

**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

Redaktor techniczny
Iwona Dobrzyńska

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Halina Wołyniec

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100	THE PROBLEMS OF THE THEORY OF THE FIRM
101	THE PROBLEMS OF THE THEORY OF THE FIRM
102	THE PROBLEMS OF THE THEORY OF THE FIRM
103	THE PROBLEMS OF THE THEORY OF THE FIRM
104	THE PROBLEMS OF THE THEORY OF THE FIRM
105	THE PROBLEMS OF THE THEORY OF THE FIRM
106	THE PROBLEMS OF THE THEORY OF THE FIRM
107	THE PROBLEMS OF THE THEORY OF THE FIRM
108	THE PROBLEMS OF THE THEORY OF THE FIRM
109	THE PROBLEMS OF THE THEORY OF THE FIRM
110	THE PROBLEMS OF THE THEORY OF THE FIRM
111	THE PROBLEMS OF THE THEORY OF THE FIRM
112	THE PROBLEMS OF THE THEORY OF THE FIRM
113	THE PROBLEMS OF THE THEORY OF THE FIRM
114	THE PROBLEMS OF THE THEORY OF THE FIRM
115	THE PROBLEMS OF THE THEORY OF THE FIRM
116	THE PROBLEMS OF THE THEORY OF THE FIRM
117	THE PROBLEMS OF THE THEORY OF THE FIRM
118	THE PROBLEMS OF THE THEORY OF THE FIRM
119	THE PROBLEMS OF THE THEORY OF THE FIRM
120	THE PROBLEMS OF THE THEORY OF THE FIRM

