

SYSTEMS MANAGEMENT: A GENERAL OVERVIEW

Part III - Development Planning in the Lebanon

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This is the third part of a three part article concerning Systems Management and presents an application of System Dynamics to development planning in the Lebanon.

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1. INTRODUCTION.

1.1 BACKGROUND

The cost of the war in human and property losses was staggering. Since the end of the conflict, the Lebanese Government has been confronted by the problems of relief, rehabilitation, and reconstruction. As these emergency needs are met, Lebanon must look to its future. As difficult as the problems of immediate relief have been; those of orderly long range development are even more demanding because the answers to these problems must be found in a new setting. Lebanon's future will not be found by a simple return to the past.

The government quickly recognized the need for forward planning and established its Council for Development and Reconstruction (CDR) three years ago. The Council's responsibilities include the preparation of an overall, comprehensive long-range development plan that would chart the direction, scope, and composition of Lebanon's future.

However, for the most part, the energies of Council members have been fully applied to problems of immediate concern. The pressures of these immediate problems have necessarily delayed serious and professional considerations of the path and style of Lebanon's future development. Moreover, the tasks of development planning and implementation have been complicated by the exodus of skills and capital during the crises. As in most countries, the expertise required to examine national objectives and to undertake development planning at the regional and national levels has never been fully developed in Lebanon. Many of the few who possessed this expertise have left.

At the present, development planning runs the risk of being indefinitely delayed, and the future of Lebanon seriously endangered. There is sufficient stability in Lebanon for reconstruction and development to begin. A blue-print for action is needed, now.

1.2 GROUND-WORK

The CDR has laid some ground-work for development planning by commissioning a series of Agenda Papers on the various sectors of the Lebanese economy, and on specific

topics of vital importance to strategic planning. These papers offer background information and suggestions for future action. Through discussion of these documents with broader segments of the Lebanese society, it is anticipated that realistic goals in each sector can be agreed upon.

In almost every case, the authors of these Agenda Papers cite the inadequacy of data and state that short term studies and long term systems of data gathering and processing are urgently needed. Although more information will be needed as development planning progresses, it would be a mistake to embark on a massive data collection exercise as a prelude to development planning. All the information that is needed is available to undertake the next important step in creating a dynamic development planning instrumentality -- a system dynamics computer simulation model to guide the reconstruction and development of Lebanon.

An interdisciplinary team of faculty and students from the American University of Beirut, with the cooperation of the Council for Development and Reconstruction, have undertaken the development of a package of system dynamics computer simulation models to help guide future reconstruction and development in Lebanon.¹

1.3 BASIC STRUCTURE OF THE PACKAGE

The research approach possesses the following major structural characteristics.

1. Lebanon, the national system, is represented in terms of four interdependent subsystems, termed regions. They are the Beirut Metropolitan Area including Mount Lebanon (BMA), North Lebanon Region (NLR), East Lebanon Region (ELR), and the South Lebanon Region (SLR). This is essential to account for the variety of geographic and socio-economic patterns that prevail in Lebanon.
2. The individual regional development systems are represented in terms of a complete set of descriptions of all essential processes which determine physical, ecological, social, technological, economic, and political development.
3. Six computer models will eventually be constructed:
 - Beirut Metropolitan Area Model
 - North Lebanon Regional Model
 - East Lebanon Regional Model
 - South Lebanon Regional Model
 - Strategic (Single Region) National Model
 - Comprehensive (Four Region) National Model

The strategic national model will be highly aggregated, the four regional models will possess more detail. The comprehensive national model will be a synthesis of the four individual regional models.

4. All six models will account for the conservation of the various material, financial, and energy flows through the system or sub-system considered.
5. All six models will possess a sectoral orientation to facilitate policy formation and evaluation.
6. All six models will be issue sensitive. That is the form of the models will be responsive to the questions to be answered. These would include, but obviously not be limited to, fiscal reform, the role of the private sector, repatriation of skills and capital, and rural-urban balance.

