AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY
Batch #31

1. SUBJECT CLASSIFICATION

A. PRIMARY: Agriculture — AE10-0000-0000

B. SECONDARY: Agricultural economics

2. TITLE AND SUBTITLE

Infrastructure to support systems modeling as a continuous and transferable process: the computer library for agricultural systems simulation

3. AUTHOR(S)

Abkin, M.H.

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1974	10p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS

Mich. State

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*

(Presented at a Sem.on the Evalution of the Korean Agr.Sector Simulation Model, Airlie, Va., 1974)

9. ABSTRACT

10. CONTROL NUMBER

PN-AAB-755

11. PRICE OF DOCUMENT

12. DESCRIPTORS

Libraries
Models
Simulation

13. PROJECT NUMBER

14. CONTRACT NUMBER

CSD-2975 Res

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

INFRASTRUCTURE TO SUPPORT SYSTEMS MODELING AS A CONTINUOUS AND TRANSFERABLE PROCESS: THE COMPUTER LIBRARY FOR AGRICULTURAL SYSTEMS SIMULATION

by

Michael H. Abkin

Presented at

A Seminar on the

Evaluation of the

Korean Agricultural Sector Simulation Model

Airlie House
Airlie, Virginia

27-29 March 1974

INFRASTRUCTURE TO SUPPORT SYSTEMS MODELING AS A CONTINUOUS AND TRANSFERABLE PROCESS: THE COMPUTER LIBRARY FOR AGRICULTURAL SYSTEMS SIMULATION

by

Michael H. Abkin

Background and Rationale

Under contracts AID/csd-1557 and AID/csd-2975, in Nigeria and in Korea, the Michigan State University (MSU) simulation team has developed and applied the generalized system simulation approach to agricultural development analysis and policy making. As part of that effort, a number of models have been built, assembled and computerized. These include, for example, models of production and processing processes; demand and consumption; demographic processes as applied to human, cattle and tree populations; commodity, regional and national accounting; resource allocation decisions; and the diffusion of innovations.

It has become clear that these and other processes are of general interest in the developing (and developed) world and that generalized models of them could be built and then adapted and assembled in various configurations to help analyze particular problems in particular countries. The use of a software library of such generalized models can greatly reduce the cost of conducting agricultural sector, subsector, policy, program and project analyses by: (1) facilitating application of the computerized system simulation approach incorporating a broad range of quantitative analytical techniques--e.g., LP models, econometric models, PERT models, state space models, etc.--to the analyses (the approach was shown to be a cost-saver in comparing the KASS and CSHRD experiences);

and (2) greatly reducing the likelihood of one team of workers, addressing a particular problem in a particular country, going through the process of developing models which may or could be virtually ident' ' to models already developed or being developed by another team in another place. For such a library to be effective, its prime concerns must include complete and clear documentation of each of its models and programming the models in a language which is acceptable to a wide range of computer models and sizes.

With this rationale, the initiation of development of such a software library was written into the first phase of the Project's AID contract, AID/csd-2975, and a Simulation Library Working Conference was held in March 1973 with representatives from national and international development assistance agencies, LDCs and relevant disciplines to get some idea of the potential demand for such a library and of how best to go about organizing it. The conferees concluded, briefly, that:*

1) there is clearly a need for developing analytical capacity, particularly in LDCs, for policy and other decision making in development planning;

2) CLASS can contribute to the satisfaction of that need;

3) the library should be open to any analytical techniques which prove themselves useful;

4) a passive clearinghouse would not be sufficient, but rather complementary inputs, particularly expertise, need to be actively provided to successfully implement library components; and

5) such expertise is a major limiting resource and, therefore, training is a high priority, complementary activity.

---

*"Summary of the Simulation Library Working Conference, March 29-30, 1973" by Michel Petit.