INDEX

The present volume comprises papers from the 1975-1976 Conference which was held in Helsinki, Finland in 1975. The conference was organized by the Centre for Economic Research and Education of the Finnish National Research Council and the Institute for Management and Control Sciences of the University of Helsinki. The main theme of the conference was "The Theory of the Firm". The first two weeks of the conference were devoted to the study of the firm as a production unit. The third week was devoted to the study of the firm as a social unit. The fourth week was devoted to the study of the firm as a legal unit. The fifth week was devoted to the study of the firm as a political unit. The sixth week was devoted to the study of the firm as a cultural unit. The seventh week was devoted to the study of the firm as a religious unit. The eighth week was devoted to the study of the firm as a philosophical unit. The ninth week was devoted to the study of the firm as a scientific unit. The tenth week was devoted to the study of the firm as a historical unit. The eleventh week was devoted to the study of the firm as a geographical unit. The twelfth week was devoted to the study of the firm as a linguistic unit. The thirteenth week was devoted to the study of the firm as a literary unit. The fourteenth week was devoted to the study of the firm as a musical unit. The fifteenth week was devoted to the study of the firm as a dramatic unit. The sixteenth week was devoted to the study of the firm as a cinematic unit. The seventeenth week was devoted to the study of the firm as a television unit. The eighteenth week was devoted to the study of the firm as a radio unit. The nineteenth week was devoted to the study of the firm as a newspaper unit. The twentieth week was devoted to the study of the firm as a magazine unit. The twenty-first week was devoted to the study of the firm as a book unit. The twenty-second week was devoted to the study of the firm as a record unit. The twenty-third week was devoted to the study of the firm as a tape unit. The twenty-fourth week was devoted to the study of the firm as a film unit. The twenty-fifth week was devoted to the study of the firm as a photograph unit. The twenty-sixth week was devoted to the study of the firm as a drawing unit. The twenty-seventh week was devoted to the study of the firm as a painting unit. The twenty-eighth week was devoted to the study of the firm as a sculpture unit. The twenty-ninth week was devoted to the study of the firm as a statue unit. The thirtieth week was devoted to the study of the firm as a monument unit. The thirty-first week was devoted to the study of the firm as a memorial unit. The thirty-second week was devoted to the study of the firm as a museum unit. The thirty-third week was devoted to the study of the firm as a library unit. The thirty-fourth week was devoted to the study of the firm as a school unit. The thirty-fifth week was devoted to the study of the firm as a university unit. The thirty-sixth week was devoted to the study of the firm as a research center unit. The thirty-seventh week was devoted to the study of the firm as a think tank unit. The thirty-eighth week was devoted to the study of the firm as a policy institute unit. The thirty-ninth week was devoted to the study of the firm as a consulting firm unit. The fortieth week was devoted to the study of the firm as a management firm unit. The forty-first week was devoted to the study of the firm as a law firm unit. The forty-second week was devoted to the study of the firm as a medical firm unit. The forty-third week was devoted to the study of the firm as a dental firm unit. The forty-fourth week was devoted to the study of the firm as a veterinary firm unit. The forty-fifth week was devoted to the study of the firm as a pharmaceutical firm unit. The forty-sixth week was devoted to the study of the firm as a biotechnology firm unit. The forty-seventh week was devoted to the study of the firm as a chemical firm unit. The forty-eighth week was devoted to the study of the firm as a physical firm unit. The forty-ninth week was devoted to the study of the firm as a mechanical firm unit. The fiftieth week was devoted to the study of the firm as an electrical firm unit. The fifty-first week was devoted to the study of the firm as a computer firm unit. The fifty-second week was devoted to the study of the firm as a software firm unit. The fifty-third week was devoted to the study of the firm as a hardware firm unit. The fifty-fourth week was devoted to the study of the firm as a telecommunications firm unit. The fifty-fifth week was devoted to the study of the firm as a media firm unit. The fifty-sixth week was devoted to the study of the firm as a publishing firm unit. The fifty-seventh week was devoted to the study of the firm as a printing firm unit. The fifty-eighth week was devoted to the study of the firm as a distribution firm unit. The fifty-ninth week was devoted to the study of the firm as a retail firm unit. The sixtieth week was devoted to the study of the firm as a wholesaler firm unit. The sixty-first week was devoted to the study of the firm as a manufacturer firm unit. The sixty-second week was devoted to the study of the firm as a service firm unit. The sixty-third week was devoted to the study of the firm as a transportation firm unit. The sixty-fourth week was devoted to the study of the firm as a utility firm unit. The sixty-fifth week was devoted to the study of the firm as a public utility firm unit. The sixty-sixth week was devoted to the study of the firm as a government firm unit. The sixty-seventh week was devoted to the study of the firm as a non-profit firm unit. The sixty-eighth week was devoted to the study of the firm as a religious firm unit. The sixty-ninth week was devoted to the study of the firm as a cultural firm unit. The seventieth week was devoted to the study of the firm as a sports firm unit. The seventy-first week was devoted to the study of the firm as a entertainment firm unit. The seventy-second week was devoted to the study of the firm as a media firm unit. The seventy-third week was devoted to the study of the firm as a publishing firm unit. The seventy-fourth week was devoted to the study of the firm as a printing firm unit. The seventy-fifth week was devoted to the study of the firm as a distribution firm unit. The seventy-sixth week was devoted to the study of the firm as a retail firm unit. The seventy-seventh week was devoted to the study of the firm as a wholesaler firm unit. The seventy-eighth week was devoted to the study of the firm as a manufacturer firm unit. The seventy-ninth week was devoted to the study of the firm as a service firm unit. The eightieth week was devoted to the study of the firm as a transportation firm unit. The eighty-first week was devoted to the study of the firm as a utility firm unit. The eighty-second week was devoted to the study of the firm as a public utility firm unit. The eighty-third week was devoted to the study of the firm as a government firm unit. The eighty-fourth week was devoted to the study of the firm as a non-profit firm unit. The eighty-fifth week was devoted to the study of the firm as a religious firm unit. The eighty-sixth week was devoted to the study of the firm as a cultural firm unit. The eighty-seventh week was devoted to the study of the firm as a sports firm unit. The eighty-eighth week was devoted to the study of the firm as a entertainment firm unit. The eighty-ninth week was devoted to the study of the firm as a media firm unit. The ninetieth week was devoted to the study of the firm as a publishing firm unit. The hundredth week was devoted to the study of the firm as a printing firm unit.

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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 dendrits 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, completion 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.

