that performance should be controlled for, in order to predicate the results on how successful an IS is in providing the information needs of a given societal decision-making process. Given the exploratory character of this study, it is extremely difficult to design objective measures of IS performance. This is so because the measurement of the performance of an IS can be understood in at least three different points of view: (a) how much of the information needs of an organization is provided by an IS; (b) how much the information provided by an IS is responsible for the level of knowledge of a given decision situation; and (c) how much information is provided at the level of resources that the organization is willing to pay for it. In none of these approaches, and many others we can think of, is an easy operationalization of the performance measurement available. If measuring the level of information provided is virtually impossible considering the present level of the IS theory, then how can we relate the information provided to information needs, knowledge, etc.? Mason (1977) has discussed this problem and proposed a framework for developing measures of information output, drawing on communication theory measures. Again, the problem of divising, operationalizing, and implementing these performance measures is far beyond the scope of this research — it is another full topic for research.

Another problem is the influence of so-called information needs on the type of information system implemented and on the level of information provided. It is hard to differentiate between information needs as a cause of the information provided from the problem of performance of an information system. This is so because information needs, perceived or measured in a given point in time, can be seen as the previous information needs less the level of information provided by the existing IS. Therefore information needs can be also interpreted as as consequence of the type of information system implemented and of the level of information provided by this same IS. Therefore the information needs can be also interpreted as a measure of performance of an IS, given that the level of resources applied in information processing is adequated to satisfy these needs.

The complexity of the subject, the difficulty of solving the theoretical relations among the variables, and the practical, operational way of measuring these relationships have forced us to impose a set of simplifying assumptions in order to make the problem manageable in the scope of the present research.

First, we will assume that the user level of satisfaction with a given information system is a relevant measure of IS attributes and characteristics. Second, we will assume that the user is able to evaluate the existing level of a given characteristic of an IS, to estimate the ideal level of the same characteristic of an IS, and to express the result of this comparison through his level of satisfaction with regard to the given characteristic of the IS. And finally, we will assume that the difference between his "logic-in-use" and "reconstructed logic" tends to zero (see Kaplan, 1964, pp. 3-11). Given these three assumptions a set of questions in the survey instrument was designed to measure: (a) the level of user satisfaction with the resources allocated to the IS — R_L; (b) the level of user satisfation with the information provided — I_L; and (c) the level of user satisfaction with the knowledge he had of the decision situation — K_L. These three measures can be seen as representing the following relations:

(a) $R_L = r/R$, where:

$r =$ the existing level of resources allocated to IS

$R =$ the ideal level of resources to be allocated to IS in order to satisfy the IS needs.

(b) $I_L = i/I$, where:

$i =$ the existing level of information provided

$I =$ the ideal level of information needs

(c) $K_L = k/K$, where:

$k =$ the existing level of knowledge of the decision situation

$K =$ the ideal level of knowledge of the decision situation.

Given that information needs possess the property of being able to be interpreted both as an explanatory variable of the IS type and as a measure of performance we decided to formulate a rationale relating the above defined variables — R_L, I_L, and K_L — and the concept of information needs, and later on to control for this new variable with regard to the influence of societal decision-making on the type of IS implemented. For this purpose (control) it does not matter if we view information needs as a cause or a consequence of the IS type, therefore solving the problems of circularity we had in defining which came first.

Information needs can be defined, or evaluated, in terms of the resources allocated to the IS, and in terms of the products or outputs of an IS. We should pursue a conceptualization and operationalization of information needs using these two views and, later, obtain a summary measure combining the two views of information needs.

(a) Evaluated in terms of the resources:

Let I_R be the level of information needs as measured by resources. A first approximation of information needs in given by: $I_R = r/R$. That is, assuming perfect knowledge of the decision situation, the level of information needs can be measured by how many of the necessary resources are allocated to the IS. For example, if only 30% of the necessary resources are allocated, we may say that the level of information needs in the organization is perceived to be low as compared with other needs, or else, the organization management would have increased this percentage to reach the level perceived to be adequate for this activity. Conversely, 80% would indicate a high level of information needs.

Since we cannot assume perfect knowledge of the decision situation a correction factor accounting for the imperfect knowledge of the situation is required in the above formula.

Therefore, the measure of information needs in terms of resources can be properly formulated as:

$$I_R = r/R \cdot k/K = R_L \cdot K_L$$

This means that if management perceives their state of knowledge with regard to a given decision situation at 80% of what it should be, and they establish the level of resources, for example, at 30% of the necessary level, then they should have been correcting their estimation of the information needs by this factor, that is, providing more resources than the existing needs in order to compensate for their imperfect knowledge. In the same example, the existing needs would be equal to 24%.

(b) Evaluated in terms of the products:

Let I_P be the level of information needs as measured in terms of the products or outputs. A first approximation of information needs is given by: $I_P = i/I$. That is, assuming perfect knowledge of the decision situation, the level of information needs can be measured by how much of the necessary information is provided by the IS. This means that if only 30% of the necessary information is produced, we may say that the level of information needs in the organization is perceived to be low as compared to what would be necessary to reach perfect information, or else the organization management would have increased this percentage to reach the perceived satisfactory level.

Since we also cannot assume perfect knowledge of the decision situation here, the same correction factor is required to account for imperfect knowledge. Therefore, the measure of information needs in terms of products can be properly formulated as:

$$I_P = i/I \cdot k/K = I_L \cdot K_L$$

This means that if management perceives their state of knowledge at 80% of what it should be, then they should have been correcting their estimation of information needs by this factor to compensate for needs that they are not able to measure today. To obtain the present needs therefore, we should discount for this correction.

An implicit assumption in the above formalizations is that the management of the organization is efficient. As such they are able to recognize the above issues and provide an optimal or satisficing solution to the resource allocation process as well as to the imperfect knowledge problem. Since no control was made in this research for organization performance we will be unable to evaluate possible deviations from the above definitions when the organizations are not efficient.

