SYSTEMS ANALYSIS OF MARKETING AND COMMUNICATION IN NORTHEAST BRAZIL

A RESEARCH PROPOSAL

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This working paper is a continuation of an earlier effort to integrate communication and marketing variables within a system analysis framework* Its primary purpose is to develop further the research design this approach requires, although several conceptual problems are also treated in greater detail than in the earlier paper. It should be emphasized that this document represents an intermediate version of the final full-blown operational plan. Comments and criticisms will be welcomed.

First, there are three points which should be discussed:

1. The integration of systems theory and field research.
2. The aid which this type of model might provide to decision-makers responsible for economic development programs.
3. The relationships between this model and a "macro-model" of the total economic structure under consideration.

In any modeling effort the goal is to describe some portion of the "real world." A model provides the investigator with a tool to predict how "reality" will change under the impact of certain influences, specifically, the ways in which the system can be changed to achieve some desired result. But how "real" the model is depends on two fundamental criteria: the variables included and the relationships assumed to exist among the variables.

MODEL —Attempts to describe→ REAL WORLD = F(Variables Included and Relationships Assumed)

We build models, then, by including certain variables and by defining the way these variables are interrelated. It is the purview of the "substantive" disciplines involved (in this case, marketing, communication, agricultural economics, and business) to specify which variables are to be included, and it is the purview of systems theory to specify the analysis of the relationships among these

*See "Communication and Marketing in Latin America: a Preliminary Conceptualization," by R. V. Farace and T. R. Webb, paper presented to the International Communication Division, Association for Education in Journalism, Iowa City, Iowa, August, 1966.

variables. This coordination is required regardless of whether the model is at a "micro" level or some more "macro" level.

In order to indicate the utility of this proposed research, the assumptions which underlie it and the data base it requires must be delineated. Assumptions enter the analysis at three levels:

a. Methodology

b. Variables

c. Relationships

We have assumed that systems theory as a methodology is a tool which can be used to describe an economic system and can aid in determining fruitful alternatives for the researcher and decision-maker. The variables included determine the limits of how realistic the model will be. The basic assumption is that variables which are included are important to "action determination" and those not included are generally not important. In the earlier paper it is argued that both technical and socio-psychological variables must be incorporated in any effort to describe realistically a marketing system in which change occurs. This single point is perhaps the most significant deviation this approach takes from previous modelling attempts, although this approach also broadens the traditional input/output concerns from "goods" to "services" and "messages" as well. The relationships among these variables are assumed linear in this initial attempt. We build our model with the assumption that the outputs or action some marketing unit exhibits is a function of its internal states (or predispositions) and the inputs it receives. This will be further delineated in the next section.

The defining of the required data base is of particular importance. This entails the operationalization of variables in such a way as to provide reliable data. The success in gathering the needed data will determine the utility of this model--as it does for any other model.

The basic purpose in using systems theory is to aid the researchers and planners in understanding the complex phenomena that exist in the "real world."

Thus, systems theory is a "way of looking at the problem" in an organized fashion, one which permits extensive observation and analysis of crucial relationships. It emphasizes the ability to break down an unmanageably large system into manageable pieces where analysis can be more realistically accomplished. Then these pieces are reassembled to form that larger system.

II. THEORETICAL BACKGROUND: SYSTEMS ANALYSIS

In the earlier paper by Farace and Webb it was stated that the behavior of any production/consumption unit (for example, a consumer, a retail store, and industry, or an economy) is a function of two basic factors: its internal states or predispositions--both technical (such as sales area) and socio-psychological (such as innovativeness)--and its inputs of goods, services and messages (or <u>information</u>).

Thus:

1. Outputs = F(Internal states, Inputs)

$$O(n) = [F\ S(n), I(n)]$$

Each of these three factors may be considered a <u>vector</u> of numerous entries (see part three of this paper) so that we can have as many inputs, outputs, and states as data collection permits. The inputs and outputs are categorized into the <u>flow</u> and <u>price</u> aspects of each good, service, or message. Also, inputs and outputs can be broken down by <u>input sources</u> and <u>output receivers</u>. The state variables are categorized into technical variables (such as "square feet of sales area") and socio-psychological variables (such as risk-opportunity perceptions). The states determine how the production/consumption unit <u>transposes</u> some set of inputs of goods, services and messages into some vector of outputs of goods, services and messages.