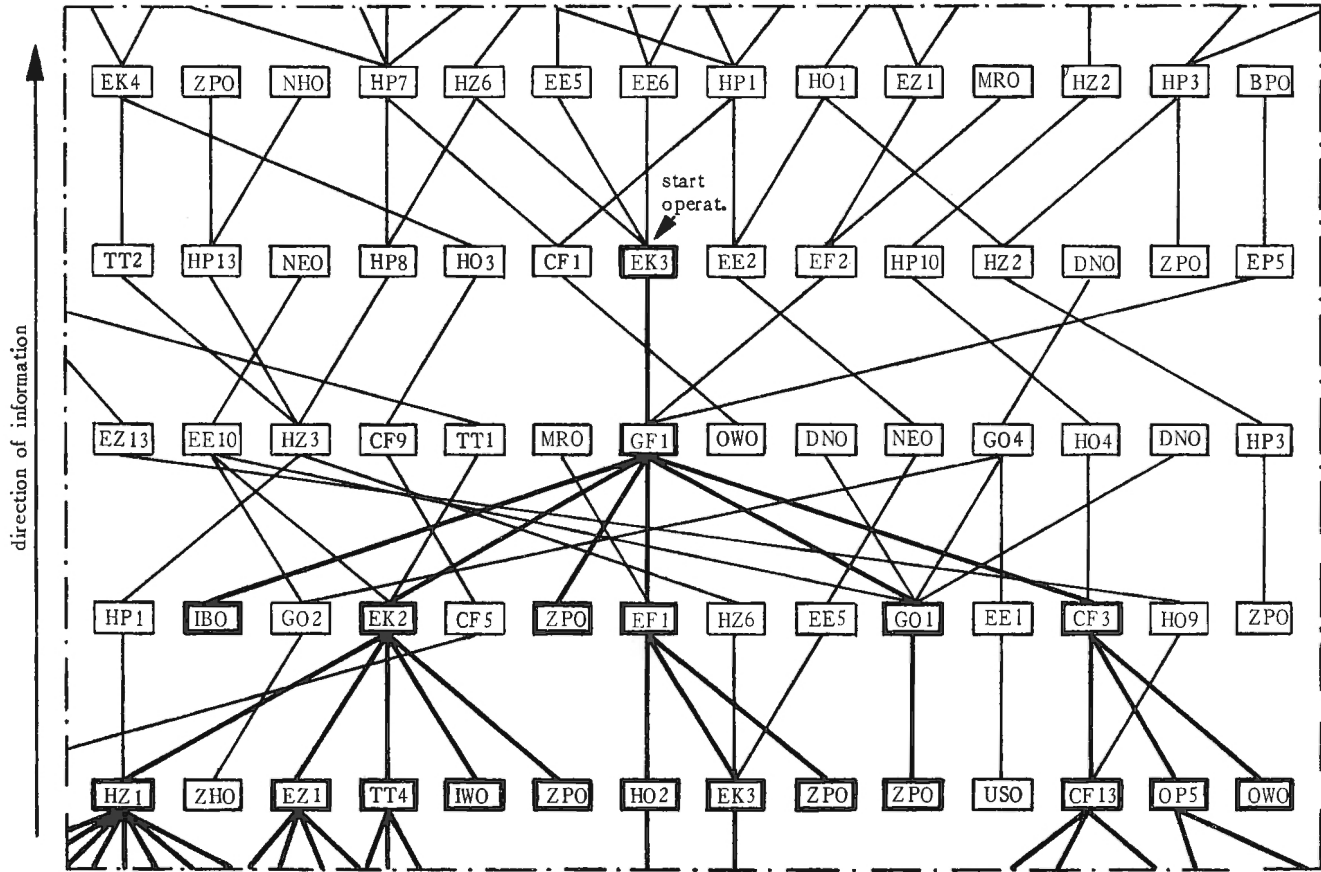


Fig. 1. Method of computer-aided synthesis of dendrit for MIS

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].

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

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]

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

and

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

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

$$\bigvee_{l=1}^8 a_l A_{10} \text{if}_I (\bigwedge_{i_r=1}^{k_I} \bigvee_{l=1}^8 a_l A_{i_r} \text{if}_{II} (\bigwedge_{i_{rr}=1}^{k_{II}} \bigvee_{l=1}^8 a_l A_{i_{rr}} \text{if}_{III} (\dots \text{if}_N (\bigwedge_{i_N=1}^{k_N} \bigvee_{l=1}^8 a_l A_{i_N}) \dots$$

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 synthesis 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

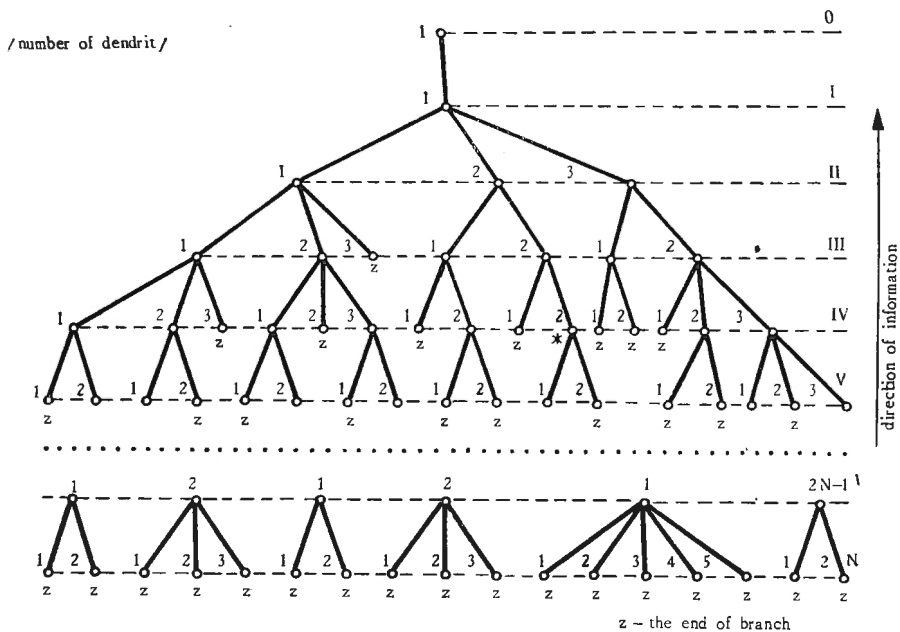


Fig. 2

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 necessity 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 spread progressively over layers of suppliers. The growth terminates when all the

