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A PROPOSAL FOR AN INFRASTRUCTURE INVESTMENT LOCATION DECISION SUPPORT SYSTEM

for
The Department of Public Works and Highways,
Government of the Philippines

by

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INTRODUCTION

The national Medium-Term Philippine Development Plan provides policy direction for economic and social development for the period 1988-1992. The regional Medium-Term Development Plans for individual regions outline development strategies for each of those regions. The strategies are well conceived but stop short of defining action-oriented programs for implementing these strategies.

At the other end of the planning spectrum, the Department of Public Works and Highways (DPWH) has developed recently a long term Physical Infrastructure Plan (PIP). That plan includes an inventory of basic infrastructure in each of the nation's 1550 or so municipalities. Preliminary standards have been devised that enabled DPWH staff to classify each municipality based on population, food production and the level of infrastructure in that municipality. Three basic classifications were used, with sub-categories in each: the **survival level** with two sub-categories in which the municipality has yet to meet minimal standards; the **subsistence level** with two sub-categories at which the municipality is meeting basic needs; and the **growth level** with three sub-categories at which the municipality is beyond basic needs. These classifications are descriptive; they rely exclusively on what exists in the community, not on the community's potential for development. Like the regional development plans, the PIP suggests action plans, but does not prescribe specific courses of action, nor does it prescribe specific investment packages to meet municipal or provincial needs.

The national and regional development plans and the Physical Infrastructure Plan are necessary elements of effective development planning, but their effectiveness can not be maximized unless a means is created for linking the development policies and strategies developed at the national and regional levels with the needs analysis generated at the municipal level. The linkage must be such that it facilitates and encourages the development of action-oriented programs that lead to the creation of investment packages, mutli-year program plans, and annual projects and budgets at the regional, provincial and municipal levels.

Integrating the PIP with the national and regional development strategies requires an effective decision support system for putting together sensible action plans and investment packages. At the current level of understanding of dynamic programming and the current level of effective economic development theory, it makes little sense to attempt to develop a complex computer program to create investment packages and to make resource allocations among sectors and locations. The human mind can do a much more effective job of creating alternatives and options, provided that it has appropriate decision support. A computer assisted decision support system is an efficient and effective way to help analysts and policy makers develop and evaluate strategies and the programs and projects needed to implement them.

This report proposes the development of a computer-assisted information and decision support system that can be of assistance within the Department of Public Works and Highways, but which could also serve more broadly to assist with national and regional development planning across agencies and sectors and which would help to integrate broad planning with specific action plans. The system would also provide a means for helping to manage donor programs, matching the desired investment objectives of donor nations with the strategic development needs of the Republic of the Philippines.

The report is presented in four parts. First the system concept is described together with the premises upon which the model is designed. Second, various input specifications and operating criteria are outlined for each decision-making level of the proposed system. Third, an outline is provided describing the various tasks necessary to operationalize the system. Finally, in an appendix, simple illustrations of system application are included to show the nature of system outputs with examples of system response to policy changes in the allocation of funds for various infrastructure purposes at different decision levels and, alternatively, system response is shown to changes in allocation criteria and development standards.

It should be stressed that all variables applied to the system at this stage are submitted for illustrative purposes only. During the operationalizing phase of the project one of the initial tasks consists of identifying and specifying the key indicators necessary to describe accurately and precisely the state of each sector in each region, province and municipality, and the information requirements for each project type in the decision process. The definition of the four indicator typology in the spreadsheet description are part of the system design, however.

THE PROPOSED SYSTEM

DESIGN PRINCIPLES

The basic philosophy underlying the design of the sytem is to produce a pragmatic, easy to operate decision-assisting tool that can be put to use without delay. Specifically, the design of the system is based on the following premises and considerations:

a The sytem will not attempt to impose an "ideal" solution on an existing institutional framework; it rather seeks to influence from within, and incrementally, the current decision making process.

b The system must be based on available information utilizing existing data bases and should, whenever feasible, incorporate in its components currently used concepts, processes and procedures of the Department of Public Works and Highways and other government agencies.

c The system must be simple and easy to understand and operate. To facilitate this design objective the necessary database must be kept to a minimum of key variables for each analytic task and project characteristic. As a corollary, if some key variables are not currently available, surrogate data should be used to the extent feasible before any new surveys, data collection exercises and/or studies are recommended in order to operationalize the system. However, the baseline data set should include time series for all key variables to show how the nation and the different regions, provinces and municipalities developed to their current state, at what rates and what shifts occurred during the developments process. These time series provide information of investment impact on the development process.

d The system must provide for vertical linkages from the Physical Infrastructure Plan of the DPWH to the various national, regional, provinicial and municipal plans, and for horizontal linkages at each system level to the various sectoral and independent agency plans, e.g. power and railroads. However, the system should not depend on a "tight coupling" of horizontal linkages.

e. The system design and its operationalization must relate to the personal computer hardware capabilities of the Department of Public Works and Highways and its current staff and management skills and resources.

THE SYSTEM MODEL.

The Decision Support System (DSS) consists of three interactive operational decision levels:

1. A **national/regional level** which allocates investment from the national to the regional level and, for the specific purposes of the DPWH, identifies projects of national interest and allocates funds for such projects.

2. A **regional/provincial level** which defines by location -- region, province, municipality -- by project type and by time frame -- immediate, intermediate, long range -- the various investments in each province.

3. A **provincial/municipal level** which provides for the determination of standards, cost efficiency and cost benefits in the budgeting of specific projects at the municipal level.

The three decision levels of the system, as shown diagrammatically on the next page, are linked by two parallel vertical streams:

a. On the right is a set of three **three dimensional spreadsheets** representing the national-regional, the regional-provincial and the provincial-municipal levels of government, and providing a natural resources carrying capacity related socio-economic comparative profile of the developmental state of each unit in the three layers including the state of public services and facilities in each unit. It is a computerized, empirical two-way information flow subsystem.

b. On the left are sets of **nine-cell strategic decision matrices** at each spreadsheet level for resource and project allocation decisions and for "what if?" analyses of alternative allocation strategies in the context of investment purposes, project characteristics, time frame considerations, regional, provincial and municipal conditions and resource constraints. It is an interactive, decisionmaking subsystem providing for cashflow from the national to the municipal level.