Since the two equations for measurement of information needs can be assumed to be evaluating the same phenomenum, a simple summary figure in terms of both views of information needs can be obtained by taking the average of I_R and I_P, as shown below:

$$I_N = (R_L \cdot K_L + I_L \cdot K_L) / 2 = K_L \cdot (R_L + I_L) / 2.$$

We are ready, now, to formulate the hypothesis of this research as follows:

1. <u>There are at least three different types of Information Systems</u>: the hypothesis will be tested by significative occurrence of cases of the three types hypothesized as a result of the analysis of the survey instrument.

2. <u>There are at least three types of IS associated with at least three types of societal decision-making</u>: specifically our hypothesis in that each type of IS is associated with each type of SDM as shown below:

IS type	SDM type
Data analysis	Ecological
Decision Analysis	Analytical
Inquiring Systems	Bureaucratic

This hypothesis will be measured through the strength of relationship between I_i and S_i, where

I_i = IS type = 1 - Data Analysis
2 - Decision Analysis
3 - Inquiring Systems

S_i = SDM type = 1 - Ecological
2 - Analytical
3 - Bureaucratic

Controlled for:

I_N = information needs level
= 1 - Low
2 - Average
3 - High

IV. RESEARCH METHODOLOGY

The methodology used to determine the decision models explaining the local departments/divisions behavior in regard to public policies enactment is described in Bento (1980, pp. 42-53).

The information systems study is based upon the perception of public officials and staff of the 91 departments of local government organizations with regard to the characteristics of the departments' IS's.

A letter was sent to the City Manager's Office (or the main administrative officer) of each of the thirteen cities studied requesting their support in conducting the survey on information system types. They were supposed to complete a Validation Questionnaire and send a support letter to the department's heads along with the survey instrument. A follow-up telephone call was made to each of the City Manager's Offices to acknowledge their participation and to clarify and doubts the survey instrument and validation questionnaire might have generated. Appendix A shows a facsimile of the letter to City Managers, the Validation Questionnaire, and the Survey Instrument used in this part of the research.

The nature of survey research calls for discussion of three methodological issues before we can define a procedure to test the hypothesis based on a survey instrument. The first refers to the difference between "reconstructed logic" and the "logic-in-use," and how we can minimize this difference by design. The second refers to the errors associated with the repeated use of the same measure and how to make an instrument more reliable and to evaluate this reliability. Finally, how can we assure that differences in the scores of a given measure reflect true differences in the characteristics we seek to measure, and how can we measure this property — validity — in a given situation. None of these issues is trival, nor are we able to give a definitive answer to any of these questions within the limits of this research — they are philosophical endeavors beyond the limitations of the present research effort. The answers to these issues provided in this part of the research are close to assumptions and based upon existing traditions of dealing with these issues.

Kaplan (1964, pp. 3-11) discusses at length the difference between reconstructed logic and logic-in-use. The former refers to the way we think about the things we do; while the latter refers to the thinking we do when we are doing things. We tend to review and reinterpret the things we do differently from the way we think when we are doing the things we do. In the case of a survey we might do it because the instrument induces us to do so; because we might think that the way we do things is not sophisticated enough — with the connotation of doing "bad" or "low quality" jobs; because we cannot accept the actual reasons we do things — be it for emotional or rational motives; or because our view of the world can only allow us to see things in a given way. Many other reasons could be added, almost indefinitely to the above list in order to explain the difference between the two logics. But regardless of the reason we choose to consider, a solution to minimize this difference can be seen as one in which we are forced to treat the answering of the survey instrument in the same way we treat the things we normally do. Therefore, if, by design, we are induced to think of factual situations we are familiar with and we are asked for a choice between descriptions of these situations, rather than judgments of their merits, characteristics, and the like, we will use, more probably than not, our common logic-in-use. We are not saying that this choice is not a judgment, and that all the above reasons will not interfere with our answers. What we are saying is that there are designs that will stimulate our logic-in-use more than others, and that as much as we deal with scenarios we are familiar with, the more we will be prone to use what is more familiar to us in this circumstance — the logic-in-use.

The survey instrument designed for this research reflects the above point of view. Instead of a set of detailed questions that would require analysis and interpretation of the information system that public officials and staff are exposed to, we limited to the minimum possible. The detailed and, generally, numerous questions are a powerful stimulus to use reconstructed logic and can only succeed if the instrument is so complex that we are unable to keep a conscious consistency in our answers, and we are forced to use our logic-in-use to answer the questions. On the other hand, a set of "loaded" questions, where the more factual nature of the actual situations are preserved, stimulates us to think of the question as a whole, as complex as it is presented in the actual situation, and to make us use our logic-in-use to generate a choice the way we do in real life situations.

The reliability of the instrument is an issue well discussed in the literature, as is the means of measuring the instrument's reliability. To cope with the problems of fluctuation errors of the instrument, one should add redundancy to the measures contained in the instrument. For this reason, as seen previously in the research hypothesis of this chapter, we are measuring the information system type through five items, all with regard to the same dimension of the IS — the information paradox. In addition, we are measuring the information needs through three items, all with regard to the same dimension of information needs — the user satisfaction level.

The reliability of the instrument is to be measured by Cronbach's alpha coefficient (for a description see Carmines and Zellner, 1979, pp. 43-48) as computed by the procedure Realiability of SPSS and described in Hull and Nie (1979, pp. 110-144). Although other versions of this measure have been discussed in the literature — in Nunnally (1967) and Winer (1972) for example — Cronbach's alpha was selected because it can be applied to more than two items forming a scale (whereas the Spearman-Brown split-half coefficient can only be used for two items); because it does not require the assumption of a Guttman scale (where Guttman's lower bounds for reliability does); and also because it does not require the assumption of a parallel model (if the parallel model is assumed, alpha is also a maximum likelihood estimate of the reliability coefficient). For these reasons "alpha is perhaps the most widely used reliability coefficient" (Hull and Nie, 1979, p. 125).