CODE OF OPERATION

CODE OF RECEIVER

0 3 1

CODE EXECUTIVE

0 2 5

1	1	2	2	2															
---	---	---	---	---	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Name of operation: *Rejestracja of reklamacja*

Type of function: *performing*

Number of performing 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 overall 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.

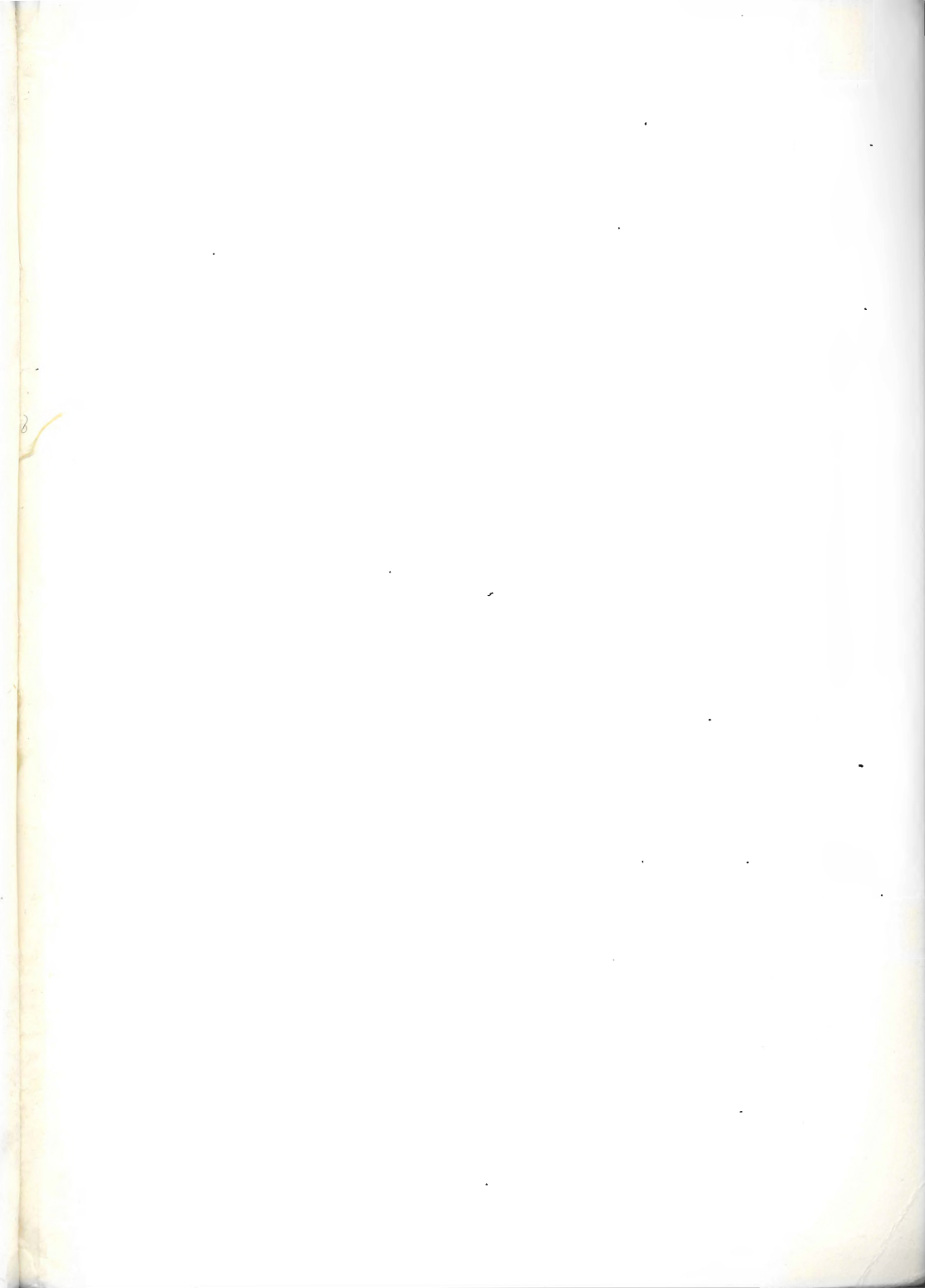
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