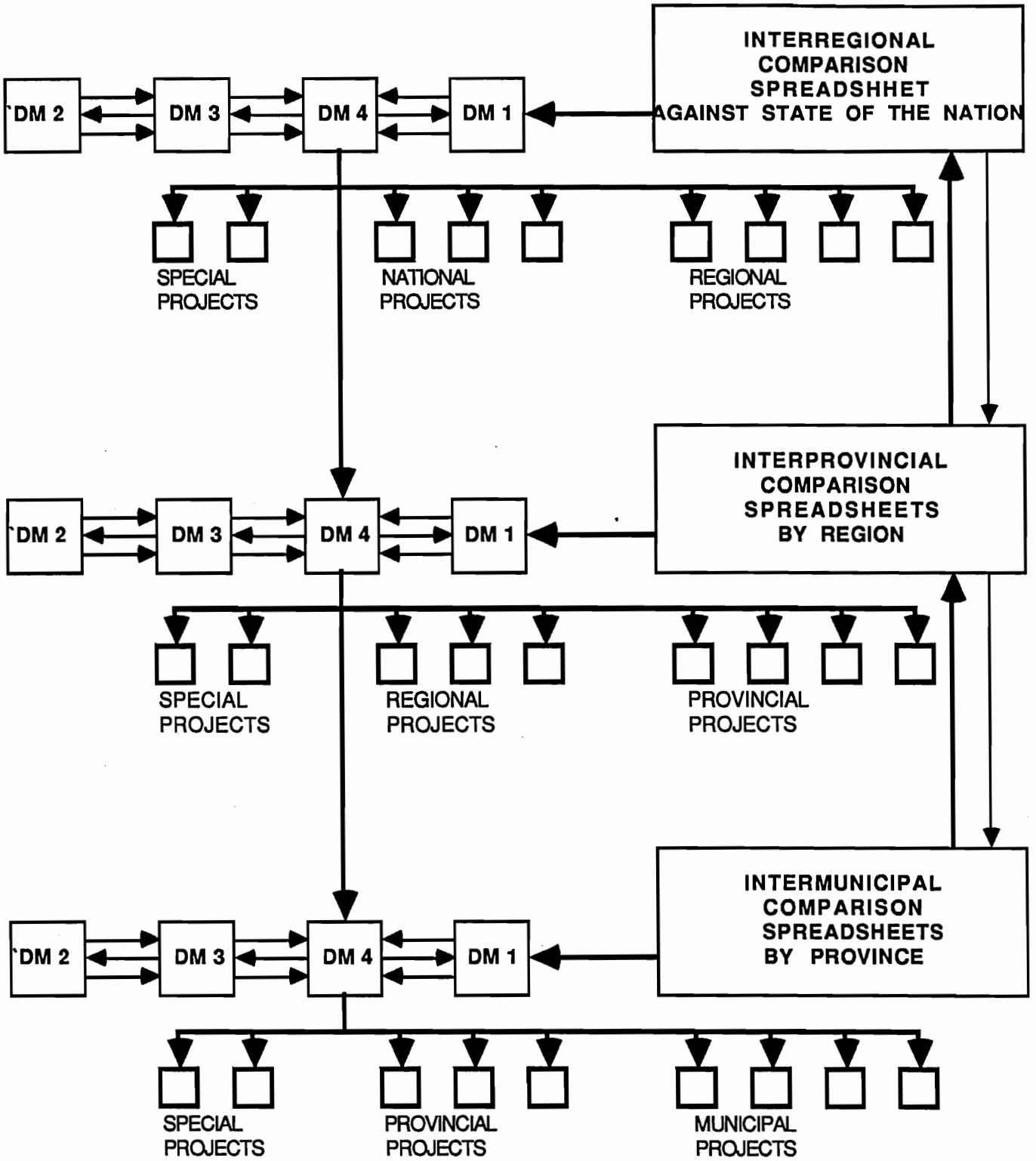


FIGURE 1 THE PROPOSED DECISION SUPPORT SYSTEM (DSS)

The Three Dimensional Spreadsheets

The proposed spreadsheets represent a synthesis of ideas originating in the writings of the Dutch Nobel laureate economist Jan Tinbergen, the German industrial engineer Erich Jantsch, and the American sociologist Gerald Hage, first presented by the senior author of this proposal as a policy diaggregation model in 1969 and subsequently expanded into "state of the region" spreadsheets" in 1973 and 1981.

The basic principle is simple: one compares sets of key indicators sector by sector in the columns of the matrix to geographic units of government operating at the same administrative level in the rows of the matrix to one another and to the next higher level of government of which they are part. In the Philippine case one would compare the regions to the nation, the provinces to the region of which they are part, and the municipalities to their respective provinces. The comparison can be simply descriptive, however it is suggested that somewhat more sophisticated analytical statistical techniques be used, e.g. the calculation of means and standard deviations as well as indexing to allow for easier intersectoral comparison.

As shown on the diagram of the spreadsheet concept in Figure 2 below, the third dimension represents time. It is fortunete that the latest versions of personal computer data base software have incorporated a z axis which in this case allows for the incorporation of time series into one spreadsheet instead of requiring separate sheets or elaborate and cumbersome cell arrangements. The third dimension makes it possible to include historical time series for each indicator together with projected and/or expected future outcomes.

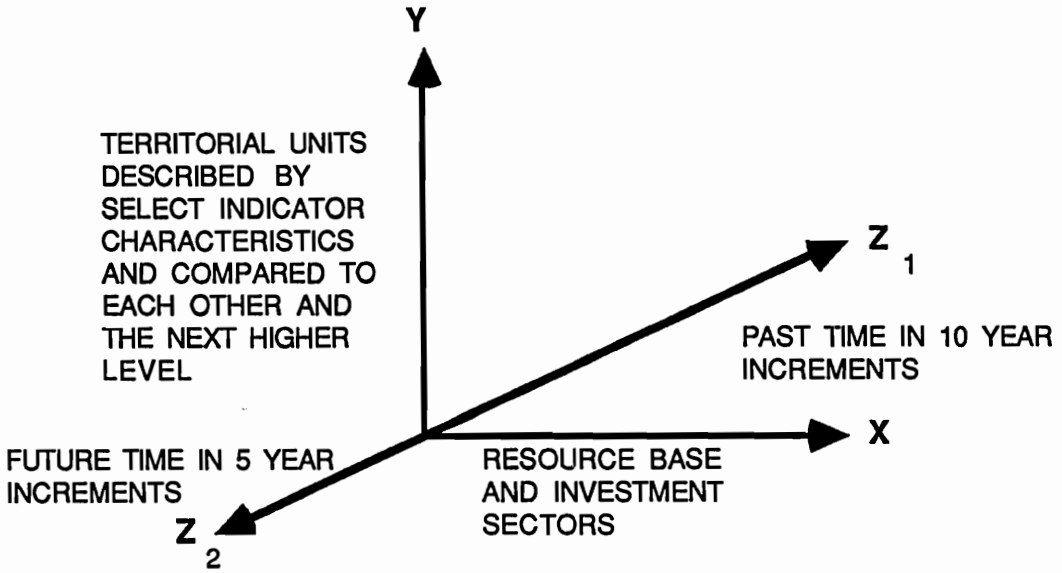


FIGURE 2 THE 3 - D SPREADSHEET CONCEPT

To maintain simplicity and clarity one must avoid an overload of data in the design and loading of the spreadsheet. In particular, it is important that:

1. Not more than one or two key indicators can be selected for each resource area and socio-economic and service sector.

2. Each key indicator is described in four dimensions. These are: (a) The **scale** (magnitude, size) of the phenomenon described as an absolute number, e.g. total population, the size of the regional GDP in pesos, the length of the road network in kilometers, etc. (b) The **structure** of the scale indicator presented as the per-centage of a key component of the scale indicator, e.g. percent all-weather roads. (c) The **intensity** of the scale indicator expressed in per capita terms, e.g. GDP per capita, arable land per capita of farm popu-lation. (d) The **opportunity cost** inherent to scale indicator expressed as a percentage of the scale having a positive or negative consequence for public policy, e.g. percent urban unemployed.