A first approximation assumes a static, linear relationship between the three factors:

2. $O(n) = AS(n) + BI(n)$, where A and B are the coefficients relating S's to O's and I's to O's.

The I(n) and O(n) of equation 2 can be broken down into their respective price and flow values, with the result being:

3. $$\begin{vmatrix} X_o(n) \\ Y_o(n) \end{vmatrix} = \begin{vmatrix} a_{11} \\ a_{21} \end{vmatrix} S(n) + \begin{vmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{vmatrix} \begin{vmatrix} X_i(n) \\ Y_i(n) \end{vmatrix}$$

Where:

X's are the prices of outputs and inputs, respectively.

Y's are flows of outputs and inputs respectively.

S is the internal states.

Equation 3 says simply that the prices and flows of the outputs at any point in time are a linear function of the internal states and the prices and flows of the inputs. For example, the output flow of "credit sales" may be a function of the retailer's attitudes toward non-cash business (state variables), and the cost and payment schedules on the products he buys from wholesalers (input).

To make this model dynamic two considerations can be added:

1. Internal states are not constant but change over time.
2. Internal states are a function of the types of inputs (including their prices and flows) of goods, services, and messages received, especially the information inputs in the form of messages.

This can be characterized by the following equation:

4a $$S(n+1) = PS(n) + HI(n)$$

or

4b $$S(n+1) = PS(n) + \begin{matrix} h_{11} & h_{12} \end{matrix} \begin{matrix} X_i(n) \\ Y_i(n) \end{matrix}$$

Here, equation 4b states that the state or predisposition of any production/consumption unit to act <u>next time</u> is a function of its state last time and his input prices and flows last time. Combining the two models represented in equations 2 and 4a:

5a $S(n+1) = PS(n) + HI(n)$ COMPONENT/STATE MODEL

5b $O(n) = AP(n) + BI(n)$

In systems theory this can be considered the component model of the production/consumption unit. A simple example would be that a retailer's internal state to innovate--S(n+1)--next time is a function of his present innovative state S(n) and the inputs he receives of government investment information I(n). The new state to innovate, and this information, will determine (partially) the output of the new products which he may sell.

Within the time and resources available this year, the determination of changes in internal states over time (equation 4) seems unattainable. Thus equation 5 is an ideal; it perhaps could represent the orientation of future work. Our intent is to develop a workable dynamic model within a year by following a slightly different approach. This will be accomplished by grouping a set of components (say all retailers or all consumers) into a set of types of homogeneous groups. Equation 2, $O(n)=AS(n) + BI(n)$, states the relationship between outputs and the internal states and inputs for the <u>total population</u> of components at a particular level (all retailers or all consumers). From the survey work in Puerto Rico this very aggregative relationship is too coarse, too summarative. It is quite realistic to assume that there is a great deal of <u>variance</u> within that population as to how a particular participant reacts to a given set of inputs, and certainly there is a wide spectrum of internal states. To get a more precise picture of the population under analysis, it could be broken down into a number of <u>types</u>, or groups of components, such that the variance across inputs, state and output variables is considerably <u>less</u> than the variance across the entire population of components. We would be looking at the same sets of variables within each group, although the <u>coefficients</u> for each variable would likely be different from group to group, and in comparison with the coefficient for the entire population. The problem is determining the basis on which the

population or sub-system should be broken up. Since the "real world" will probably not show distinct groups, the criteria chosen is to minimize the variance within any group. The division would be based on some sub-set of the internal state variables (or all of them). It could be uni-variable using either a technical variable (sales volume, location, or square footage of retailers; or income or age for consumers) or on a socio-psychological variable such as risk-opportunity perceptions. This, however, may not provide the adequate homogeneity of variance within types. An alternative would be division based on multi-variable characteristics that could be determined, for example, through the factor analytic approach.

We are considering the state of a system of production/consumption units which are grouped by some set of factors. The number in each group (N) becomes crucial in determining the aggregative action of the sub-system. The surveys of a random sample of components will provide the relative numbers in each group or type, but the total number of components in the population must be obtained from census data.

