POLSKA AKADEMIA NAUK
INSTYTUT BADAŃ SYSTEMOWYCH

PROCEEDINGS OF THE 3rd ITALIAN-POLISH CONFERENCE ON APPLICATIONS OF SYSTEMS THEORY TO ECONOMY, MANAGEMENT AND TECHNOLOGY

WARSZAWA 1977

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FAST METHOD OF COMPUTER-AIDED DESIGN OF MANAGER INFORMATION SYSTEM

1. INTRODUCTION

A network of information connections formed for a management system under study in the course of diagnostic analysis [1], [2] can be used for the synthesis of denderits of a Manager Information System [MIS] to be constructed. The best illustration of the idea constituting a basis for such a procedure is provided by Fig. 1. Prospective users of MIS have to select all the operations (from thesaurus), outcomes of which are to be afforded by MIS. Operations chosen are fed into a computer to start the synthesis of trees corresponding to them. Hence, they are considered as start operations. The synthesis consists in making a search in the network of information connections (stored in a computer memory) in order to find immediate suppliers of a start operation under consideration. Next, suppliers of those previously found are to be looked for. The process is repeated up to reaching initial points of a network examined [3]. Trees obtained are combined into a network of MIS (repeated branches of dendrits are eliminated).

The description of each node of a network is given in the parametric form (labour consumption, completition time, type of operation etc.). Data mentioned are analysed in order to minimize a resulting network of MIS., detect its deficiencies, generate a uniform time coordination and to select operations suitable for computer implementation. Accomplishing of the last function makes it possible to determine whether a digital computer is necessary for a given MIS and in the case of a positive answer it allows to precise a type of computer needed.

The procedure discussed permits to carry out a computerized diagnostic analysis of the whole management system under investigation as well as to estimate requirements for computer techniques to be used [4]. However such a procedure requires to carry on labour and time consuming studies during the acquisition of data on information connections. Hence, if it is necessary to construct MIS only, a simplified, much more effective procedure can be suggested. It will be discussed in the next section.