1.4 FEATURES AND REQUIREMENTS OF THE RESEARCH

A dynamic, interactive package of computer models will be constructed that can simulate development options for Lebanon with respect to the interfaces of agriculture, industry, infrastructure and services. Specific features and functional requirements of the model are that it:

1. Serve as a development planning laboratory for Lebanon as well as a training laboratory in development analysis for AUB students from the Middle East.
2. Provide a conceptual framework for integrating within the four regional subsystems and the national system population, agriculture, industry, infrastructure, and services, thereby providing a rational means for policy formation and evaluation.
3. Aid CDR personnel to perform development analysis that will enable them to compare alternatives based on technological, social, political and institutional changes.
4. Identify data requirements useful in the design of a management information system which will provide comprehensive demographic, agricultural, industrial, and land-use information to support program and project management at the operational level such as in the conduct of project feasibility studies, in developing priorities consistent with regional policies, and in monitoring and controlling such activities as land reform, tax assessment and collection, etc.
5. Prepare a framework for organizing a continuous transdisciplinary research and evaluation efforts — physical and socio-economic — as a means of preparing for technological and social change.

1.5 IMPLEMENTATION OF THE MODELS

Implementation of the models in the CDR and acceptance of the models by local administrators throughout Lebanon can only be achieved if these groups have participated in the development of the package to the extent that the models are "theirs". Consistent with this ideal, four steps will be taken:

1. Approximately ten AUB graduate students a year for two years representing the faculties of Arts and Sciences, Engineering, Agriculture, and Public Health will participate in model development with the understanding they will join the CDR upon graduation. Their topics in partial fulfillment of their master degrees at AUB will

deal with various phases of this research so that all will bring a complete understanding of the construction and use of the models to the CDR!

2. A Counterpart Team consisting of CDR personnel and other national, regional and local agencies, as well as the private sector, will be formed to assist in the research.
3. Formal workshop-type sessions will be conducted to familiarize the Counterpart Team with the methodology and the modeling, and to enable the Research Team to obtain a better understanding of the subjective aspects of Lebanon's problems.
4. To make sure that this endeavor does not degenerate into self-perpetuating, self-fulfilling research, the following schedule for implementation will be adhered to:

- Development of the strategic national model (1 year)
- Development of the four regional models (18 months)
- Development of the comprehensive national model (2 years)

Since these models would be developed concurrently, all six models will be operational in two years.

2. DESCRIPTION OF MODEL COMPONENTS

2.1 DEVELOPMENT ORIENTATIONS

The computer model is being structured to accommodate three basic development orientations: (1) resource development, (2) regional development, and (3) sectoral development. The model has four regions (North Lebanon, East Lebanon-Bakaa, South Lebanon, and Beirut-Mount Lebanon) each represented by six basic sectors (Agriculture, Industry, Infrastructure, Social Overhead, Demographic, and Government) to deal with the four fundamental resources (natural, land, water, and human).

2.2 RESOURCE COMPONENTS

Natural Resources. Lebanon is relatively poor in natural resources, minerals and fossil fuels. Only the construction materials industries such as cement, glass, brick, etc. rely on local materials. Ingredients for the chemical and petrochemical industries must be imported except for very limited quantities of locally produced components such as salt, alcohol and non-mineral oils. For the purpose of the model, raw materials are classified as either local or imported.

Land Resources. Lebanon is one of the greenest countries in the Middle East with almost one-third of its total area either arable or cultivated with permanent crops. The soils are derived primarily from limestone, are calcareous, with medium texture and low in organic matter. For modeling purposes, land categories will include: potentially arable land, arable land, land under permanent crops, pastures, forests, irrigated land, urban land, and suburban land.

Water Resources. As in the case of land resources, a master plan at the national level is essential in formulating a program for water resource development aimed at satisfying the future demands for water by the various beneficiaries. Since precipitation is more or less constant, while the demand for water is increasing, competition for water among agriculture, industry

and tourism is inevitable and must be reconciled rationally. The model will describe the input, inventory and distribution of water both as to groundwater and surface water nationally and by region.

Human Resources (Manpower). The fundamental premise of Lebanese reconstruction policy has to be that manpower is the country's most valuable asset. The energy, ingenuity, and initiative of the Lebanese people are striking, when served by the appropriate incentives. Areas that are being taken into consideration in developing the model are manpower mobility (internal geographic mobility and immigration), skills training, education, health, housing and productivity.

2.3 REGIONAL COMPONENTS

A critical concern in the process of development in Lebanon is the pattern of the geographic distribution of the development activities. Administratively, Lebanon is divided into five governorates: Beirut, Mount Lebanon, North Lebanon, South Lebanon and the Bekaa (East Lebanon). The first two are being combined so as to form four regional components of the model.

Beirut Metropolitan Area. This region includes the Governorate of Beirut which is constituted by the City of Beirut and the Governorate of Mount Lebanon which includes the suburbs of Beirut. About 60% of Lebanon's population is contained in this region and the suburban population is growing faster than the population in Beirut.