It should be evident at this point that the power of this type of method is significant. While each of the groups is assumed to be static over time--i.e., a constant-time type--the subsystem is definitely dynamic because as the number in each group changes over time, the aggregate of inputs and outputs for that sub-system will also change.

Let us now show this algebraically.

From survey results
of random sample
all retailers

6. $$O^T(n) = AS(n) + BI(n)$$

Retailers split into
groups based on some
subset of S(n)
(say 3 groups of retailers)

7. $$\begin{bmatrix} O_1(n) \\ O_2(n) \\ O_3(n) \end{bmatrix} = \begin{bmatrix} A_1 \\ A_2 \\ A_3 \end{bmatrix} S(n) + \begin{bmatrix} B_1 \\ B_2 \\ B_3 \end{bmatrix} I(n$$

The number in each group can be classed by (N)

8.
$$\begin{bmatrix} N_1(n+1) \\ N_2(n+1) \\ N_3(n+1) \end{bmatrix} = \begin{bmatrix} f_{11} & f_{12} & f_{13} \\ f_{21} & f_{22} & f_{23} \\ f_{31} & f_{32} & f_{33} \end{bmatrix} \begin{bmatrix} N_1(n) \\ N_2(n) \\ N_3(n) \end{bmatrix}$$

Each group in equation 7 is static in its characteristics, but as the number in each group changes over time according to equation 8 (simple migration matrix or first order Markov Chain). Thus:

9.
$$O_i^T(n) = N_i(n) \cdot C_i(n)$$

10.
$$O^T(n) = \sum_{i=1}^{K} O_i^T(n) = \sum_{i=1}^{K} N_i(n) \cdot O_i(n)$$

The result is that while $O_i^T(n)$ is constant the total output $O_i^T(n)$ will hange as the number in ith group changes--i.e. the system is now dynamic.

'ow, what can cause the migration from one group to another:

a. New demand information
b. New information from government
c. Government assistance or investment
f d. Change in perceived Risk-opportunity set
e. Change in innovativeness

<u>Inputs</u> I (n)

<u>Internal States</u> S (n)

:hus:

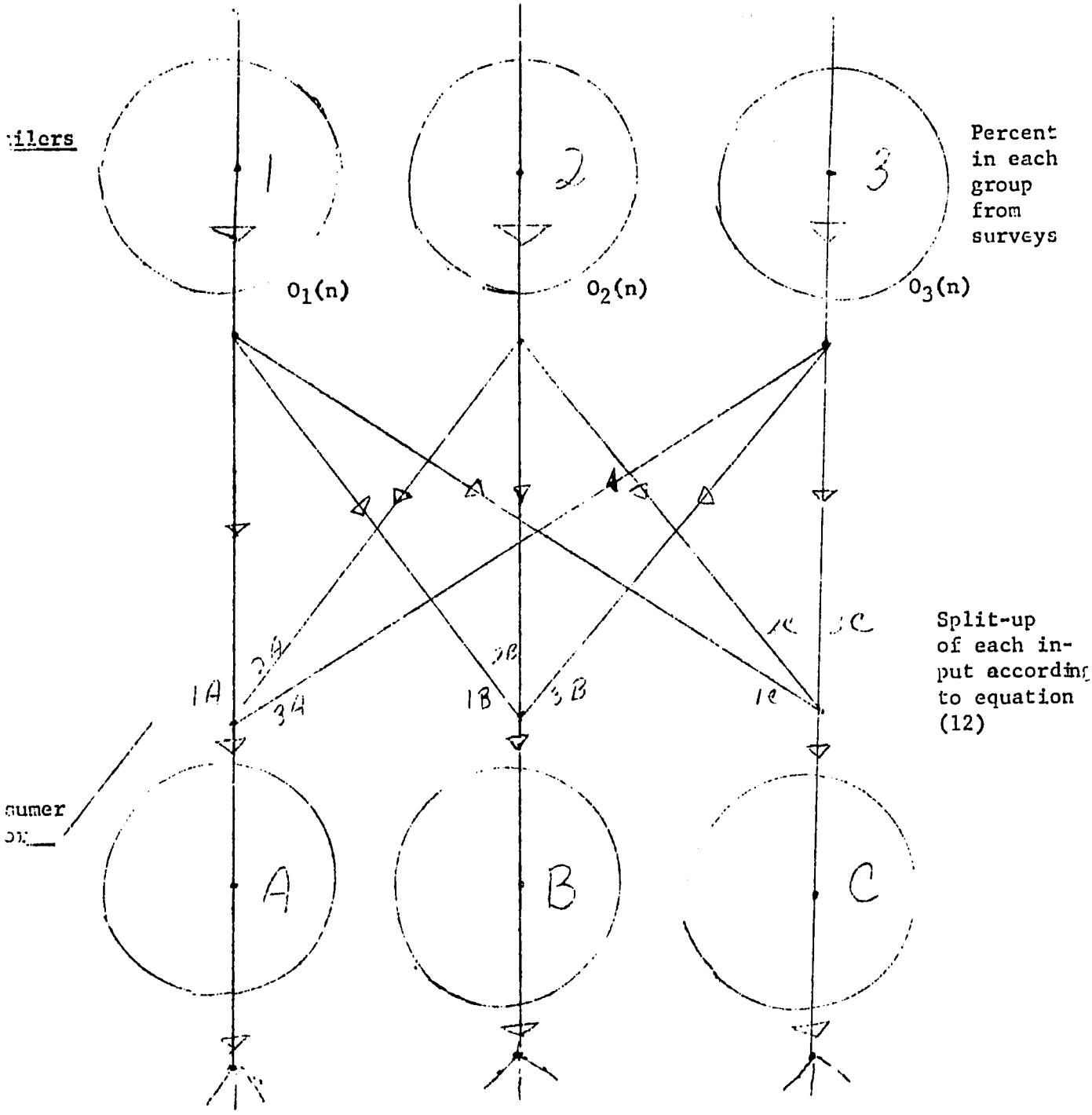
.1.
$$\begin{bmatrix} N_1(n+1) \\ N_2(n+1) \\ N_3(n+1) \end{bmatrix} = \begin{bmatrix} f_{11} \cdots f_{13} \\ \vdots \qquad \vdots \\ f_{31} \cdots f_{33} \end{bmatrix} \begin{bmatrix} N_1(n) \\ N_2(n) \\ N_3(n) \end{bmatrix} + \begin{bmatrix} S_1 i_1 \\ S_2 i_2 \\ S_3 i_3 \end{bmatrix} \begin{bmatrix} S'(n) \\ I'(n) \end{bmatrix}$$

Some sub-set of the total S(n) and I(n) vector.

This same kind of analysis would be done for other sectors. (For instance, .he consumers). One problem that is left is linking the particular sub-systems .ogether. Each input can come from a variety of sources. This problem can tenta-:ively be handled by developing an interim matrix of the following form.

2. Each Input Type
$$\begin{bmatrix} I_a \\ I_l \\ I_c \\ I_w \end{bmatrix} = \begin{bmatrix} \pi_{11} \cdots \pi_{1n} \\ \vdots \qquad \vdots \\ \pi_{w1} \cdots \pi_{wn} \end{bmatrix} \begin{bmatrix} \text{Source } 1 \\ \text{Source } 2 \\ \vdots \\ \text{Source } n \end{bmatrix}$$

each row states the percentages of an imput coming from each possible source.


:ilers
1
2
3
$O_1(n)$
$O_2(n)$
$O_3(n)$
Percent in each group from surveys
1A
2A
3A
1B
2B
3B
1C
2C
3C
Split-up of each input according to equation (12)
numer
A
B
C

LABOR/CAPITAL/MESSAGES

The determination of the population retailer total output is affected by amounts of inputs, number in each, and internal states. It is limited by the capacity (number) which is in the group; but within those limits outputs are a function of the inputs to consumers (demand) and the particular characteristics of product "mix" (distribution). The development of alternative linkage schemes may be needed. The next paper in this series will deal more fully with this crucial conceptual problem.

III. RESEARCH DESIGN: THE INTEGRATION OF FIELD RESEARCH AND SYSTEMS METHODOLOGY

It is required that we state how variables are to be "handled" and the data needs of the model. But, finally, field research must be designed to collect that data from which the functional relationships between those variables can be established. There are five sequential considerations which are crucial:

1. The determination of the Production/Consumption unit to be modeled.
2. The determination of the variables to include in the vectors of O, S,, and I of equation 5.
3. The operationalization of the variables so that they can be precisely measured. This includes defining the price and flow of each input and each output for the production/consumption unit, as well as the construction of an instrument which acts as an indicant of each state variable.
4. Given steps 1,2,3, the coefficients in equation 5 must be determined.
5. Finally given the coefficients, the simulation and analysis can proceed.