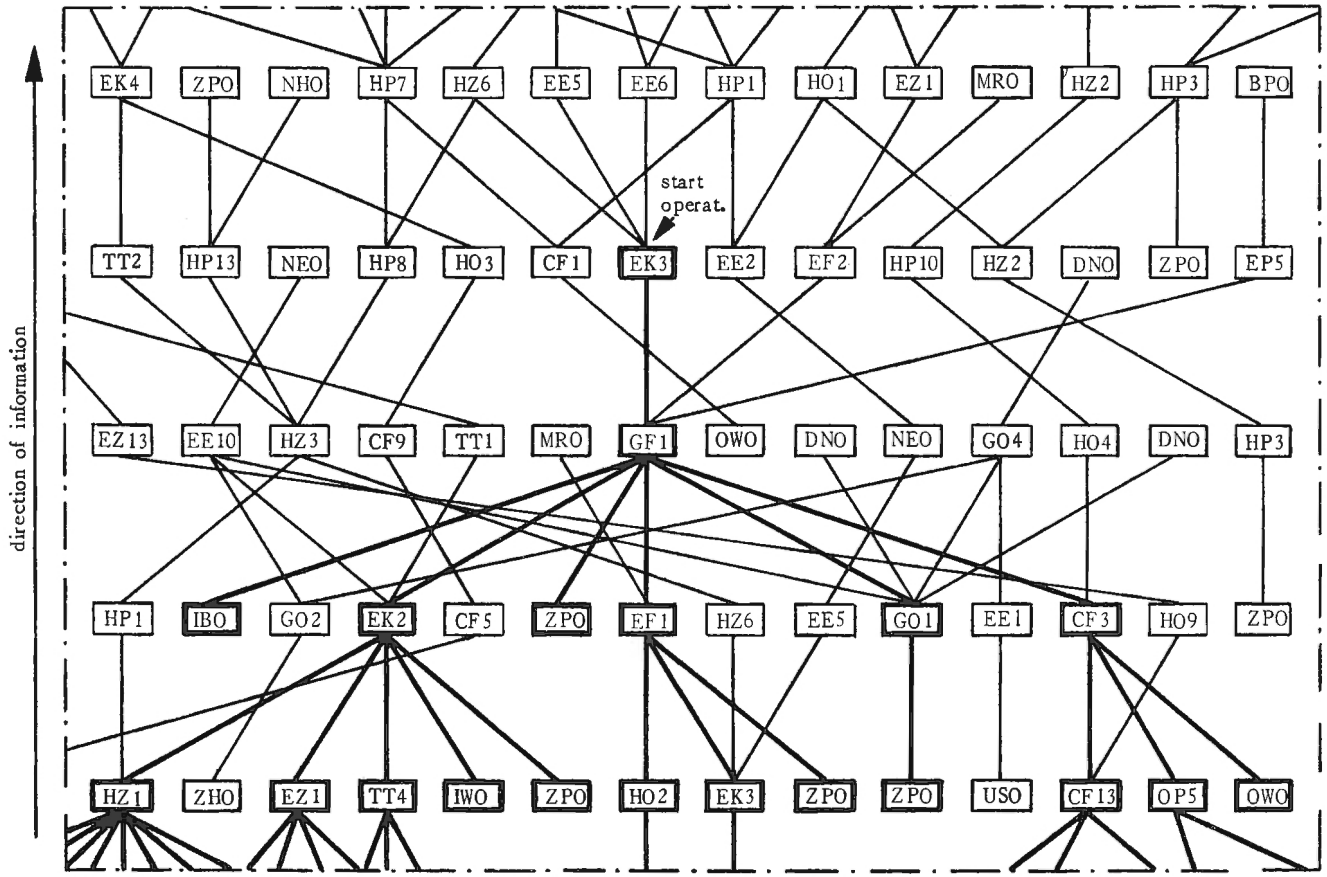

Fig. 1. Method of computer-aided synthesis of dendrit for MIS

2. PREMISES TO SIMPLIFIED PROCEDURE

The generation of trees corresponding to output operations of MIS by means of a simplified procedure is based on the fundamental relationship describing connections among operations [5].

$$\bigwedge_{i=1}^{m}\bigwedge_{j=1}^{n} W_{ij}\left(\bigvee_{l=1}^{8} a_l A_{ij}\right) \quad \text{if} \quad \bigwedge_{f=1}^{k}\left(Z_{(ij)f}\bigvee_{l=1}^{8} a_l A_f\right) \tag{1}$$

where

W_{ij} — the i-th operation of the j-th executive cell
$Z_{(ij)f}$ — the f-th operation of the supplier cell, outcome of which is used by W_{ij}
a_l — the l-th operation type (according to [3] 8 types of operations have been distinguished)
A_{ij} — algorithm for accomplishing W_{ij} operation
A_f — algorithm for accomplishing $Z_{(ij)f}$ operation

The following relations are satisfied [6]

$$\bigwedge_{f=1}^{k} Z_{(ij)f}\left(\bigvee_{i=1}^{m}\bigvee_{j=1}^{n}\left(Z_{(ij)f} = W_{ij}\right)\right) \tag{2}$$

and

$$\bigwedge_{f=1}^{k} A_f\left(\bigvee_{i=1}^{m}\bigvee_{j=1}^{n}\left(A_f = A_{ij}\right)\right) \tag{3}$$

Using them, the relation (1) can be written in the form

$$\bigvee_{l=1}^{8} a_l A_{1_0}\, if_I\left(\bigwedge_{i_I=1}^{k_I}\bigvee_{l=1}^{8} a_l A_{i_I}\, if_{II}\left(\bigwedge_{i_{II}=1}^{k_{\gamma\gamma}}\bigvee_{l=1}^{8} a_l A_{i_{II}}\, if_{III}\left(\ldots if_N\left(\bigwedge_{i_N=1}^{k_N}\bigvee_{l=1}^{8} a_l A_{i_N}\right)\ldots\right.\right.\right.$$

The relation obtained can be presented in the form of a tree describing the generation of a given output operation

Fig. 2 illustrates a method of assigning codes to nodes of a tree. It is based on the assumption that a code of the following node consists of that of the preceding one and the number of a given node. According to this notation a code of the node marked by star in Fig. 2 is as follows 11222.

3. PRACTICAL IMPLEMENTATION OF SIMPLIFIED PROCEDURE

On the basis of the discussion presented above two variants of a card for MIS trees identification have been worked out. The first one corresponds to the case when further processing of data acquired is accomplished by a computer. The second one represents the sythesis carried on without the use of a computer. The latter is possible for small systems only, i.e. when "the depth" of a corresponding tree is not high and what follows the amount of data