To test the (external) validity of the instrument we should have some "objective" measure of the characteristics of information systems in public organizations' departments. This is so that we can compare the results obtained with the instrument to the "objective" measures. Without discussing what an "objective" measure is — be it in epistemological or in psychological grounds — and whithin the limitations of an exploratory study, we can only attempt to follow a weak procedure of construct validity to the instrument. A Validation Questionnaire was designed to obtain from the City Manager's office an evaluation of the type of information system the various departments surveyed have in the same city. As in the case of any "objective" measure, we will always be left with the question of what we will be measuring. If both measures — the instrument and validation questionnaire — do agree we can always think and argue that both measures could be wrong together; or if they do not agree — as, for example , happened to Downey and Slocum (1975) — we will not know which of the two measures is measuring the wrong thing, or if both are wrong measures that do not agree. Or further, that both measures are measuring the proper thing, but the phenomena that they are measuring are not the same. In this sense any validity is weak and confined to the terms that the hypothesis was operationalized and measured through the given instrument.

The procedure followed to test the hypothesis of this part of the research is divided in two parts: (a) calibration of the instrument — the pre-test, and (b) testing of the necessary and sufficient conditions for an IS contingency theory.

1. Calibration of the Instrument — the calibration of the instrument was done in two steps: rough calibration and fine calibration. In the first step the wording of the survey instrument was adjusted. In the fine calibration the content of the instrument was adjusted.

A. Rough Calibration: 16 students and staff members of GSM/UCLA were used as subjects:

staff members: 2 (1 faculty and 1 administrative)
foreign students: 4 (2 MBA's and 2 Ph. D.'s)
Ph.D. students: 4 (2 accounting and 2 CIS)
MBA students: 6 (exposed to IS concepts)

It was thought that a variety of subjects would make the test more representative of individual differences with regard to the wording of the instrument. All subjects had at least had exposure to IS concepts and/or budget concepts and usage in common.

The instrument was slightly changed from the form shown in Appendix A. Each questionnaire had an a priori selection of IS type, and only the description of the selected IS type was supplied to the subjects. The subjects were supposed to read the IS type description and choose the answers to the four first questions of the instrument. Finally the subjects were randomly assigned to instruments marked with a specific IS type and ten different agencies of a hypothetical city. This was done in order to facilitate the comparison with the data yet to be collected from Torrance (the fine calibration) subjects.

Based upon the comments received, the IS type descriptions were changed. The changes are incorporated in the instrument as shown in Appendix A.

Questions on satisfaction level were not considered in this stage of the pretest, but to test the statistical procedures to be used. The subjects were asked to answer questions as they wished.

A second aim of this phase, besides adjusting the wording, was to assess the extent to which the measures used gave consistent results, that is, the reliability of the instrument. Three different procedures were used to do so: contingency table analysis, correlation analysis (ordinal and interval), and reliability coefficient analysis.

In order to assure — mainly in the case of an interval type of test — that the tests performed well with the data we had, two counter-hypotheses were also used: perfect relationship and no-relationship between the variables. The two counter-hypothesis tests turned out as expected — the statistics used became one or zero respectively.

In the case in which more than one answer existed to a hypothetical agency, the average of the scores attributed by the subjects was used, maintaining all scales in the interval they originally had.

Table III — Pre-test Results — Students show the results obtained in the three procedures to test the reliability of the instrument as follows:

(a) contingency analysis: The τ_B statistic (the most appropriate in this case) for IST1 and IST2 is .90909 — showing a very high relationship between the answers (summarized by IST1) and the pre-assigned IS type (IST2). The same statistic for individual questions also shows a high relationship between them, except for between Data and Report, and Data and Processing.

(b) correlation analysis: the τ_k and r_s (ordinal) and r (interval) statistics for IST1 and IST2 are all over .9 — showing a very strong relationship between the answers and the pre-assigned IS type. The same statistics for the individual questions also shows a strong relationship between them, except for between Data and Report, and Data and Processing.

(c) reliability coefficient: this is an interval type of measure, and since our data is ordinal and has a significant degree of skewness (except Report and IST1) and a pronunciated degree of negative Kurtosis, the results are to be interpreted carefully. The α, reliability coefficient, for IST1 and IST2 is. 96386 shows a very high degree of consistency between the answers and the pre-assigned IS type. The same conclusion applies to the individual questions, which have a somewhat lower coefficient — .89772. The usage of the Z-transformation to standardize the results in the various scales is also a problem, because it assumes that the data is of interval type. The α_z's — standardized reliability coefficients — were generated in order to assure that the variables are already in the same scale, and not for the purpose of standardization through the Z-transformation, if possible. The small difference between the α's and α_z's seems to indicate that all the variables are in the same scale (1 to 3).

Given the above results, we concluded that the instrument was reliable with regard to its wording.

B. Fine Calibration: 12 staff members of the City of Torrance, from ten different departments/divisions, were used as subjects.