1. The determination of the unit of study: the production/consumption unit under analysis. This step is done in a three phase process based on the project's commitments, project goals, basic hypotheses which are to be analyzed, and the level of disaggregation desired;

		Example	
a.	Define the system	Distribution system	Sisal Industry - Northeast Economy
b.	Define the sub-system	Retailers	Sisal Processor - Food-Distribution
c.	Define the Production/ Consumption	A retailer type or specific retailer	a particular processor type - Retailers

The determination of the actual system is crucial, along with the "level of entry" into that system. The approach is a function of project research needs and the best "example" that can serve to show the usefulness of systems in analyzing dynamic development problems. Whether we want to analyze the distribution of food and its effects on other sectors of the economy or the link between the rural farmer and urban consumer goods industry will affect the place of entry into the system, but not the structure of the model. We will be looking at broad segments of the distribution and consumption/labor sectors; thus, these can serve as pivotal points in the design. It would seem that relatively narrow vertical cuts at the economy, preferably by commodity or commodity groups (food and non-food) would produce the best results. This would entail the analysis of a commodity or a group of commodities from production through distribution to consumption, and the labor and capital tie-backs to the production and distribution sectors. The type of channel characteristics might be a major criterion for the choice of the commodity to analyze. One with an entrepreneurial "channel captain" or one with a very active and influential processor or retailer would be advantageous because it provides a focus for analysis and the potential location of viable "change agents."

The reasons behind this relatively micro orientation should be explained. The research outline emphasizes the socio-psychological characteristics which are crucial to understanding behavior and changes in behavior. As yet, the relationships are not fully understood. Their inclusion is important, but the first attempt should concentrate on developing relationships and the only way this might be accomplished within the time constraints is with a relatively micro analysis. This probability of being able to have a dynamic model of a very large segment of the economy is very small. However, the approach has several advantages:

1. We would be looking at an entire process through all levels of the economy.
2. The structure would be essentially the same for other vertical segments of the economy.
3. It would show the importance of second-order effects of changes in one part of the sub-system, i.e. changes in the distribution sector affects labor requirements in the production sector.
4. It would be a valuable example in showing how the whole system "might" look, by building basic relationships and structures.

We will be looking for homogeneous types within a subsystem (usually some horizontal segment of the sub-system under analysis). At this stage, the numbers in each type must be determined and the factors which influence migration from one type to another defined and researched. Statistical factor analysis should prove useful in defining relatively exclusive and homogeneous types of production/consumption units with the sector for that part of the research, as we noted above.

2. The determination of variables to include in the vectors of outputs, inputs, and propensities. Given the production/consumption unit which is to be analyzed, the variables to include in each of the factors must be determined. This entails certain assumptions as to the importance of each variable in the determination of action and the action which one would like to be measured. Considerable prior research, including the project's efforts in Puerto Rico, provide evidence on the

probable importance of many variables. However, it should be evident that considerable exploratory efforts will be needed.

The following list is suggestive of the variables which might be included. This might represent those variables relevent for a small retail type.

INPUTS	OUTPUTS.	STATE	
		age income size of firm size of family mobility military service education intensity of resourse use legal organization machinery output capability city location	TECHNICAL
Government programs private programs credit discounts		risk-opportunity perception modernity innovativeness political knowledge business, competitive and economic perceptions world views-knowledge of environment trust cosmopolitanness source credibility and perception knowledge of sources of assistance self-perception relative to others in area reason for purchase	SOCIO-PSYCHOLOGICAL
	publications mass media exposure conversations with who frequency content when condition advertising point of purchase gov. publications information price information sources		

3. The operationalization of the variables designated in step 2. This step can be divided into two parts: operationalization of the input and output variables and operationalization of the propensity variables.

