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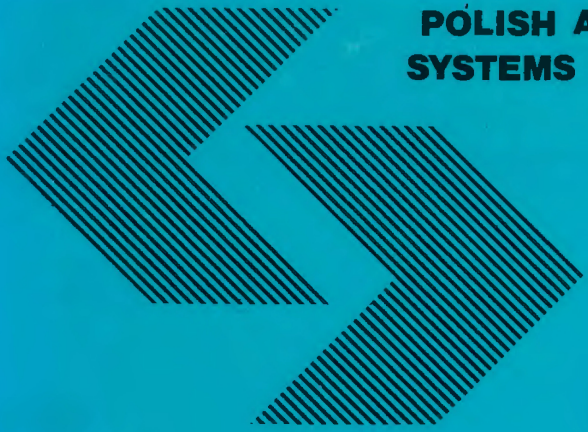

STRATEGIC REGIONAL POLICY

A. STRASZAK AND J.W. OWSIŃSKI
EDITORS

PART II

WARSAW 1985

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Paradigms, Methods, Issues and Case Studies

A. Straszak and J.W. Owsiński
editors

Documentation of the workshop on "Strategic Regional Policy", December 10 - 14, 1984, Warsaw, organized by the Systems Research Institute, Polish Academy of Sciences and the International Institute for Applied Systems Analysis

PART II

WARSAW 1985

VII. SOFTWARE

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Alternatives Concerning Development and Implementation of Software*

1. Introduction

It is well known that one may divide the computer software systems into two types:

- universal packages for solving a wide class of concrete problems,
- oriented systems prepared altogether for concrete implementations.

Universal packages of programs make a library of modules, while oriented systems are subsets of a modules' library. In the case of oriented systems, linkage of necessary modules leads to formation of a concrete system. The linkages can be within or of universal packages. An example of a linkage is presented in Fig. 1.

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*transcription of the presentation given during seminar (eds.).

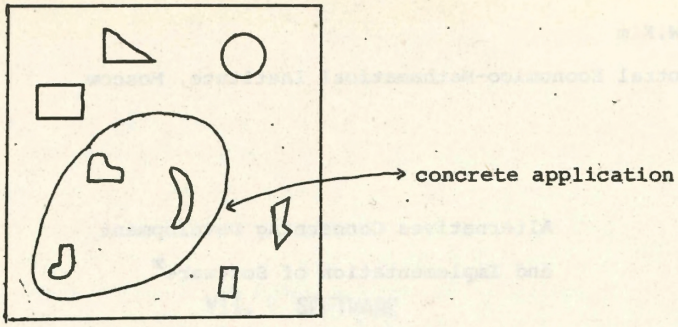

Fig. 1. Universal package

Proceeding in this manner we may create a computer system for solving a concrete problem. Of course, it will be a subset of linked modules from a library, as illustrated in Fig. 2.

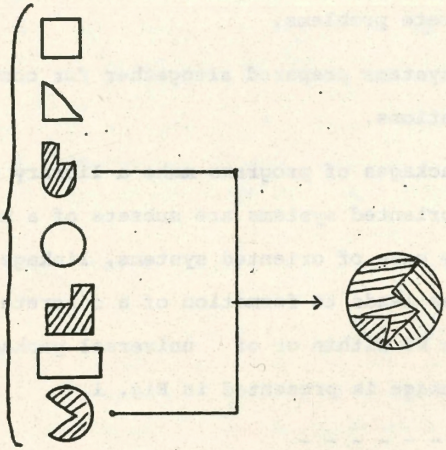

Fig. 2. Problem oriented system for concrete implementation.

In practice both universal packages and oriented systems are created. It is known that universal packages are created rarely and applied frequently while oriented systems are created more frequently and applied rarely.

We may formulate main requirements as to the elaboration of oriented systems and as to creation of module sets (libraries):

- requirements as to elaboration of oriented systems
  1. adequacy of modules,
  2. facility in utilization, service, availability, accuracy,
  3. output effectiveness: accuracy, speed, reliability,
  4. quick development possibility

- requirements as to a module set (library)
  1. wide scope of functions accounted for,
  2. high quality level,
  3. standard inputs and outputs
  4. incorporation in one machine (network) with one programing language.