The instrument, as shown in Appendix A, was applied

Table III

Pre-Test Results

Statistic	Data & Rept	Data & Proc	Data & Modf	Rept & Proc	Rept & Modf	Proc & Modf	IST1 & IST2
STUDENTS							
<u>contingency</u>							
λ	.25000	.33333	.66667	.66667	.50000	.66667	.83333
τ_B	.36364	.24242	.64623	.78788	.73855	.64623	.90909
γ	.50000	.33333	.77778	.92857	.92308	.77778	1.00000
<u>correlation</u>							
τ_k	.42670	.34340	.65760	.84720	.73000	.69630	.90910
r_s	.51450	.38420	.71570	.90140	.85030	.71480	.92860
r	.54356	.40582	.74455	.89592	.79303	.71372	.93250
<u>reliability</u>							
α	------	------	------	.89772	------	------	.96386
α_z	------	------	------	.89593	------	------	.96507
TORRANCE							
<u>contingency</u>							
λ	.44444	.33333	.33333	.60000	.40000	.60000	.40000
τ_B	.51848	.41478	.55304	.61290	.16129	.54839	.53452
γ	.71429	.60000	.80000	.76000	.21739	.68000	.72727
<u>correlation</u>							
τ_k	.51850	.44230	.55300	.60330	.16130	.53980	.53450
r_s	.53460	.45010	.56850	.61920	.15000	.54090	.55980
r	.58328	.47717	.58628	.62317	.23499	.59113	.53452
<u>reliability</u>							
α	------	------	------	.81040	------	------	.69565
α_z	------	------	------	.81005	------	------	.69666

(b) correlation analysis: the τ_k and r_s (ordinal) and r (interval) statistics for IST1 and IST2 are all over .9 — showing a very strong relationship between the answers and the pre-assigned IS type. The same statistics for the individual questions also shows a strong relationship between them, except for between Data and Report, and Data and Processing.

(c) reliability coefficient: this is an interval type of measure, and since our data is ordinal and has a significant degree of skewness (except Report and IST1) and a pronunciated degree of negative Kurtosis, the results are to be interpreted carefully. The α, reliability coefficient, for IST1 and IST2 is. 96386 shows a very high degree of consistency between the answers and the pre-assigned IS type. The same conclusion applies to the individual questions, which have a somewhat lower coefficient — .89772. The usage of the Z-transformation to standardize the results in the various scales is also a problem, because it assumes that the data is of interval type. The α_z's — standardized reliability coefficients — were generated in order to assure that the variables are already in the same scale, and not for the purpose of standardization through the Z-transformation, if possible. The small difference between the α's and α_z's seems to indicate that all the variables are in the same scale (1 to 3).

Given the above results, we concluded that the instrument was reliable with regard to its wording.

B. Fine Calibration: 12 staff members of the City of Torrance, from ten different departments/divisions, were used as subjects.

The instrument, as shown in Appendix A, was applied to the subjects. Twenty questionnaires were distributed and 60% of them were returned fully answered. All subjects are involved in the budgetary process in the City of Torrance.

The objective of this phase of the pretest was to test the reliability of the instrument in a setting similar to that in which we were to apply the survey instrument. We were measuring the variability of both parts of the instrument.

Both the variables used and the testing procedures were the same as the ones described in the gross calibration. Table III - Torrance shows the results obtained by the three procedures to test the reliability of the instrument, as follows:

(a) <u>contingency analysis</u>: the τ_B statistic for IST1 and IST2 is .53452 — showing a reasonable level of relationship between the answers of the first and second parts of the instrument. The same statistics for the individual questions of the first part also show a reasonable level of relationship between them, except for between Report and Modification.

(b) <u>correlation analysis</u>: All the τ_k and r_s (ordinal) and r (interval) statistics are over .5 — showing a reasonable level of strength of relationship between the answers of both parts of the instrument. The same statistics for the individual questions of the first part of the instrument also show a reasonable level of strength of relationship between them, except for between Report and Modification.

(c) <u>reliability coefficient</u>: again this is an interval type of test applied to ordinal data with a pronounced degree of negative skewness and a pronounced degree of negative kurtosis, which should be carefully considered. The α for IST1 and IST2 is .69565 — showing a reasonable degree of consistency between the answers of both parts of the instrument. The same statistic for the individual questions of the first part — .81040 — shows a high degree of consistency among them. The α_z's are, in both cases, approximately the same as the α's — indicating that the variables are measured in the same scales.

Finally, some adjustments to the wording of the first part of the instrument and changes in the content of the second part of the instrument were made. These are included in the facsimile shown in Appendix A.

2. Test of the Necessary and Sufficient Conditions of an IS Contingency Theory — the testing of the hypothesis was divided into three parts: (a) reliability and validity analysis, (b) necessary condition, and (c) sufficient condition of IS contingency theory. In the first part, the same type of analysis as was performed in the pre-test was conducted. In (b) and (c) non-parametric tests were used to test the hypothesis of this part of the research.

A. Reliability and Validity Analysis — Since the reliability procedure has already been discussed extensively and exemplified in the pre-test, only the validity procedure will be reviewed here.

The City Manager's Office received a Validation Questionnaire, in which they were supposed to indicate the type of IS the city department had. This questionnaire was completed independently of the survey instrument: neither the City Manager's Office nor the departments knew what answers each group was giving to similar questions. The answers to the survey instrument were summarized by the IS index, I_i, as described in the hypothesis testing section of this chapter; while the answers to the questionnaire (validation) were represented by I_v — a direct measure of the type of information system in existence in the departments as seen by the City Manager's office. A contingency analysis was to be performed to relate I_i and I_v, using tau and Somer's d to measure the strength of the relationships between them. A Pearson's r was also to be computed as an evaluation of the problems with the numbers attached to the categories of IS.

B. Necessary Condition Testing — Assuming that I_i was a valid measure of the IS type, the significance of the occurrences of the IS types was to be tested, again using the contingency analysis. In the case of missing values of I_i, but where we did have answers to the validation questionnaire. I_v would be used as the surrogate for the missing answer from the departments. The already familiar τ_B and d rank correlation measures will be used. In addition, r will be computed to assure the proper representation of the ordinal scales by the numbers attached to it.

C. Sufficient Condition Testing — The strength of relationship between I_i and S_i will be measured using contingency analysis and the value of τ_B and d. The control for information needs — I_N — will be made through the usage of partial rank correlation, using Kendall's tau, as described by Siegel (1956, pp. 223-229) using the following formula:

$$\tau_{xy.z} = \frac{\tau_{xy} - \tau_{zy} \cdot \tau_{xz}}{\sqrt{(1-\tau_{zy}^2)(1-\tau_{zx}^2)}}, \text{ where:}$$

τ_{xy} = rank correlation of I_i and S_i

τ_{zy} = rank correlation of I_N and S_i

τ_{xz} = rank correlation of I_i and I_N

A word of caution should be introduced here, because the results we are to analyze in light of the present methodology do not account for the influence of possible relevant variables to explain information system implementation other than societal decision-making, although we have controlled for information needs.