First, each input and output variable should be defined relative to its rate of flow into the production/consumption unit and its unit price. Some of the previously mentioned variables may have to be combined to provide a set of workable variables. This is intuitive for the physical goods entering and leaving the production/consumption unit. Services can also be done within this context. For example, credit, delivery, the hours a store is open etc., all have at least an opportunity cost, and the flow could be based on relative percentages of sales on credit or that are delivered. The information flow and price of messages is perhaps more difficult, but is still possible. The flow rates could be the number of messages or subscription received from a source, or some index of various media exposures. The price of the messages could be the advertising budget, or the wage expense associated with the time spent in particular facets of inter-personal communication.

Much work is needed in a better definition of the informational and service aspects of the input and output variables. The above are only suggestions of potential means to obtain the price-flow relations.

Second, instruments must be developed to index the socio-psychological and technical aspects of the propensities. Presently a workbook of communication and attitudinal variables is being compiled; it will include many potentially relevent variables from the Puerto Rican study plus others which may prove useful. The emphasis of this workbook is on ways in which each variable can be measured and alternative instruments to use in that measurement. It would seem useful to complete the same type of workbook for the marketing and economic variables which are of such obvious importance to the inputs and outputs, and technical propensities. Final selection of the measuring instruments, will be done "on site" through extensive pre-testing of survey and interview questions.

The suggested model will need data which can be quantified and where differences in results have at least ordinal relationships. This would suggest much more extensive use of scaled questions-especially on the internal state variables.

One example should emphasize the difficulty but importance of effective operational definitions. The risk-opportunity perceptions, of participants in any component may greatly effect their action. It might be hypothesized that such states as "profit motive" are indeed present but R-O set does not permit the participant from showing this motive. The measurement of a participant's R-O set may be able to serve as a "surrogate" for many of the internal state variables. To measure the value of such a variable which is useful to modelling, there must be a scale of scores on which each participant ranks. The use of a Guttman (intensity-direction) scale or a set of semantic differential scales may serve this purpose.

Given steps 1,2, and 3 the coefficients in equations 5b and then 5a must be determined. The explicit design of the method used in gathering the data and processing it to fit the desired format is relatively simple. The following is a suggested approach for gathering and processing the required data.

a. The initial attempt is to determine the coefficients in equation 2:O(n)=AP(n)+BI(n). This could be restated in vector form to show each of the inputs, outputs, and propensities.

$$\begin{bmatrix} O_1 \\ \vdots \\ O_n \end{bmatrix} = \begin{bmatrix} a_{11} & \cdots & a_{1m} \\ \vdots & & \vdots \\ a_{n1} & \cdots & a_{nm} \end{bmatrix} \begin{bmatrix} P_1 \\ \vdots \\ P_m \end{bmatrix} + \begin{bmatrix} b_{11} & \cdots & b_{1k} \\ \vdots & & \vdots \\ b_{n1} & \cdots & b_{nk} \end{bmatrix} \begin{bmatrix} I_1 \\ \vdots \\ I_k \end{bmatrix}$$

OUTPUTS	PROPENSITIES	INPUTS
O_1	P_1	I_1
O_2	P_2	I_2
O_3	P_3	
	$\vdots$	$\vdots$
	P_n	I_k
O_n		

*Remember that the O's and I's each have two segments--price and flow, though each O or I does not have to use both.

b. Randomly sample production/consumption units from the universe of units determined in the first step of the above considerations.

c. Gather data across the production/consumption units on each of the variables. This would entail some survey work and "in store" interviews and observations. Observation could play an important role in determining the values of many of the variables in the unit. For example, market basket analysis, promotional displays, inter-personal information received by managers; and some technical variables such as shelf-space useage.

d. The result would be a matrix of O', P', and I', where each row represents a variable over the same participants and each column represents a particular participant over each variable. The O' or output matrix would look like the following: (The P' and I' would look similar).