Based on remarks presented above, in the Central Economico-Mathematical Institute (CEMI) in Moscow software for Regional Development System (SRD) has been elaborated. This system shall be presented in the subsequent section.

2. Structure of the Software for Regional Development System (SRD)

The work upon SRD include both elaboration of the module library and of the problem oriented systems.

Below, we present the main modules from library for SRD and the main oriented systems.

A. the library (set of modules)

1. systems of equations,
2. optimization module,
3. applied statistic,
4. data visualisation,
5. conversational procedures,
6. model generators and others

B. Problem - oriented systems:

1. Production functions,
2. System of intersectoral and territorial interdependences,
3. Transportation problems,
4. Location problems,
5. Infrastructural design,
6. Network planning procedures and other.

For example, we present more exactly the optimization module from library. This module consists of the following submodules:

1. linear and quadratic programming problems,
2. nonlinear programming problems,
3. transportation problems.

This module is created in such manner, that it is possible to link each submodule within or of universal package of SRD for solving the concrete problem.

The optimization module consists of 59 programs:

- 9 programs for solving linear programming problems,
- 2 programs for solving quadratic programming problems,
- 30 programs for solving nonlinear programming problems,
- 18 programs for solving transportation problems.

The methods used for solving these problems are based on standard algorithms, for example the simplex algorithm, the Dantzing algorithm, the Wolfe algorithm or the branch and bound method.

Now, we present more exactly a chosen oriented system. The system is meant for analysis of production functions. This system consists of the following modules:

1. screen editor of functions,
2. screen editor of matrix data,
3. function interpreter,
4. interpreter of derivatives,
5. function graphics,
6. nonlinear programming of the form

   min $f(x_1,\ldots,x_n)$ subject to $d_i<x_i<b_i$.

This set of modules ought to fulfil the following conditions:

1. user works in a natural language,
2. any function $y = f(x_1,\ldots,x_n)$ can be represented,
3. user can himself define whatever data, is necessary for drawing up a function,
4. derivatives $(\frac{\delta f}{\delta x_i})$ with respect to any argument are automatically generated,
5. graphics can be custom-made.

We may now formulate the following remark. It is very effective to work out at first the universal package of modules and thereafter to create the problem - - oriented systems for concrete tasks. For example after working out the universal package for SRD the system for analysis of production functions was obtained from this package in just one day.

3. New direction of SRD system development

Now, we can formulate the new directions of development of SRD. These are as follows:

1. Direct utilization of a problem - oriented system by an end - user or a decision maker, without the intermediary of programmer, without any knowlege of programming language and of the operating system.
2. Development of methods and means of quick junction of a problem - oriented system. Thereby: increase of effectiveness of computer

experiments in research and analysis.

3. Recent developments in modules of:

   - data visualisation,
   - conversational procedures,
   - model generators.

4. Special "naturalized" languages for user's comunication with computer.

DISCUSSIONS

Paper by K.W. Kim

Discussion participants: K. Polenske, R. Espejo, K. Kim.

It was clarified in the discussion that it is possible to apply the approach outlined to interconnected systems, and that this solely depends upon the availability of appropriate data. With regard to centralization-distribution question it was stated that at the moment of presentation the software systems were still created and run in a centralized manner. The problem of distribution was at the time being solved, both on the theoretical and on the technical levels. The main issue was to provide adequate links in cases when models are run in different locations.

Paper by A. Umnov

Discussion participants: R. Espejo, J. Hołubiec, A. Umnov.

Certain technical and methodological aspects of the software were discussed, and in particular: the model was presented as being manipulated mostly on the output rather than input side, so that it is possible to change a desirable state of the system once a solution is obtained and its rationality is assessed. Furthermore, the constraints to which solutions are subject allow avoiding of not quite uncommon spatial bang-bang solutions, practically infeasible in some situations (e.g. full specialization in foreign trade).

Paper by L. Kruś and J. Sosnowski

No discussion was recorded - main exchange of opinions took place in an informal way during the game playing.

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