V. RESULTS AND CONCLUSIONS

The overall results of this research confirm our hypothesis that the sufficient condition of the information systems contingency theory does occur in practice, as shown in Table IV. There is evidence to conclude that the societal decision-making model does influence the type of information system in existence in a given public organization.

The simple rank correlation between societal-decision-making and information systems is .2 and it is significant at .04; likewise r was found to be .21, significant at .04. This type of result allows us to say that the relationship does exist in population, and that the relationship is not strong. A fair interpretation of the results is that, although societal decision-making has a bearing on the type of the information system, it is not the only factor. Other factors account for the majority of the reasons which explain the information system type implemented in public organizations. This does not contradict our hypothesis because societal decision-making does have a direct influence over the information system type, and, probably, also has an indirect influence through other variables that are not accounted for in this research.

The above results were shown without control for information needs. The partial rank correlation between societal decision-making and information system type is .18; the partial r is also .18. Therefore there is no significant impact of the control for information needs in the relationship between societal decision-making and information systems type.

It is important to note that 30 of the 68 cases (44%) conform perfectly to our hypothesis and that another 19 cases (28%) are imperfect approximations of our hypothesis. The most striking deviation is the case where information system type is data analysis while the societal decision-making is incremental,

Table IV

Summary of the Results

SDM	ISTY Count Row Pct Col Pct	Data Analysis 1	Decision Analysis 2	Inquiring Systems 3	Row Total
Satisficing	1	10 58.8 35.7	2 11.8 14.3	5 29.4 19.2	17 25.0
Rational	2	4 57.1 14.3	1 14.3 7.1	2 28.6 7.7	7 10.3
Incremental	3	14 31.8 50.0	11 25.0 78.6	19 43.2 73.1	44 64.7
	Column Total	28 41.2	14 20.6	26 38.2	68 100.0

Kendall's tau B = 0.19765. Significance = 0.0388

Somers's d (symmetric) = 0.19631

Pearson's r = 0.20727 Significance = 0.0449

Table V

Frequency of Information Systems
Types by City

City	Data Analysis	Decision Analysis	Inquiring Systems	Missing (to be discussed later)
Alameda	2	4	0	1
Alhambra	0	0	0	7
Berkeley	0	0	0	7
Compton	4	2	2	0
Long Beach	4	1	3	0
Los Angeles	7	0	0	0
Oakland	3	1	3	0
Sacramento	0	3	4	0
San Diego	2	1	4	0
San Jose	1	0	6	0
Santa Ana	0	0	0	7
Whittier	3	2	3	0
TOTAL	30	15	26	23
% of Non-missing Total (71)	42.3	21.1	36.6	-

Note: Three unrequested questionnaires were answered for departments which were not selected. These three answers were considered in the survey results but not in further analysis with other variables, such as societal decision-making, for example.

which accounts for 21% of the cases. Since no control was made for organization efficiency and given the limitations of an exploratory study, we are left with the question of the effect of the abnormality found previously in Bento (1980, pp. 109-110) — organizations using the incremental decision-making model in reactive environments (17 cases) — on the present results. It does seem that, if these deviant cases os decision-making models could have been corrected, the results we would have obtained here would have been quite different.

There is evidence to say that different types of information systems do exist in the public organizations studied. As can be seen in Table V, 42% of the cases were found to be Data Analysis, 21% Decision Analysis, and 37% to be Inquiring Systems.

To measure the significance of our results a series of counter-hypotheses were considered against the overall hypothesis taht the three types of information system did exist in the population:

(a) There is only Data Analysis IS in the population,
(b) There is only Inquiring Systems IS in the population,
(c) There are only Data Analysis and Inquiring Systems in the population; the decision analysis results are due to random erros of the measures, and
(d) The results could have been obtained by choosing random numbers between one and three.

These counter-hypotheses were translated in terms of expected frequencies of each of the information systems type as follows:

Table VI

Counter-hypothesis Expected
Frequencies (%) and χ^2 Values

IS Type	Data Analysis Only	Inquiring Systems Only	No Decision Analysis	Random Numbers
Data Analysis	100	0	50	33
Decision Analysis	0	0	0	33
Inquiring Systems	0	100	50	33
χ^2 statistic	278.8	344.2	21.8	6.0

Using the χ^2 test we are able to reject the three first counter-hypothesis at .001 and the last at .05 levels of significance. Therefore, it seems that the three types of information systems did exist in the population.

The results of the validity test are shown in Table VII. Unfortunately, the number of cases in which we had answers to the survey instrument and the validation questionnaire was only 39 out of the 91 expected (43%). This did not affect our ability to generalize the results to the population since the significance level was .002 in the measure of strength of relationship between I_i and I_v. But this makes us wonder if the strength of the relationship found — tau and r equal .43 — is not underestimated, given that a great number of departments found using an Inquiring System and Data Analysis IS were missing in the validation questionnaire.

Nevertheless, it does seem that the two measures of the IS type in the departments are significantly and reasonably related. It seems that there is a tendency on the part of the respondents of the validation questionnaire to evaluate the type of IS in the <u>city</u> rather than in the departments — only one city out of six (17%) gave different evaluations of IS type to the departments of the same city: all others marked the same type in all departments. If this is the case, the validation questionnaire measures a different phenomenon — the city IS type, although this other phenomenon is related to the IS types existing in the departments.