Output Variable

$$\begin{bmatrix} O_1 & O_2 & O_3 & O_4 & \cdots \\ O_1 & O_2 & O_3 & O_4 & \cdots \\ O_1 & & & & \\ \vdots & & & & \\ O_n & & & & \end{bmatrix}$$

One column for each sample participant

1 .....Participant.....M

in the sample

e. Multiple regression analysis would be used to evaluate the coefficients in the A and B matrix of equation 2.

$$O_1 = \alpha_{11} S_1 + \alpha_{12} S_2 \cdots \alpha_{1m} S_m + B_{11} I_1 + B_{12} I_2 \cdots B_{1k} I_k$$
$$O_2 = \alpha_{21} S_1 + \alpha_{22} S_2 \cdots \alpha_{2m} S_m + B_{21} I_1 + B_{22} I_2 \cdots B_{2k} I_k$$
$$\vdots$$
$$O_n = \alpha_{n1} S_1 + \alpha_{n2} S_2 \cdots \alpha_{nm} S_m + B_{n1} I_1 \cdots B_{nk} I_k$$

f. The solution to the n set of simultaneous equations will give the alpha and beta coefficients, which are then placed back into equation 2 with the resultant matrix formed as follows.

$$2a. \quad \begin{bmatrix} O_1 \\ \vdots \\ O_n \end{bmatrix} = \begin{bmatrix} \alpha_{11} & \alpha_{12} & \cdots & \alpha_{1m} \\ \alpha_{21} & \alpha_{22} & \cdots & \alpha_{2m} \\ \vdots & & & \\ \alpha_{n1} & \alpha_{n2} & \cdots & \alpha_{nm} \end{bmatrix} \begin{bmatrix} S_1 \\ \vdots \\ S_m \end{bmatrix} + \begin{bmatrix} B_{11} & B_{12} & \cdots & B_{1k} \\ B_{21} & B_{22} & \cdots & B_{2k} \\ \vdots & & & \\ B_{n1} & B_{n2} & \cdots & B_{nk} \end{bmatrix} \begin{bmatrix} I_1 \\ \vdots \\ I_k \end{bmatrix}$$

The data matrix need not be standarized, since the coefficients are in units which cancel appropriately during the matrix multiplication.

g. Now equation 2 (2=2c) is ready for simulating various values for the propensity and inputs vectors, and their effects on the outputs or actions of any production/consumption unit (or group of production/consumption units).

An initial attempt is underway to analyze the retailer's survey from Puerto Rico in the method just described. Since the variables in the Puerto Rican efforts were not gathered with this purpose in mind, considerable leeway must be granted. Nevertheless, the analysis should prove interesting and give some further insights into the feasibility of the approach.

5. Simulation and analysis of the results. The simulation efforts will be applied to the equation developed in 2c. The initial simulation will take various levels of the propensity and input vectors from the data already collected and determine the type of outputs which evolve. Then through a sort of "delphi" approach, various changes in the propensities and inputs--based on government action, foreign investment, or changes in production/consumption units--will be hypothesized and tested. These results will show the first-order effects on the outputs of the production/consumption sub-system and, more importantly, the second-order effects on the other parts of the system. If the analysis shows only what variables do change, and in what direction they change, it will have been worth the effort.

It should be noted that we have not discussed the research design for gathering and processing the data for the more complex dynamic case of the proposed model (equation 4b and 5a). It seems feasible, over a longer range program, to take measurements with the same instruments over time (say at six months or one year intervals) to show how the state values change as a function of those states in the previous time period and the previous inputs.

The alternative given the time constraints which are present, is to develop the constrant-time types suggested in the theoretical development of part II. We can sample from the universe of production/consumption units. Thus, through factor analysis we can determine potential types based on the items in that factor analysis. These we would have to define as constant-time types, i.e., their propensity characteristics do not change over time--only the number in each type changes. The problem then becomes the determination of the number in each type and the tendencies and rates for migration between components. (First approximation to equation 8 and 9.) The initial effort would be to hypothesize some migration rate and determine the changed output characteristics; or determine the desired outputs of the subsystem (made-up of several types) and find out the amount of migration that would have to take place for the degree of output change to take place.

A second kind of simulation which could be run on the grouped production/consumption unit types would be to change the overall input and propensity characteristics across types, and observe how both migration between groups and outputs are effected, based on hypothesized or required relationships. This design would permit addition of components which are not presently in the system with alternative hypotheses as to how the number in each group will change. For example, if three types of retailers were determined, each with constant-time characteristics, the introduction of supermarkets with specific characteristics can be simulated with various

rates of growth relative to those types of retailing already present. Another example would be the effect on outputs of differe . flows of information to each of the types. This might indicate those types of retailers which are most receptive to new information and where future effort in this would best be promoted.