3. Time series should be extended into the past in 10 year increments for at least three decennia. However, projections into the future should be limited to 15 years maximum and presented in 5 year increments. In todays worldwide state of uncertainty to project and forecast for longer periods of time is an exercise in futility notwithstanding all the elegant mathematical models and elaborate equipment available.

The spreadsheets are aggregated from the bottom up. That means that the data are collected at the municipal level. However, due to differences in the decision making focus which ranges from the strategic/normative/allocative at the national and regional levels to the project/action/implementation orientation at the provincial and municipal levels, the upward aggregation is selective. For example, key indicators required for local road decisions at the municipal level may not be required for strategic decisions at higher levels of government. Furthermore, strategic decisions should not be obscured by voluminous numbers. A well known American corporate president, discussing strategic planning, observed that in his experience over the years the fewer the numbers, the more lucid and meaningful was the strategic plan.

Two illustrative spreadsheet outlines are appended to this report.

The Nine-Cell Strategic Decision Matrices

The DSS diagram shows four nine-cell strategic decision matrices, DM1 - DM4, at each of the three decision levels. The two left side matrices, DM2 and DM3, provide for a normative input by the key decisionmakers at each level of government. In these matrices allocations are made, alternatives are manipulated and trade-offs evaluated. Also questions regarding the need for action and the ability to influence are evaluated. The right side matrix DM1 acts as a control by displaying the developmental state of each region, province and municipality on one axis and the three basic investment purposes defined by the model on the other axis. This information flows from the spreadsheets at each level. The central matrix DM4 combines the empirical and normative dimensions of the model by determining project purposes and characteristics and their respective allocations at any given point in time.

Examples of some strategic decision matrices are shown in Figure 3 on the next page. It should be pointed out, however, that more than two matrices could be applied at the left side of the model. Their number is determined by the number of different "what if?" questions and alternative parameters used in the decision process. They perform the role of successive sieves through which a large volume of proposed projects, programs and funding requests can be reduced to a manageable, affordable and implementable number at each decision level of the proposed system.

Because of its simplicity and clarity the strategic matrix in its many variations has become a key element in many corporate and public strategic decision-making frameworks for identifying issues and creating priorities for action. In its application the technique helps organize information, and focus discussion and policymaking.

STATE OF THE REGION

INVESTMENT PURPOSE	RAPID GROWTH	STABLE GROWTH	SLOW GROWTH
DEVELOPMENT MAXIMIZATION	H	H	M
DEVELOPMENT SUPPORT	H	M	L
DEVELOPMENT INITIATION	M	L	L

NINE CELL DECISION MATRIX 1

IMPLEMENTATION CAPACITY

PROJECT PRIORITY	HIGH	MEDIUM	LOW
DEVELOPMENT MAXIMIZATION	H	H	M
DEVELOPMENT SUPPORT	H	M	L
DEVELOPMENT INITIATION	M	L	L

NINE CELL DECISION MATRIX 3

STATE OF THE REGION

INVESTMENT ALLOCATION BY PROJECTS AND LOCATIONS	RAPID GROWTH	STABLE GROWTH	SLOW GROWTH
DEVELOPMENT MAXIMIZATION	H	H	M
DEVELOPMENT SUPPORT	H	M	L
DEVELOPMENT INITIATION	M	L	L

NINE CELL DECISION MATRIX 4

H HIGH PRIORITY
M MEDIUM PRIORITY
L LOW PRIORITY

FIGURE 3 ILLUSTRATIVE EXAMPLES OF NINE - CELL STRATEGIC DECISION MATRICES

THE THREE DECISION-MAKING LEVELS: AN OVERVIEW

In the following, a brief description is provided to illustrate the main characteristics of each of the three levels of the proposed Decision Support System. The models at each level are presented in ascending order because the Provincial-Municipal level provides the basis for data collection for all three levels. Also the data requirements needed to operate at that level are broader and the grain of the data is finer. Some general comments are in order, however.

In regard to the terminology used for classifying regions and provinces by their state of development, it is suggested that **growth** be considered **rapid** for regions which exceed by one standard deviation the national norm, or by another similar measure to be determined during the implementation phase of this project. Growth in the center of the distribution is considered **stable**, whereas growth below one standard deviation, no growth or decline is considered **slow**. The use of these three terms eliminates the stigma attached to such commonly used word pairs as lead and lag, etc. At the municipal level the classification scheme developed in the PIP should be retained so that the links to that plan remain clear.

Similarly, to avoid an investment policy term like "basic needs satisfaction", the terms **development maximization**, development **support** and development **initiation** are suggested to describe alternative investment strategies, programs and projects are used at all three levels of the system.

Data entered and stored by municipality will be aggregated to provinces, then to regions, and then to the nation. Information entered at the national and regional level that is subsequently disaggregated to the provincial and local level (such as population projections or upper bound constraints on population growth) will update the municipal models. Hence, the three layers of models interact with one another. The higher level models disaggregate information to the lower level models. The information that is more appropriately generated at the lower levels will be aggregated upward toward the higher level models.

Annually, DPWH staff will update or modify community standards for infrastructure in various sectors. These standards, based on advice and counsel from other organizations such as NEDA, will define what constitutes various levels of community conditions. Communities that do not yet meet minimal threshold standards are at the lowest level, frequently not meeting basic needs for human survival. Communities at the next level meet subsistence levels. At the highest standards, communities meet development maximization standards. The standards, such as the desired number of kilometers per square kilometer of arable land or potable water sources per 100 persons, refer to infrastructure provided by both DPWH and other agencies. Based on its infrastructure and on other indicators of community well-being, a composite indicator will be calculated for each municipality. The composite indicator will be the one on which the municipality will be classified. These standards and indicators are purely descriptive. That is, they do not describe what ought to be, but, rather, what is. Each province will be classified into one of the categories based on its composite index , as will each region.

The Provincial-Municipal Level

The Provincial-Municipal Model operates at the third level of the Decision Support System. Its purpose is to aid decision making in planning and budgeting for infrastructure improvements at the municipal and provincial level. Like the models at the national-regional and the regional-provincial levels, this model is designed to assist the Department of Public Works and Highways and other Philippine government agencies charged with developing infrastructure.