As discussed in the methodology section, the effort to construct validity in this research is a weak one, in general, it is hard to say what the above results mean. I do believe that this subject requires a better theoretical and operational treatment than the one given in this research, given its scope as an exploratory study. What we are able to say, with regard to validity, is that two phenomena are measured by the instruments

Table VII

Validity Testing for the IS Index

ISTY	Count / Row Pct / Col Pct	ISTV: Data Analysis 1	Decision Analysis 2	Inquiring Systems 3	Row Total
Data Analysis	1	16 100.0 53.3	0 0.0 0.0	0 0.0 0.0	16 41.0
Decision Analysis	2	5 71.4 16.7	1 14.3 20.0	1 14.3 25.0	7 17.9
Inquiring Systems	3	9 56.3 30.0	4 25.0 80.0	3 18.8 75.0	16 41.0
	Column Total	30 76.9	5 12.8	4 10.3	39 100.0

Kendall's tau B = 0.42885. Significance = 0.0021
Somers's d (symmetric) = 0.41558
Pearson's r = 0.43301 Significance = 0.0029

used, and that they are reasonably related. It does seem that both measure the types of information systems in the departments, but we are unable to say if they are measuring the same dimension — it seems that they are not.

The results of the reliability test, as shown in Table VIII are much better than the results obtained for the pretest subjects. Cronbach's alpha was found to be .9 for the summary scale (IST1 and IST2) as compared with the .7 found for the Torrance subjects; while the reliability coefficient of the intermediate scale (Data to Modification) was almost the same level — .77 as compared with .81 obtained previously. This indicates that the changes introduced due to the pretest results have improved the overall reliability of the instrument. In any case the results found for the reliability coefficient, per se, are sufficient evidence to say that the instrument is highly reliable with regard to IS indexes.

On the other hand R_L, and I_L, although being measured on the same basis (user satisfaction), are not measures of the same dimension of information needs. So the two measures cannot be seen as forming one scale over the same dimension. They must be interpreted as two different factors that are not necessarily in agreement or related. We might have cases where in terms of the resources information needs are considered very important, while in terms of the products information may not be provided at the same level, due to other intervening variables, such as the level of expertise or complexity of the information systems development, for example. Therefore, by averaging the two sides of the information needs we are obtaining a measure that takes into consideration the effects of other intervening variables on resources and products. And this new measure should be understood as the "constrained" information needs in the given department, as opposed to the abstract or non-constrained information needs as hypothesized in this research. Since no controls were devised to measure these other intervening variables, and since we are far

Table VIII

Realiability Testing of the Instrument

Measures	Data & Rept	Data & Proc	Data & Modif	Rept & Proc	Rept & Modif	Proc & Modif	IST1 & IST2	R_L&I_L
<u>Strength</u>								
λ	.49231	.40323	.18868	.68852	.15385	.12245	.62121	.01538
τ	.52944	.45571	.34795	.71337	.27696	.38891	.76836	.15304
d	.52842	.45503	.34447	.71335	.27607	.38742	.76601	.15303
r	.54463	.46433	.35568	.72076	.27696	.39062	.82175	.19355
<u>Reliability</u>								
α	----------	----------	----------	.77493	----------	----------	.90206	.32364
α_z	----------	----------	----------	.77228	----------	----------	.90216	.32432

from being able to determine their nature, this index has only comparative meaning — that is, between the departments — and cannot be used to further inferences regarding the characteristics per se of the departments' information needs. Table IX shows the frequency distribution of R_L, I_L, K_L, and I_N.

If we had assumed perfect knowledge of the situation, as can be seen from the figures in Table IX, the results would have been quite different.

Finally, the response rates to our survey instrument and the validation questionnaire were quite good, in light of the ones found in the survey literature. Table X summarizes the response rates for the different items and targets. The target of the survey instrument was originally 91, but since three answers were provided that were not requested, this total was adjusted to reflect in both sides these three cases.

Two cities, Alhambra and Santa Ana, did not answer the survey because they were in the middle of internal reorganization and changes in management. With regard to the third missing city, Berkeley, it is not clear why they decided not to participate. First is seemed that they had no received the necessary forms (a second copy was provided), but later, in subsequent telephone conversations, they allegedly had a high workload situation that would not allow them to participate in the survey.

We are indebted to the City Manager's Office of the various participant cities for many of the results of this research. Due to them the response rate to the survey instrument was almost 70%, and we were able to obtain the validity measure used in this part of the research.

./sspm.

Table IX

Frequency Distribution of Information
Needs' Indexes (%)

Index	R_L	I_L	K_L	I_N
Low	33.8	21.5	1.5	47.7
Average	50.8	49.2	32.3	13.8
High	15.4	29.3	66.2	38.5

Table X

Survey Response Rates

	Validation Questionnaire (cities)	Survey Instrument (departs.)	Combined cases (validation or survey instrum.)	Common cases of validation and survey instrum.
Target	13	94	91	91
Actual	6	65	68	39
Rate (%)	46.2	69.1	74.7	42.9

APPENDIX A

December 21, 1979

Mr.
City Manager

Dear Mr.

The Computer and Information Systems Research Program of the UCLA Graduate School of Management is conductiong an exploratory study on the usage of information in the budget preparation process.

Your city is one of thirteen selected as part of a representative sample of California cities. We would like to have you and your department help us conduct the survey part of the study.

In return, your contribution will be acknowledged in the final report and you will receive a copy of the survey report together with a list of available data sets (budgetary and socio-economic) on the selected thirteen cities. If any of these data sets are of interest to you we will supply them gratis.

We are requesting that you do the following:

(a) Send a letter to heads of your city departments/ divisions (seven only) forwarding our "Information Systems Questionnaire" to be answered by them, and returned directly to us (a copy is provided). The questionnaire takes only about 15 minutes of the department/division head's time.

(b) Assign a senior member of your department to fill in an "Information Systems Questionnaire" in regard to your own department.

(c) Answer a "Validation Questionnaire" (one page) concerning the type of information systems used by the departments/divisions to prepare their budgets.