Northern Region. North Lebanon contains about 17 per cent of the country's population and its largest city, Tripoli, is the second largest city in the country. It is perhaps the most viable growth pole in the formation of a rational population distribution strategy.

Southern Region. South Lebanon contained about 12 per cent of the nation's people before the war. The three major towns are the Sidon-Tyr-Nabatiyah triangle. The dominant natural feature in the region is the Litani River which will constitute a massive development project in itself.

Eastern Region. The Bekaa Region of Lebanon in the east contains about 10 per cent of the country's population. It represents a great undeveloped potential. At the present, the region contains a number of scattered development projects -- each suffering from lack of supporting activities within a broad strategy.

2.4 SECTORAL COMPONENTS

Agriculture. Lebanon, like all agriculturally developing countries, must establish the basic economic and social conditions that will encourage farmers to expand production. Therefore, the computer model must be able to inter-relate social, economic and physical variables such as crop areas, yields and production; mechanization; manpower; inputs such as fertilizers and pesticides; imports and exports; agricultural cooperatives and autonomous boards; and research and extension services. It is envisaged that the agriculture sector will be comprised of four sub-models:

- Annual Crop Production
- Perennial Crop Production
- Livestock Production (including dairy and poultry products)
- Marketing (the dynamics of supply and demand)

Industry. In Lebanon, the major branch of the industrial sector is service activity, followed by manufacturing. It has been decided that service industries and manufacturing industries will be modeled separately. The service sector will be comprised of three sub-models and the manufacturing sector of four sub-models. A brief description of these seven sub-models follows:

- **Fabricating Industries.** These industries include those that manufacture fabricated metal products, machinery, and equipment, and the construction industry. The rationale in grouping these industries are that their output is industrial capital (machinery, equipment, factories, and buildings).
- **Processing Industries.** These industries include the chemical and petro-chemical industries (petroleum refining, fertilizers, pharmaceuticals, paints, plastics, etc.) and non-metal industries (cement, glass, and construction materials). The rationale for grouping these industries together is that their output is industrial material for use by other industries.
- **Manufacturing Industries.** These industries include those that produce goods for consumers rather than for other industries. The goods may be clothes, appliances, bicycles etc. The textile, wearing apparel, and leather industries; the wood products and furniture industries; and the paper and paper products industries are included in this sub-model category.
- **Agro-Industries.** These industries are the food producing industries, including beverage industries, the tobacco industry, the sugar industry, the dairy industry, canning industries, slaughter and packing houses, etc.
- **Business Services.** The service sector of Lebanon contributes about 70% to the country's GNP. It has been decided that the service industries will be broken down into business-serving industries, household-serving industries, and tourism. The business service category will include financing, insurance, consulting services, storage, and private transport. This sector serves all the other sectors and sub-sectors in the model.
- **Household Services.** Household serving industries include wholesale and retail trade. The supply of household services come from the agriculture, manufacturing, and agro-industrial sectors. The demand for these products is a function of population, price and per capita income.
- **Tourist Industry.** Lebanon is the world's Lilliputian. Situated along the eastern coast of the Mediterranean, it can be covered lengthwise and crosswise in one day of leisurely driving, and covering it exposes one to a wealth of scenic beauty, archeological wonders, entertainment pleasures, and cultural enjoyment. Included in this sub-model are hotels, restaurants, airlines, and tour agencies.

Infrastructure. Infrastructure is comprised of two sub-systems (1) transportation and communications and (2) utilities and public works, which may be invested in three different areas: (1) urban, (2) suburban and (3) rural or *intercity*. Infrastructure is interpreted in the model development as the foundation underlying the agricultural and industrial sectors but not physical industrial plant itself. Infrastructure, thus, does not include schools and hospitals either since these are

treated under social overhead. The six sub-model categories under infrastructure are:

- Rural Transportation -- Communications Infrastructure
- Rural Utilities -- Public Works Infrastructure
- Urban Transportation -- Communications Infrastructure
- Urban Utilities -- Public Works Infrastructure
- Suburban Transportation -- Communications Infrastructure
- Suburban Utilities -- Public Works Infrastructure

Social Overhead. The social overhead sector includes all community, social, and personal services. As with infrastructure, for the purposes of modeling, social overhead is comprised of two subsystems, (1) public health and (2) education, which may be invested in three different areas, (1) urban, (2) suburban, and (3) rural, giving the following six sub-models:

- Rural Public Health Social Overhead
- Rural Education Social Overhead
- Urban Public Health Social Overhead
- Urban Education Social Overhead
- Suburban Public Health Social Overhead
- Suburban Education Social Overhead

Demographic Sector. The demographic sector of the model will be comprised of four sections:

- Population
- Consumer Expenditures
- Manpower Allocation
- Housing

The population section of the demographic sector calculates the population by region and by socio-economic category. These values are determinants of consumer demand and labor availability. At the same time this section monitors the demographic response of the population to resource and service supplies through births and deaths and to externalities such as civil strife through migration rates. Per capita income and literacy are examples of economic and social indicators of quality of life of the population.

The consumer expenditure section determines the desired expenditures on food from the agriculture and agro-industry sectors, on goods from the manufacturing sector and on services from the infrastructure and social overhead sectors.

The manpower allocation section of the demographic sector tells the model how labor is allocated between the agriculture, industry, infrastructure and social overhead sectors and their subsections. Wages and income are calculated here.

The housing section of the demographic sector relates the supply of housing to population (the demand for housing). 1970 statistics tell us that the total number of dwellings in Lebanon was 484,000 of which 396,000 were occupied primary dwellings, 37,000 were vacant and 51,000 were secondary-dwellings. Of the 396,000 primary dwellings, 8,000 were shacks or slum dwellings and another 9,500 households shared dwellings with another family. This section of the

model will be structured to include these categories and others of relevance to the Lebanese situation.

Government Sector. Lebanon has a market economy with resources owned primarily by private individuals and groups. As with other economic systems, the basic decisions are the same: (1) What goods and services will be produced? (2) How will they be produced and what resources will be used? (3) Who will use these goods and services? However, since Lebanon does operate under a democratic free-economy system, economic decision making is made by interplay between government, consumers, and producers. Essentially government, even in a free society, influences the answers to the three basic questions above through its involvement in the following five areas which will be separate sections of the Government Sector in the model:

- **Capital Allocation.** Development alternatives are generated by the ways in which producing and consumer sectors are taxed and by the way the national budget is allocated among regions and between infrastructure and social overhead. The Capital Allocation section of the Government Sector models the flow of financial resources through the economy.
- **Trade.** The trade section of the Government Sector enables the model to test the implications of exchanges of domestic and foreign resources, products, services and capital.
- **Environmental Management.** Many characteristics of Lebanese public and private institutions perpetuate a shortsightedness which tends to minimize future consequences of their policies. Entrepreneurs severely discount future costs and benefits. Corporate decision-makers seeking rapid promotions and politicians seeking continuation in office usually implement those policies that promise the most immediate beneficial results regardless of the long-term implications. Then, of course, as in all governments, no vote is given to those who must bear the long-term burden -- the children. This section of the model will permit the monitoring of pollution and the quality of the environment.
- **Public Administration.** In Lebanon the per cent of the labor force working for the government is steadily growing. This section of the model would consider government employment not accounted for under infrastructure and social overhead and would include civil servants, and those engaged in national defense and public safety.
- **Policy Formation and Evaluation.** The proposed model is conceived as an instrument for policy research -- an attempt by quantitative researchers to apply systems analysis to the understanding of policy problems and the making of public decisions. For policymakers, the chief value of the model is that it can reduce the uncertainties attendant on decision-making by clarifying the consequences that lie at the end of the proposed course of action. General policy areas include the following: (1) regulation -- the promotion of fair economic competition and the protection of public health, safety, and public well-being; (2) promotion of economic growth and stability -- the influencing of the rate, pattern, and distribution of economic development; and (3) direct support to individuals -- programs to reduce hardships for individuals.

duals who cannot meet their minimum needs due to circumstances beyond their control. This section of the model combines the objective and subjective features of the model. Regarding the former, this section of the model will contain a computational appendage that will output important socio-economic indicators such as unemployment rate, gross national product, per capita income, the

consumer price index, the composite index of leading indicators, etc. Regarding subjectivity, the model will eventually feature an interactive model which would permit "conversational analysis" in which the decision-maker becomes actively involved during the system's evolution and contributes to a better representation of the adaptive characteristics of Lebanon's reconstruction and development.

REFERENCES

1. DREW, D. "A Systems Approach to Guiding Reconstruction and Development in Lebanon". Executive Development Seminar, American University of Beirut. June 1980.