The system is intended to operate on an annual cycle as shown in Figure 4 on the next page. Each quarter, consistent with DPWH infrastructure reporting practices, DPWH staff update a computer model with the changes made in infrastructure during the preceding quarter by municipality. Some infrastructure will have been added to municipalities through construction. Some may have been lost because of natural or technological disaster or for some other reason. The staff will also update statistical indicators of community infrastructure status, although such changes might be updated only annually or semi-annually to save time and resources. The computer program will store, display, and print the inventory and indicators by municipality. The program will actually be a template developed from a standard spreadsheet. Where possible, the model will utilize the rapidly emerging three-dimensional spreadsheet programs.

It is important that municipalities be classified as development initiation, development support, or development maximization based on itsdevelopment potential in addition to its current status. A municipality classified as being only at the subsistence level might have sufficient development potiential that it is classified as a development maximaization municipality for purposes of public and private investment. DPWH staff will refer to regional and provincial development strategies to identify population projection rates and/or constraints on municipal growth in order to review municipal classifications generated for communities automatically by the computer program.

Because the model at this level contains both an inventory of infrastructure by municipality and a set of standards for each muncipality based on its classification, the computer is able to compute deficiencies by municipality by type of infrastructure. Illustratively, the computer can calculate the number of schoolrooms a municipality needs, subtract the number it has, and calculate how many it should have. The computer spreadsheet will also contain cost estimating relationships so that it can compute automatically the estimated cost in Pesos to construct the number of schoolrooms needed to bring the municipality up to standards. A time dimension has been incorporated into the model, along with population projections, so it is a simple matter for the computer to calculate the number of school rooms that will be needed in five and ten years based on current population projections for school age children.

Each year, DPWH staff will review cost-estimating relationships and update cost factors. One such cost factor would be the estimated cost per square meter for construction of an elementary school. The staff, with edcuation specialists, would review the standard of the number of square meters needed per child or the standard for the number of children in a classroom.

The model actually consists of two spreadsheet templates. The first is a template listing all municipalities within a province. The spreadsheet template is similar in form to the summary sheets developed at the national-regional and the regional-provincial levels, except that some indicators from those levels have been dropped in favor of others more appropriate to the muncipal level. As before, each spreadsheet is three-dimensional. The municipal spreadsheets aggregate to the second local level template, the interactive summary sheet, providing analysts and decision makers with an opportunity to assess "what if?" situations across sectors. For example, one could analyze the effects of receiving only 65 percent of the requested funds to examine where and how funds might be utilized to best advantage. Alternatively, one could examine the sensitivity of regional expenditure needs to changes in the standards. For example, suppose the standard for students per classroom were changed from 40 to 42. What would be the impact on needed classrooms and funds?

The products of the model will assist DPWH staff develop annual budget proposals and multi-year program plans.Because the infrastructure estimates go beyond areas for which DPWH has responsibility, the Provincial-Municipal model can contribute to other agencies' budgeting and planning efforts.

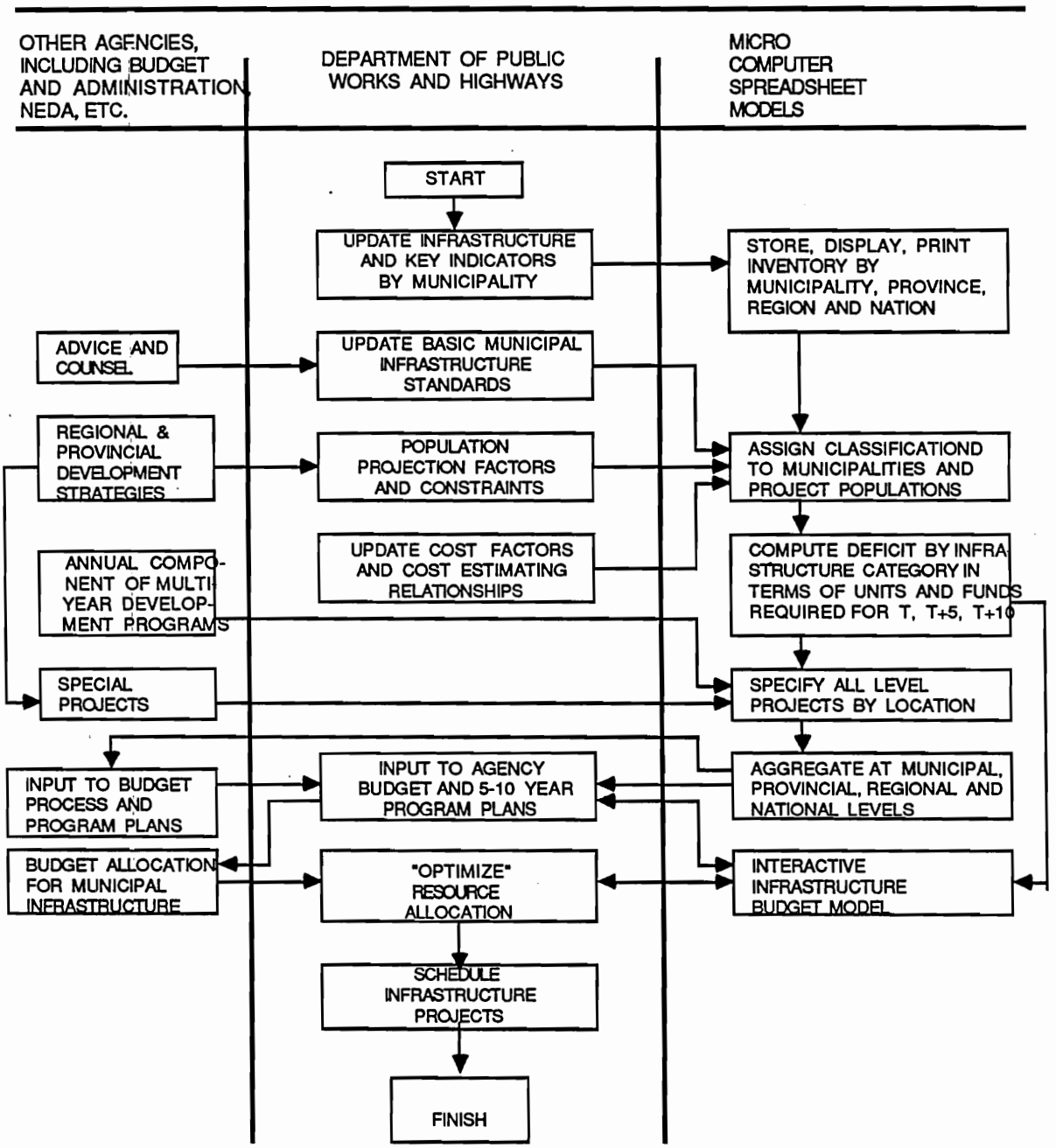
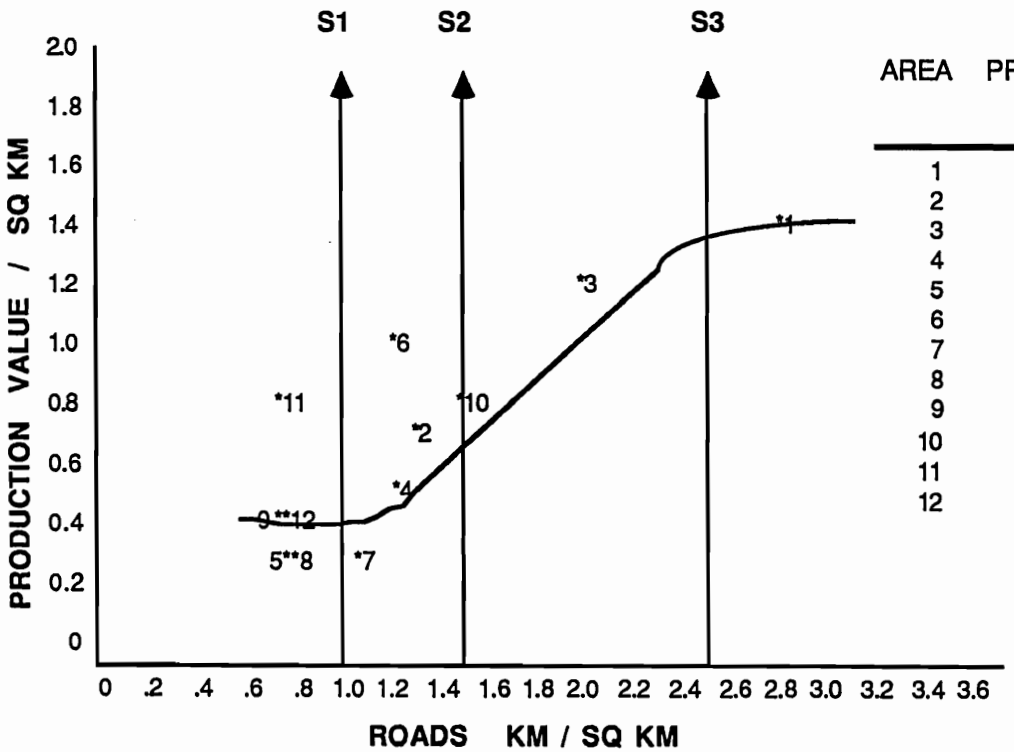