Your cooperation is essential to achieve the objectives of the study. Our experience has shown that a letter from you to the department/division heads will assure a higher level and quality of response than might otherwise be expected.

Mr.
Page 2

Enclosed are all the materials you will need, and a checklist to facilitate your participation.

The local government budgetary process in our state deserves more attention and care than it has received in the management and academic literature. Please, help us in making an effort to advance the knowledge in the field.

I will be calling you or your secretary by January 11, 1980 to answer any questions you may have and to acknowledge your participation.

Sincerely,

Alberto Bento

INFORMATION SYSTEMS QUESTIONNAIRE

INSTRUCTIONS

1. The questions you are about to answer are related to budgetary allocation process in your department/division. The questions are, primarily, concerned with <u>how information is obtained to allocate the budget</u> among the various departments, sections, of your department/division before the proposed budget is submitted to the Mayor/Council/City Manager/Controller.

2. Do not feel compelled to choose one answer over another because this is what you think is <u>should be</u>, but rather because this is what actually is happening.

3. All answers in this instrument are confidential, and will be aggregated to provide a general classification of the information you use, so that no individual question will be displayed, even as a total.

4. The questions are followed by alternative situations' descriptions, among which you are supposed to choose your answer. In many cases you will feel that no description is <u>exactly</u> your case, but you should always be able to identify one closer to your case than the others.

5. CHOOSE ONLY ONE ANSWER PER QUESTION! Do not mark more then one answer, choose the closest to your case, and not a combination of answers.

6. Feel free to make the comments you think important to be made, in the comments section, at the end of the questionnaire.

7. If you wish a copy of the final report, please fill in the enclosed return label and send it together with your answer to the questionnaire.

8. Please return the questionnaire by January 28, using the enclosed business reply mailing envelope, directly to the Computers and Information Systems Research Program at the UCLA Graduate School of Management.

Thank you!

CITY: ____________________

DEP/DIV: ____________________

CHOOSE THE DESCRIPTION CLOSEST TO THE SITUATION YOU HAVE:

1. The approach used to collect data considered necessary to prepare reports (handwritten, typed, or computer printed) for the budget allocation process is primarily:

   a. to assemble existing data of the normal activities of your agency (such as payroll, accounting, etc.), analyze it an prepare the reports from it. ( )

   b. to create a procedure or model, collect whatever data is required by it, and use the results of the procedure or model as the basis for the report. ( )

   c. to assemble the existing data for certain items (as in a above) and to collect whatever data is required by a procedure or model (as in b above) for other items. ( )

2. The reports used in the budget allocation process are, primarily:

   a. tabulations of data by department, section, and/or revenue and expense items, with sub-totals, totals, and summaries. ( )

   b. results of estimates computed by models or procedures, with sub-totals, totals, and summaries. ( )

   c. a combination of the above plus special studies of out-of-line situations (new projects and activities, impacts of risky situations, crisis, etc.). ( )

3. The proposed budget figures are obtained, primarily, by:

   a. estimates of city officials/staff based on their experience and understanding of resource needs. ( )

   b. estimates and projections computed through a model of procedure (manually, with calculators or computers). ( )

   c. a combination of above and computations of alternatives for out-of-line situations during the budget cycle. ( )

4. Modifications in the preliminary budget consolidation (s) for your agency are primarily made by:

   a. direct changes of line items — expenses, revenue, etc. ( )

   b. recomputations of the estimates using models or procedures. ( )

   c. a combination of the above and computations of new alternatives for the out-of-line situations. ( )

EVALUATE YOUR PRESENT LEVEL OF SATISFACTION WITH:

	low		avg		hi
5. The amount of money which is expended in the presentation of the proposed budget.	[_]	[_]	[_]	[_]	[_]
6. The amount of information you obtain from the reports you use to prepare the proposed budget.	[_]	[_]	[_]	[_]	[_]
7. Your level of understanding of the problems related to the allocation of the budget to the departments/sections.	[_]	[_]	[_]	[_]	[_]

8. PLEASE READ THE DESCRIPTIONS OF INFORMATION SYSTEM TYPES THAT FOLLOW. THE DESCRIPTION OF THE INFORMATION SYSTEM TYPE CLOSEST TO YOUR IS:

Information System Type A	( )
Information System Type B	( )
Information System Type C	( )

INFORMATION SYSTEM TYPE A

An agency collects data for its normal activities such as payroll, accounting, control, etc. Prior to the beginning of a budget allocation cycle, all data considered necessary to prepare reports during the budget cycle are selected and organized.

Reports are also defined prior to the budget cycle, and are primarily tabulations of data by department, section, and/or expense and revenue item, with sub-totals, totals, and summaries.

The processing involved (manual, with calculators, or computers) is the calculation of the proposed budget figures using estimates made by city officials/staff using their experience and understanding of resource needs. In a second step, these proposed figures are consolidated and the reports defined previously are prepared.

The reports are presented to the top official of the department/division for approval and modifications. The modifications — cuts and increases — are reflected in the reports through changes in specific expense and revenue items, and a final proposed budget is prepared (typed, computer printed, etc.).

Many repetitions of this last phase — top official review and modifications — may be necessary before the final proposed budget is considered acceptable.

INFORMATION SYSTEM TYPE B

An agency creates a model or procedure — accounting-like, simulation, statistical, mathematical, etc. — to estimate revenue and expense for its sections and departments prior to its budget allocation cycle. Based upon this model or procedure, and also prior to the very beginning of the budget cycle, data is collected specifically to meet the needs of computations of this model.

Reports are defined to show the results of the projections and estimates of the model by department, section, and/or revenue expense items, with sub-totals, totals, and summaries.

The processing involved (manual, with calculators, or computers) is the calculation of the projections and estimates using the formulas defined in the model or procedure. In a second step, these projections are consolidated and the reports previously are prepared.