As stated, the addition of the types to the analysis is significant because we can have basically a staid set of types defined, which eases the research requirements: yet, have the sub-system dynamic by virture of the migration between types of production/consumption units.

IV. CONCLUSIONS

The research design that has been proposed is obviously far from complete. More work is needed on the explicit delineations of variables to inclu n the relationships hypothesized, and on the data needed. But it does represent an outline of a method which could prove useful from the viewpoints of the field research time, the decision model, and a more aggregative macro-model.

How does this model fit into the general field research?

1. It forces the focusing of attention on relevant variables and their operationalization.
2. It aids in the organization and compatibility of all surveys.
3. It is one major method of analysis which stresses relationships and interaction between participants at various levels.

4. It could prove to be a major aid in the other parts of the research analysis.

How does this model fit with the desire to develop a planning model for decision-makers in the economic development field?

1. It should prove to be a realistic and potential example of what system's theory can accomplish at the behavioral level, as opposed to the grossly aggregate level.
2. It should aid in validating systems theory as an effective tool of analysis.
3. It includes many behavior variables previously not incorporated in more macro-models.
4. It should have a significantly greater ability to predict the behavior of specific components than a more aggregative model.
5. It stresses the importance of the idea that to understand a system it is crucial to understand the components that make it up.
6. It should aid in showing the number of alternative choices available and what their effects might be (investment in new institution or investment in new information).

How does this model relate to a more macro-model of the economy of the region?

1. The reliability of relatively gross models as a decision tool is often suspect because of the problems of data collection which are even severer than those of more approaches.

2. Many persons fear quantitative modeling altogether. This model, because it is relatively micro in scope, may have certain intuitively persuasive characteristics which could overcome some of these fears.
3. There seems little hope of developing a total model of Northeast Brazil within the year--particularly one which project researchers would view with confidence if intended for immediate use by policy workers. This model is aimed initially more at validating its scientific usefulness than its immediate pollicy usefulness.
4. If we are interested in the variability across components, within any sector, and how this variability is related to the actions of these components, this type of micro approach is required.
5. The analysis of change is crucial, particularly the effects of changes in people on the overall marketing process. Macro models tend to ignore "people variables.
6. The model suggested clearly has the ability to show how behavioral factors help or hinder when changes are investigated in such areas as labor, investment alternatives, and the rural-urban movement of consumer goods.
7. The model suggested can be adapted to fit into a more aggregative model to show the flexibility of the general model and as a first approximation of showing total interaction of the economy.

It has been mentioned frequently that the type of component

and model will depend on the type of problem under analysis. One of the basic purposes in using systems theory is to show relationships between the various potential controls and the internal conditions of the system. Thus, the analysis of employment problems and investment problems should be able to be done from the same model, not with two different ones. Further, in analysis of distribution problems the production/components must be present to show secondary but crucial effects. In assessing the relative efficiency of different inputs (control strategies) for producing new behavioral characteristics, it is crucial that the factors which affect that action determination and those control strategies be comparable. Comparability of both input control strategies to change a part of the system and the functional and disfunctional results of that change should be conscientiously sought.

For example, certain production/consumption units acting in a given way, but the policy planners may feel that these units should be acting differently. We would like to be able to say and to initiate that change most efficienty. This demands comparability. No matter how far in the future that capability lies the research should strive to achieve it. Initially the important concentration is on the <u>effects</u> of various alternatives within the framework of the model. The decision-maker must still weigh those factors outside the model to determine that particular one which gives the most desired results.

In order to develop a realistic model of the total economy of any region or country it is important to understand the functioning of the individual components of the system. The research approach suggested here does allow aggregation to the total economic system. Further, it has the feasibility of being completed within the time commitment of one year. Third, it should prove to be an interesting example of how the system would look in a more aggregative analysis. Fourth, it stresses the need to define some basic relationships within the system before the problems of aggregation limit the predictive ability of the model. Thus, time, variable analysis, basic relationship determination, justification of more general use, and field research capabilities tend to define the need for a relatively narrow initial effort.

This approach would give much more power to projecting to the total population of the production/consumption units of any sub-system than starting from the more aggregative direction. However, this approach can be used aggregatively once the researcher is confident that the building blocks are sound and the methodology flexible enough to warrant a more aggregative approach.