FIGURE4 THE PROVINCIAL-MUNICIPAL ANNUAL DSS CYCLE

In some cases it will be necessary to test the sensitivity of needs in terms of standards. Some standards are well established, based on significant analysis and extensive experience. In other cases, there may be no existing standards or it may be desirable to review existing standards in the light of empirical data. For example, there is very recent analysis that establishes a relationship between the existence of farm to market roads and agricutlural productivity per square kilometer of arable land. This work, conducted by the Department of Agriculture, suggests one way to look at developing standards. Logic suggests that, at very low levels, the total number of kilometers of road per square kilometer of arable land may not contribute significantly to total production. Similarly, in areas where there are many kilometers of road per squarekilometer of arable land, the addition of another half kilometer may have negligible effect. However, between those two extremes, the addition of road may have very marked positive impacts on production per hectare. Such a relationship suggests the traditional S or logistic curve as shown in Figure 5. In such cases simple plots of data may suggest interim standards for municipalities at various levels of development. The figure simply plots the number of kilometers of road per square kilometer of arable land against the production (in millions of pesos) per square kilometer of arable land for each of the twelve areas. The curve is in the illustration is hand drawn, but could be fit easily utilizing least square regression techniques. The point is that the curve suggests three standards. There is a high probability that communities in the lower left hand corner of the figure where there is both low prodution and few roads would benefit in terms of agricultural production if the standard S1 were made the lower level standard. Communities clustered in the middle would increase production still further if S2 were made their standard. It is unlikely that there would be much marginal benefit to adding farm to market roads to communities in the upper right hand portion of the figure; they appear to be at the level of diminishing marginal return.



AREA	Y PRODUCTION VALUE/ SQ KM	X KM ROAD/ SQ KM
1	1.4	3.1
2	0.7	1.5
3	1.2	2.2
4	0.6	1.4
5	0.4	0.8
6	1.0	1.4
7	0.4	1.1
8	0.4	0.8
9	0.5	0.8
10	0.8	1.6
11	0.8	0.8
12	0.5	0.8

FIGURE 5 ILLUSTRATIVE ANALYSIS FOR MINIMAL, MIDDLE AND UPPER LEVEL MUNICIPAL STANDARDS

The Budget Allocation component of the Provincial-Municipal Model identifies the number of units of infrastructure that can be built in each municipality for the funds allocated. These are infrastructure expenditures for local purposes. The model is also able to accept input, either manually or disaggregated from higher level models, for provincial projects. These are projects that must be built in a municipality but which serve a provincial need. Thus, funds allocated to meet provincial needs show up in the model, but not as expenditures on local infrastructure.

Once a budget allocation is made to the agency, the interactive model will provide help to the decision makers who must "optimize" their expenditure packages. This can best be done with regional goals and strategies in mind and by manipulating the interactive model. Once decisions have been made about how to allocate the resources, DPWH staff schedules infrastructure projects and the annual planning-budgeting cycle begins anew.

The Regional - Provincial Level

In a national planning and decision making system the regional/provincial level is a most crirical and complex level because, at this level, at least the following must take place:

- national development goals must be regionalized;
- national socio-economic plans and programs must be disaggregated and given a spatial interpretation for regions and provinces at differing stages of development;
- a regional/provincial strategic plan frame must be developed not only to mirror the national perspective, but, most importantly, to reflect an area's specific social, economic and environmental condition;
- sectoral programs and projects must be coordinated with and integrated into the strategic plan frame;
- resources for translating strategy into action programs and projects must be identified and mobilized;
- mechanisms for monitoring and evaluating program and project implementation must be designed and put into operation; and
- channels must be identified for regional/provincial advocacy at the national level and for the arbitration and balancing of conflicting interests and expectations at the level of, and between, municipalities.

The information flow channels of the three layer system will solve some of the above tasks. However, the interactive strategic decision matrices are the most important system component at this decision level. The above list of tasks alone suggests a host of "what if?" questions which the computer can only display in part. The normative element in the decision process plays, therefore, at the regional/provincial level a dominant role.