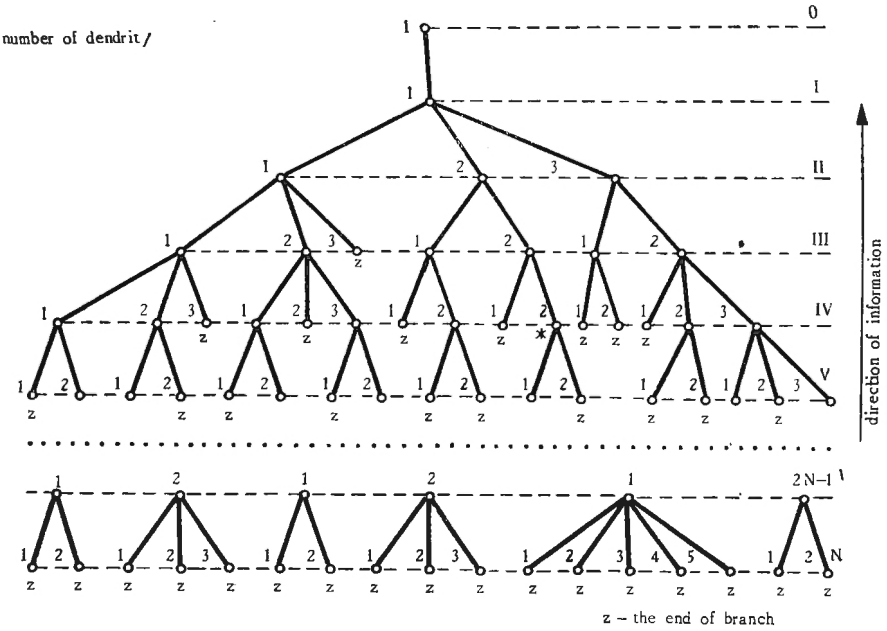

Fig. 2

to be processed is small. A sample of the identification card to be used in this case is shown in Fig. 3. A card for identification and analysis of MIS trees with the use of a computer differs from that previously described in the nesessity to code appropriately data characterizing executive operations and suppliers. Moreover, its form should be fitted to direct data punching.

A procedure for filling up cards is as follows:

For every start operation (from the list of operations selected by prospective users) the upper part of a card is filled in (by users mentioned). In this case the user is a receiver and a cell accomplishing a given start operation is a performer.

In the first column of a code of an operation the serial number from the list of selected operations is written down. Prepared cards are transferred to appropriate performers. The remaining part of a card is filled in by them in such a way that in the centre of it a characteristic of the operation considered is given. The lower part is for characteristics of their suppliers. Codes of operations are formed as described above. If an operation occurs in more than one tree, then in the last column of a code of this operation a special index is written down. Next, a separate card is filled up for each individual supplier (upper part only). They are asked to fill in remaining blank spaces. Due to this the growth of questionnaires has an avalanche character. They spred progressively over layers of suppliers. The growth terminates when all the

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CARD FOR IDETIFICATION OF MIS DEDRIT

CODE OF OPERATION | CODE OF RECEIVER 0 3 1 | CODE EXECUTIVE 0 2 5

1	1	2	2	2													

Name of operation: *Rejestration of reclamation*

Type of function: *performing*

Number of performining persons: *2*

Average number of unitar realization per year: *520*.

Average time of unitar realization: *8 hours*

Period: *week*

For periodic:

normative time of start: *2-th day* and finish *5-th day*

Output shape /name or code of document/ *WRS-2*

DELIVERERS:

Code of operation | Code of cell 0 1 4 | Delay *little* | Mistake *absence*

1	1	2	2	2	1												

Code of operation | Code of cell 0 2 1 | Delay *little* | Mistake *absence*

1	1	2	2	2	2												

Code of operation | Code of cell | Delay | Mistake

Code of operation | Code of cell | Delay | Mistake

Code of operation | Code of cell | Delay | Mistake

Code of operation | Code of cell | Delay | Mistake

Code of operation | Code of cell | Delay | Mistake

REMARK:

suppliers can be considered as external cells with respect to an examined object.

It is worth mentioning that subsequent codes of the receiver-supplier- performer sequence combined with codes of operations uniquely describe a tree of MIS. What more, each code of an operation gives an exact description of that tree branch, in which the operation outcome is utilized. Hence, in order to generate the everall tree of MIS for a given start operation, it is enough to arrange cards according to codes determined. For illustration purposes a card filled up for the operation marked by star in Fig. 2 is shown.

If a characteristic of supplier is not required, then a card for identification and synthesis of MIS tree can be simplified by using the upper part of it only (over the dashed line).

4. IMPLEMENTATION OF THE SIMPLIFIED PROCEDURE WITH THE USE OF A DIGITAL COMPUTER

If a computer is used for data processing, the algorithm (4) is applied for transforming codes of operations into the standard form. Having it, the next stage consists in the application of worked out programs for computer analysis and synthesis of management systems [7].

Aggregation of trees into MIS network is automatically accomplished on the basis of the index of operation repetition. Due to the use of these programs a resulting network of information connections for MIS under design is minimized. They make it possible to determine network inputs (source information), intermediate operations and outputs (receivers- users of MIS). A computer also provides such characteristics of a network as estimates of labour consumption, critical paths, time coordination and possible deficiencies. On the basis of characteristics determined operation suitable for computer implementation are selected.

The procedure presented was successfully tested on a real plant, medium-size paint and varnish factory.

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SUMMARY

A special kind of inquiry is presented. Its base is a model of computer diagnostic analysis of large management systems. As a result of inquiry the trees of designed management information systems are directly obtained. The data (among them the parameters describing the particular tree nodes) fed to the computer (ODRA 1325) are processed and the detailed analysis (integration of trees forming the net of information connections, detection of diseases in the net, estimation of labouriousness, seeking the critical paths, etc.) is performed. The final result is the minimized net of information connections of designed system with list of its inputs (source information), intermediate operations and outputs (receivers). The time coordination of particular operations is given and the computer realisable operations are proposed.

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