The reports are presented to the top official of the department/division for approval or modifications. The modifications — cuts and increases — are reflected in the reports through recomputations of the model or procedure, and a final budget is prepared (typed, computer printed, etc.).

Many repetitions of the last phase — top official review and modifications — may be necessary before the final proposed budget is considered acceptable.

INFORMATION SYSTEM TYPE C

An agency creates a procedure or model to estimate, at least, the total revenue and expenses of the agency and each of its sections, and/or departments, prior to the budget allocation cycle. Data is collected specifically to meet the needs of computations of the model or procedure. Also, all other data considered necessary to prepare reports in the budget cycle are selected and organized from normal activities data.

Reports are defined: (a) in part prior to the budget cycle (such as tabulations of data by department, section, expense and revenue items, results of computations of the model or procedure, with sub-totals, totals, and summaries), and (b) in part during the budget cycle as back-up materials for out-of-line situations (such as new projects and activities, contingency for risky situations, sudden changes in cost of resources, crisis, etc.).

The processing involved (manual, with calculators, or computers) is divided into:

(a) computations of the estimates of the proposed budget (using models or procedures, and public officials' estimates) for the agency and its sections/departments. The purpose of these computations is to determine the problems existing in the budget allocation process (such as out-of-line situations, unbalanced growth of certain items, etc.).

(b) computations of possible alternatives to resolve the problems encountered, and measure their impact on the totals.

(c) consolidation of all previous computations, and the reports defined previously are prepared.

The reports are presented to the top official of the department/division for approval or modification. The modifications — cuts and increases — are reflected in the reports through recomputations of the models or procedures, changes in specific expense and revenue items, and/or calculations to search for new alternatives to the problems encountered, and their impact on the totals. A final proposed budget is prepared (typed, computer printed, etc.).

Many repetitions of the last phase — top official review and modifications — may be necessary before the final proposed budget is considered acceptable.

COMMENTS

THE END

VALIDATION QUESTIONNAIRE
CITY OF...

Please read the enclosed information System description and select the information system type closest to the ones existing in each of the following departments/divisions of your city.

	TYPE		
	A	B	C
1. POLICE	I.......I	I	I
2. FIRE	I.......I	I	I
3. LIBRARY	I.......I	I	I
4. BUILDINGS	I.......I	I	I
5. PARKS & RECREATION	I.......I	I	I
6. PUBLIC WORKS	I.......I	I	I
7. OTHER	I.......I	I	I

COMMENTS:

(Use the back of this page or an additional sheet if necessary)

VALIDATION QUESTIONNAIRE
INFORMATION SYSTEM DESCRIPTIONS

Information System Type A

An agency collects data for its normal activities such as payroll, accounting, control, etc. Prior to the beginning of a budget allocation cycle, all data considered necessary to prepare reports during the budget cycle are selected and organized.

Reports are also defined prior to the budget cycle, and are primarily tabulations of data by department, section, and/or expense and revenue item, with sub-totals, totals, and summaries.

The processing involved (manual, with calculators, or computers) is the calculation of the proposed budget figures using estimates made by city officials/staff according to their experience and understanding of resources needs. In a second step, these proposed figures are consolidated and the reports defined previously are prepared.

The reports are presented to the top official of the city/department/division for approval and modification. The modifications — cuts and increases — are reflected in the reports through changes in specific expense and revenue items, and a final proposed budget is prepared (typed, computer printed, etc.).

Many repetitions of this last phase — top official review and modifications — may be necessary before the final proposed budget is considered acceptable.

Information System Type B

An agency develops a model or procedure — accounting-like, simulation, statistical, mathematical, etc. — to estimate revenue and expense for its sections and departments prior to its budget allocation cycle. Based upon this model or procedure, and also prior to the very beginning of the budget cycle, data is collected specifically to meet the needs of computations of this model.

Reports are defined to show the results of the projections and estimates of the model by department, section, and/or revenue expense items, with sub-totals, totals and summaries.

The processing involved (manual, with calculators, or computers) is the calculation of the projections and estimates using the formulas defined in the model or procedure. In a second step, these projects are consolidated and the reports defined previously are prepared.

The reports are presented to the top official of the city/department/division for approval or modifications. The modification — cuts and increases — are reflected in the reports through recomputations of the model or procedure, and a final budget is prepared (typed, computer printed, etc.).

Many repetitions of the last phase — top official review and modifications — may be necessary before the final proposed budget is considered acceptable.

Information System Type C

An agency develops a procedure or model to estimate, at least, the total revenue and expenses of the agency and each of its sections, and/or departments, prior to the budget allocation cycle. Data is collected specifically to meet the needs of computations of the model or procedure. Also, all other data considered necessary to prepare reports in the budget cycle are selected and organized from normal activities data.

Reports are defined: (a) in part prior to the budget cycle (such as tabulations of data by department, section, expense and revenue items, results of computations of the model or procedure, with sub-totals, totals, and summaries), and (b) in part during the budget cycle as back-up materials for out-of-line situations (such as new projects and activities, contingency for risky situations, sudden changes in cost of resources, crisis, etc.).

The processing involved (manual, with calculators, or computers) is divided into:

(a) computations of the estimates of the proposed budget (using models or procedures, and public officials' estimates) for the agency and its sections/departments. The purpose of these computations is to determine the problems existing in the budget allocation process (such as out-of-line situations, unbalanced growth of certain items, etc.).

(b) computations of possible alternatives to resolve the problems encountered, and measure their impact on the totals.

(c) consolidation of all previous computations, and the reports defined previously are prepared.

The reports are presented to the top official of the city/department/division for approval and modifications. The modifications — cuts and increases — are reflected in the reports through recomputations of the models or procedures, changes in specific expense and revenue items, and/or calculations to search for new alternatives to the problems encountered, and their impact on the totals. A final proposed budget is prepared (typed, computer printed, etc.).

Many repetitions of the last phase — top official review and modifications — may be necessary before the final proposed budget is considered acceptable.

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