The National - Regional Level

At the National-Regional level one spreadsheet describes the state of each region in comparison to each other and to the state of the nation. In regard to the nation it is suggested that two figures be used. One describes the state of the nation excluding Metro-Manila, the other includes the capital region. The reason for this dual presentation is to exclude the skew Metro-Manila figures cause on many national indicators reducing the true coomparability of the other regions in the context of the development of national and subordinate regional infrastructure investment strategies. In particular, the Metro-Manila skew can affect the location of a region on the proposed three part growth rate and investment purpose scales.

In oreder to link the spreadsheet to the national plan the columns of the spreadsheet as shown in the illustrative appendix represent the issues and sectors discussed in the Medium-Term Philippine Development Plan. For the purpose of regionalizing the plan special attention is given to the issues and sectors linked to natural resources and the environment as well as the condition of infrastructure facilities. We suggest that infrastructure is one of the key investment areas which can act as a catalyst for development and the improvement of the quality of life at the local level.

From this spreadsheet through indexing or other statistical techniques empirical information flows into the interactive strategic decision matrices on the left side of the system model in Figure 1. To reduce the abstraction of that model diagram a flowchart, Figure 6, was constructed to depict the various steps and inputs requiered to operationalize the three level system.

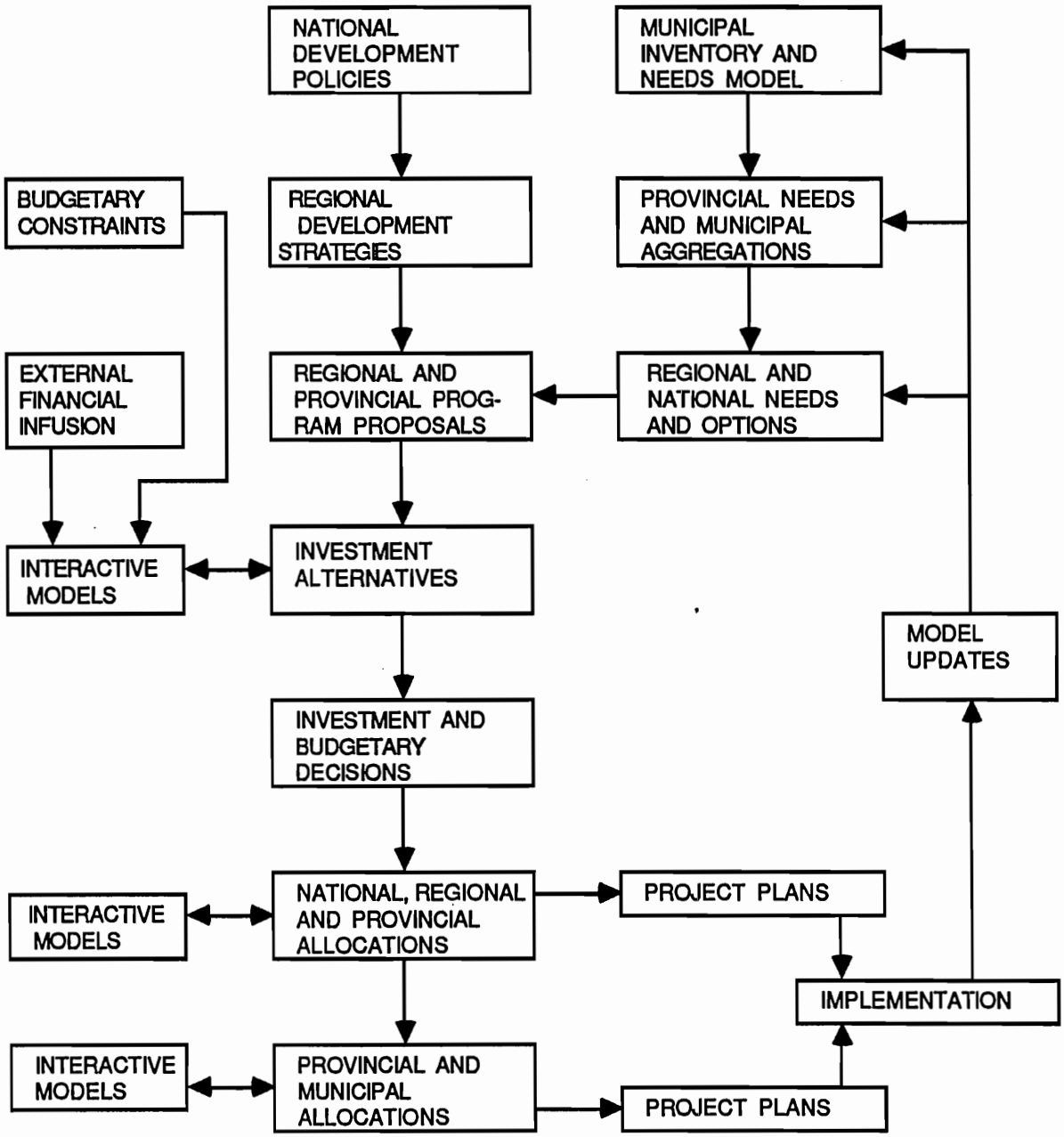


FIGURE 6 THE MULTI-LEVEL INVESTMENT DECISION FLOW

THE IMPLEMENTATION PROGRAM

Introduction

This report documents the conceptual phase of the proposed decision support system. The implementation program, as shown in Figure 7 on the following page, consists of two phases organized into three parallel streams.

Phase 1 began as an effort to link the DPWH's Physical Infrastructure Plan (PIP) with that Department's process for planning and budgeting for infrastructure development. It was concluded shortly into the conceptual stage that the effort could serve the broader purpose to integrate national and regional development strategies and action plans by government agencies. The proposed Decision Support System provides an opportunity to involve a full range of agencies and government organizations engaged in development from strategic planning through infrastructure construction.

There are two major components to any new system: **the technical** and **the behavioral**. The technical component is typically the easier to deal with. The behavioral component takes patience, planning, and involvement of those who will be stakeholders in the new system. The implementation plan incorporates both the behavioral and technical components.

The original work program envisioned two successive phases,Phases 2 and 3, to operationalize the Decision Support System. Phase 2 was to consists mainly of :

- assisting in the development of appropriate standards and indicators describing municipal, provincial and regional needs;
- collecting and organizing data required for the Decision Support sSystem;
- assisting in developing projection algorithms for population and other time series, and;
- documenting the data elements, standards and indicators.

Most of the data required for the Decision Support System were thought to exist in already established data series so that no extensive data generation activities would be required.

Phase 3 had three primary objectives. The first was to work with officials from DPWH and other agencies with interests in infrastructure planning and budgeting, such as NEDA and the Department of Budget and Administration, in order to develop a collaborative approach to shaping and utilizing the Decision Support System. Inter-agency workshops would help to ensure that the system meets needs and is integrated with existing institutional and interorganizational processes. The second objective was to develop the detailed components of the computer models within the system and to have the system operating smoothly in sufficient time for the budget planning cycle that begins in January, 1991.