With this background, the library and its scope have been defined as follows:

The Computer Library for Agricultural Systems Simulation (CLASS) is viewed as a unit which acquires, catalogs, maintains and distributes computer programs and associated documentation. These computer programs are of generalized simulation models and routines designed specifically for the analysis of agricultural development problems and processes. In particular, the library sets standards of admissibility for programs and documentation; catalogs and indexes programs and documentation so as to facilitate their retrieval by users seeking a set of programs to be used in a specific problem analysis; and distributes programs and documentation to users.

To enhance the effectiveness of the library, its functions also include identifying and soliciting needed models; actively bringing programs and documentation up to the library's standards; and providing limited consultation in identifying and implementing appropriate library programs for a particular application. A subsidiary function of the library in conjunction with the identification and solicitation of models is to survey and catalog ongoing research in agricultural systems modeling and simulation.

It is essential that CLASS remain closely associated with, if not a part of, one or more organizations charged with model development, research and analysis applications, and training. In the short run these broader functions will be carried out in fulfilling MSU's obligations under its AID contract, AID/csd-2975. In the long run, however, as the library expands and acquires applications experience, it will be desirable, even necessary, that it move from MSU to, or to some association with, one or more national or international development assistance agencies.

Component Generality

In the terminology of the library itself, the word "component" refers to the unit maintained and distributed by the library, much as a book is the unit of a book library. CLASS stocks two kinds of components: utility routines and models of socioeconomic processes. When a set of such models and routines are linked together, they become, in systems terminology, sub-models or components of a larger system model, e.g., the KASS model or the Nigerian simulation model.

Utility routines include programs of mathematical operations and algorithms which have been found to be useful in simulation models. Examples include discrete and continuous time delays, table functions, LP algorithms, gradient search techniques, PERT routines, matrix inversion routines, and the like. The general applicability of such utility routines is obvious, and no further discussion is necessary here.

Models of socioeconomic processes may be general in two dimensions. First, a model can be generalized across applications. For example, a demographic model may be applicable to human, tree, livestock or capital equipment populations, or a processing model may be suitable for the processing of cocoa, oil palm products, rubber or tobacco (as in the Nigerian simulation model). The other dimension of model generality is with respect to geographic and problem areas. For instance, a population model, a demand model or a production model may be applicable to analyses of food production problems in Tanzania, cattle industry problems in Venezuela or Colombia, or agricultural sector problems in Nigeria or Korea.

It is difficult to measure the generality or generalizability of a model. We can say with confidence that complete generality--a model which is all things to all people--is not only impossible but nonsense. We may also assert that extreme generality--less than complete--is undesirable for reasons of model development and application efficiency; likewise, extreme specificity would be inefficient from the point of view of the library's stocking and maintenance of a component with very limited demand potential. The implication is that the library must aim for a middle ground and, hence, a set of models for each process

(including different levels of aggregation) so that within the set can be found a model which meets the requirements of a given application. Of particular relevance for the kinds of models to be included in CLASS is the fact that, as models become larger and more problem-oriented they of necessity lose generality. Thus, there will be trade offs to consider.

Component Standards

For CLASS to be of service to, and thereby attract, users, library components must maintain standards in three areas. First, components must: 1) meet the test of generality as discussed above; 2) be theoretically and empirically valid, realizing, of course, the limitations of the body of social and economic theory upon which the models must be based; and 3) be mathematically sound, i.e., as to the use of techniques, algorithms and logic.

Perhaps the most crucial aspect of a component from the point of view of user access is its documentation. It is primarily through the documentation that the scope, assumptions, limitations and applications of a component will be communicated to the users. Therefore, strict documentation standards are maintained which specify topics to be discussed (e.g., rationale for the model, mathematical description, sample run) and call for readibility, thoroughness, and the citation of relevant references. Included also is documentation of the component's computer program to enable a programmer to implement it at the local installation.

Finally, the computer program itself is expected to meet a set of standards. A basic requirement is that programs be in the FORTRAN language so that they may be compatible with as wide a range of FORTRAN

compilers as possible on a variety of computers around the world. In addition, recognizing the role of the program itself as a vehicle of communication with the user, clarity and readability are also important criteria. Computational efficiency is also a factor, particularly if library components are to be implemented on small computers, and this then means that trade offs must be made with the compatibility and readability considerations.