During the prodess of conceptualizing and designing the system it became clear that the objective of Phase 3 to institutionalize the utilization of the system in the DPWH and in as many other agencies as may wish to use it is most effective when prospective system users are part of the planning, development and debugging stages of a system. Users must feel some 'ownership" of the system. Thus, Phase 3 requires active involvement of DPWH personnel in system development, modification, and documentation. Their active involvement will ensure a sense of ownership and ensure efficient and effective training. Active involvement will maximize the probability of successful implementation.

To assure this involvement it is now recommended that Phases 2 and 3 must proceed largely concurrently in three parallel streams: data collection and development, organizational interaction, and technical program development and documentation. The interaction among the streams and the list of tasks required is described in Figure 7 on the following page. Phase 2 consists of the data collection and development stream. Phase 3 consists of the remaining two streams.

The Phase 2 and Phase 3 Tasks

1.0 Preliminary Data Collection.
Collect data for the illustrative spreadsheets according to the specifications outlinen in this report.

2.0 Initiate Software Development.
Examine alternative 3-D software programs and develop preliminary spreadsheet models and templates.

3.0 Interagency Workshop on the Decision Support System
Utilizing the materials developed in Task 1.0 and 2.0 an interagency workshop will be developed and conducted to outline the proposed Decision Support System. The objectives will be to enlist multi-agency participation for creating appropirate indicators and standards, to make known the potential means for integrating development strategies with action plans, and to ascertain the extent to which other agencies are interested in participating in developing the system and utilizing it when it is operational.

4.0 Specify Standards and Indicators
To be conducted in conjunction with the organization assigned responsibility for data collection (Phase 2). Develop definitions and specification for each indicator and standard utilized in the decision support system. Develop cost estimating relationshps. Develop first round cost factors. Evaluate and redefine, as needed, criteria for descriptive classification of municipalities, provinces, and regions into Development Initiation, Development Support, and Development Maximization categories.

5.0 Develop Data to Support Standards and Indicators
Task 5 requires developing data to support standards and indicators for a sample of regions and provinces as well as for the nation. The data will provide the basis for a subsequent task in whicvh interested agencies and participants will evaluate how the results of the first workshop have manifested themslves in data collection and display.

6.0 Develop Detailed Spreadsheet Models
Develop templates for computer-driven spreadsheets using both MS-DOS and Apple based software to permit use of either system. Templates must provide for inventory and needs assessment at the municipal, provincial, regional and national levels and must provide for interactive "what if?" analyses at the provincial, regional and national levels.

7.0 Model Interfaces
Develop interfaces between spreadsheet models so that higher level models update lower level models and vice versa.

8.0 Link Data for Several Test Regions to Spreadsheet Models.
Enter data generated in Task 5 to models generated in Task 7.

9.0 Develop Interactive Simulation
Using real numbers for real regions, develop an interactive computer-assisted simulation for analysts and decision makers.

10.0 Inter-agency Simulation Workshop and System Review
With the Phase 2 consultant, conduct an inter-agency workshop utilizing the products of Task 9. The objective of the workshop is to ascertain the effectiveness of the models and the data in meeting user needs. The models, indicators, standards, data and system processes will be evaluated and redesigned or adjusted as needed. The equivalent of a "value engineering" component will be integrated with the workshop.

11.0 Complete Data Collection and Data Entry
Complete the work initiated in Task 6, as modified by the results of Task 10.

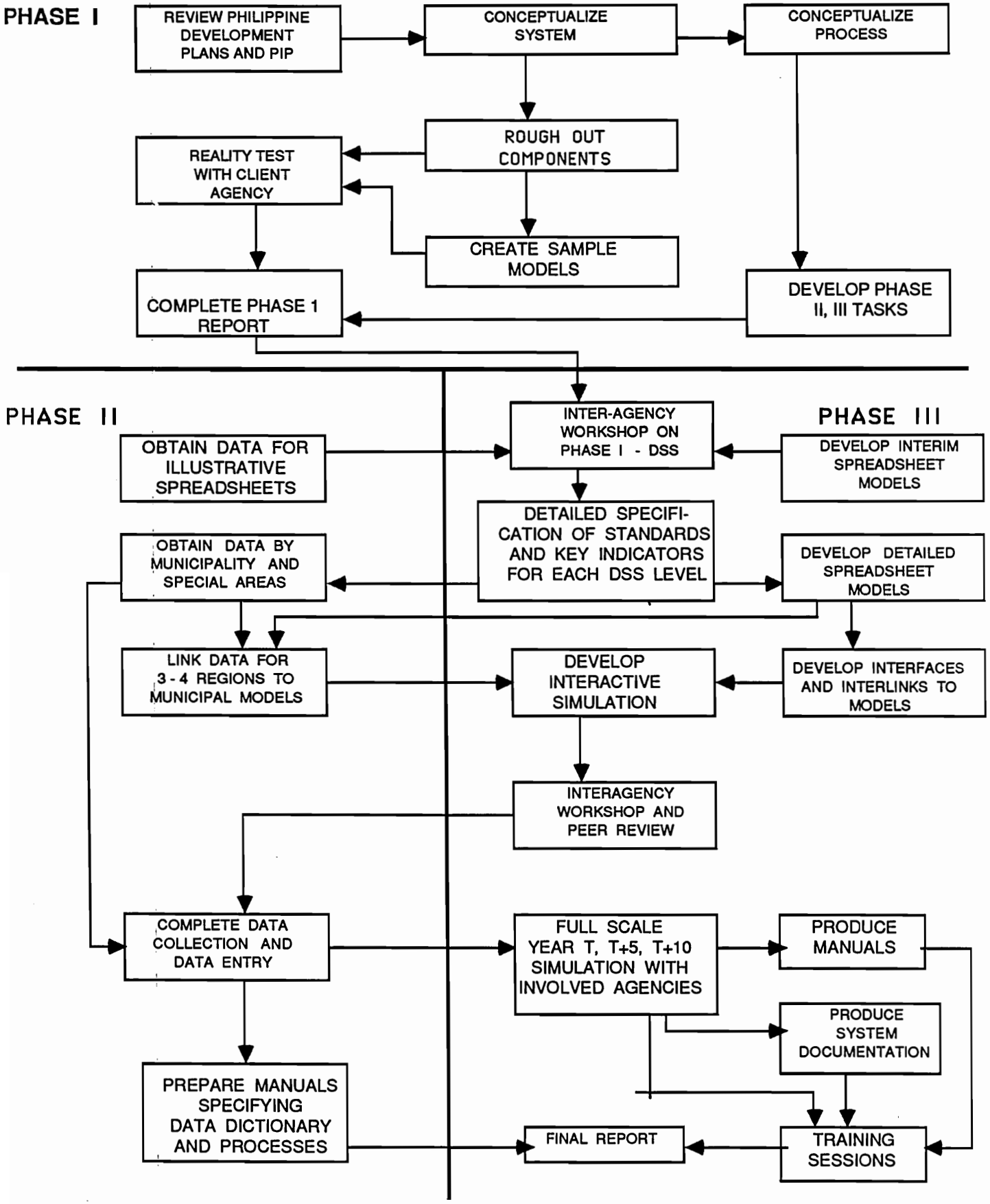


FIGURE THE PHASING FLOWCHART

12.0 Full Scale Simulation With Involved Agencies
Conduct a full scale simulation of the system sufficiently prior to the initiation of budget preparation for 1991 to permit adjustments to the system. The simulation should involve all agencies that anticipate parti-cipating in the system.

13.0 Prepared Manuals Specifying Data Dictionary and Processes
Prepare report detailing development of data produced for the models and the indicators. Specify methods and models used for projections.

14.0 Produce Manuals Outlining the DSS Procedures
Prepare documentation outlining the behavioral and procedural elements of the annual cycle and use of the Decision Support System.

15.0 Produce System Documentation
Prepare documentation specifying the design of the templates for the decision support system.

16.0 Develop and Conduct Training Sessions
Prepare and conduct training sessions as required for agency staff on use and application of the Decision Support Systems and the component spread-sheet models.

17.0 Final Report
Prepare the final project report .

APPENDIX 1

ILLUSTRATIVE SPREADSHEET TEMPLATE FOR DATA SELECTION AND MANAGEMENT

INTERREGIONAL COMPARISON SPREADSHEET

	1	2	3	4	5	6	7
1		SECTORS	POPULATION	LAND &	AGRICULTURAL	ECONOMY	AGRICULTURAL
2	VARIABLE TYPE			NATURAL	LAND		PRODUCTION
3				RESOURCES			
4	(A) SCALE	REGION 1	PERSONS IN	AREA IN	ARABLE	GDP IN	VOLUME OF
5		REGION 2	1000'S	SQ.KM.	LAND IN	PESOS	PRODUCTION
6	*A KEY VARIABLE*	REGION 3			SQ.KM.		IN TONS
7	*EXPRESSED AS*	REGION 4					
8	*AN ABSOLUTE*	REGION 5					
9	*NUMBER*	REGION 6					
10		REGION 7					
11		REGION 8					
12		REGION 9					
13		REGION 10					
14		REGION 11					
15		REGION 12					
16		NATION					
17		METRO MANILA					
18							
19	(B)STRUCTURE	REGION 1	PERCENT	PERCENT	PERCENT	PERCENT	PERCENT
20		REGION 2	URBAN	FOREST	IRRIGATED	MANUFACTUR.	CASH CROPS
21	*A KEY VARIABLE*	REGION 3		LAND			
22	*DESCRIBING A*	REGION 4					
23	*STRUCTURAL*	REGION 5					
24	*DIMENSION OF*	REGION 6					
25	*VARIABLE (A)*	REGION 7					
26	*IN PERCENT*	REGION 8					
27		REGION 9					
28		REGION 10					
29		REGION 11					
30		REGION 12					
31		NATION					
32		METRO MANILA					
33							
34	(C) INTENSITY	REGION 1	PER CAPITA	PER CAPITA	PAR CAPITA	PER CAPITA	PAR CAPITA
35		REGION 2	NON URBAN	FOREST	ARABLE	INCOME	AGRICULTURAL
36	*A VARIABLE*	REGION 3	LAND	LAND	LAND		PRODUCTION
37	*DESCRIBING THE*	REGION 4					
38	*RATIO OF ANOTHER*	REGION 5					
39	*KEY VARIABLE TO*	REGION 6					
40	*VARIABLE (A)*	REGION 7					
41	*ON A PER CAPITA*	REGION 8					
42	*BASIS*	REGION 9					
43		REGION 10					
44		REGION 11					
45		REGION 12					
46		NATION					
47		METRO MANILA					
48							
49	(D)OPPORTUNITY	REGION 1	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT
50	COST	REGION 2	POPULATION	UNMANAGED	IN MINIMAL	OF GDP IN	FARMERS
51		REGION 3	AGE 65 AND	NON-FARM	FARMS	AGRICULTURE	BELOW
52	*A STRUCTURAL*	REGION 4	OLDER	LAND			POWERTY
53	*VARIABLE*	REGION 5					LEVEL
54	*EXPRESSING AS*	REGION 6					
55	*A PERCENTAGE*	REGION 7					
56	*AN OPPORTUNITY*	REGION 8					
57	*OR DEFICIENCY*	REGION 9					
58	*IN VARIABLE (A)*	REGION 10					
59		REGION 11					
60		REGION 12					
61		NATION					
62		METRO MANILA					

INTERREGIONAL COMPARISON SPREADSHEET

	8	9	10	11	12	13	14
1	INDUSTRY	COMMERCE	EDUCATION &	HEALTH	HOUSING	INFRASTRUCT.:	INFRASTRUCT.:
2			MANPOWER	NUTRITION &		ROADS	WATER
3				FAMILY PLAN.			
4	INDUSTRIAL	TOTAL RETAIL	SCHOOL AGE	NUMBER OF	NUMBER OF	LENGTH OF	VOLUME OF
5	PRODUCTION	SALES IN	CHILDREN	HOSPITAL	ROOMS	ROAD	POTABLE
6	IN PESOS	PESOS		BEDS		NETWORK	WATER
7						IN KM.	SUPPLY
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19	PERCENT	PERCENT	PERCENT	PERCENT	PERCENT	PERCENT	PERCENT
20	DURABLE.	FOOD	ATTENDING	MUNICIPAL	WITH INDOOR	ALL WEATHER	PIPED TO
21	GOODS				SANITARY		HOUSES
22					FACILITIES		
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34	PER CAPITA	PER CAPITA	PER CAPITA	PER CAPITA	PER CAPITA	PER CAPITA	PER CAPITA
35	INDUSTRIAL	FOOD	EDUCATION	HEALTH CARE	PUBLIC	TRANSPORT	WATER SUPPLY
36	INCOME	CONSUMPTION	EXPENDITURES	EXPENDITURES	HOUSING	EXPENDITURES	EXPENDITURES
37					EXPENDITURES		
38							
39							
40							
41							
42							
43							
44							
45							
46							
47							
48							
49	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT
50	NON-FARM	SCHOOL	SCHOOL	POPULATION	POPULATION	POPULATION	POPULATION
51	POPULATION	CILDREN	DROP-OUT	WITHOUT	LIVING IN	WITHOUT	WITHOUT
52	UNEMPLOYED	BELOW	RATE	ACCESS TO	SUBSTANDARD	ACCESS TO	ACCESS TO
53		WEIGHT		MEDICAL	HOUSING	ALL WEATHER	POTABLE
54		STANDARD		SERVICES		ROADS	WATER
55							
56							
57							
58							
59							
60							
61							
62							