Simulation Language

To facilitate user access to models constructed from library components, CLASS is developing a FORTRAN-based simulation language. The language is conversational and interactive and allows the policy analyst to sit down at a computer terminal and enter parameter values to "tell" the model what he wants to do with it and how he wants output displayed--without the need of programming skills. For example, he can specify whether he wants to perform a policy experiment or sensitivity tests; if a policy experiment, what policy combinations and levels (e.g., budget levels, tax rates, etc.); what endogenous variables to display at what intervals and in what format (e.g., graphs, histograms, tables, etc.); and the time period to simulate and whether he wants to interact and possibly change policies in the course of simulation or to see results only at the end.

A second phase of the simulation language development will focus on facilitating the job of the model builder/programmer in linking up library components into the particular configuration desired as a model for the specific application at hand.

Field and Training Links

Aside from actual use of the library and its services, there are important two-way links between the CLASS activity and the field applications (i.e., Korea) and training program activities of the total agricultural simulation project.

The field and training activities feed into CLASS by:

1) identifying needed components as a result of field experience and training requirements;

2) testing library components in actual field and training applications.

3) building models which could be generalized and otherwise adapted to serve as CLASS components

4) testing, and thereby demonstrating the strengths and weaknesses of, the simulation language under actual field and training conditions; and

5) identifying useful output formats and testing output-generating routines in field and training applications.

Likewise CLASS services the field applications and training program by:

1) supplying components to serve a teaching and training function;

2) supplying the field with models and routines either not yet in place or in need of replacement;

3) providing and maintaining the simulation language system to facilitate non-programmer interaction with the models;

4) providing and maintaining output-generating routines; and

5) making the KASS and other field experiences (models, etc.) readily available to other agricultural development researchers, analysts, advisors and consultants in the field. This last contribution relates particularly to the Simulation Library Working Conference's viewing CLASS as a means of conserving, utilizing and disseminating the capital (i.e., models and expertise) created under AID/csd-1557 and AID/csd-2975.

CLASS Advisory Boards

In view of the fact that the library's objective is to provide a service--and a rather unique and novel one at that for the agricultural development field--it is considered essential that potential users and other experienced professionals have an input into its development and operationalization. Formally, this input will be channeled through technical and policy advisory boards whose functions, in general, will be to review, evaluate, advise and recommend. The Policy Advisory Board has been constituted, and its first meeting is scheduled for early May 1974; the Technical Advisory Board will be defined at a later date once the Policy Advisory Board has specified its parameters.

The specific charge given the Policy Advisory Board will be to:

1) Evaluate the quality and coverage of library components, and recommend where existing components should be revised and where further modeling is needed. Coverage here refers both to the modeling of subject matter areas (i.e., socioeconomic processes) and to the incorporation of various analytical techniques, e.g., cost-benefit analysis models, PERT models, optimizing models (linear programming or otherwise), linear-in-the-parameters simultaneous equations systems, stochastic process models, input-output models, etc.

2) Review and evaluate the library's scope and operations as to the level of usage and effectiveness of its components and services, and recommend modifications of services and operating procedures as necessary for improvement.

3) Recommend and evaluate alternative means of disseminating information to users and potential users on CLASS components and services.

4) Based on the performance of CLASS during the AID contract period, consider and advise on the library's ultimate geographic and institutional location and means of financial support.

The Ultimate CLASS

The last function of the Policy Advisory Board discussed above arose out of discussions at the Simulation Library Working Conference

concerning the ultimate nature of such a library. It was generally recognized that it would be neither appropriate nor efficient for an operation such as CLASS, once it has been established and has become a regular "business," so to-speak, to be located at any university. Rather, its proper place will be within a national or, preferably, international agency charged with performing--and developing indigenous capacity to perform--the analysis necessary for development planning and policy making.