L. TÖVISSI
I. IVAN
E. MOSCOVICI
Department of Economic Cybernetics
The Academy of Economic Studies

Solving Methods for a Production Section Management Model

The study presents a solving method for a management model which had been analysed in a previous work [1]. The complexity of the model has required the finding of a special solving method consisting of the establishment of an operational process deck.

1. INTRODUCTION

A number of stages is necessary to be covered from the general form of the model presented in [1] to the solution proper of a practical problem. Thus, the phenomena connected with the section's production processes must be analysed, the objectives must be established and the essential aspects deriving from the real conditions of the section must be formalized. In the end, we pass on to the planning of the tests and to data collection in view of quantifying the process in constraints.

Thus, the concrete form in which parameters are established in the form of constant values is obtained by starting from the general form of the model, by taking into account the particularities of a certain section. Obviously, to bring the model into a concrete form, statistical calculi, such as for example estimations and hypothesis verifications, are necessary.

Therefore, it results that for the same production section several variants of concrete forms can be constructed which will afterwards subject to selections so that in the end, a single concrete form of the model should lead to the obtaining of solutions. The selection of the variants of concrete forms is based, among other things, on the criteria: the modelling level and the results of comparisons, between the solution and the real evolution of the section, in the testing phase.

2. ORIGINAL AND FINAL STRATEGIES OF THE SECTION'S EVOLUTION

In carrying out the operational programme, we distinguish two moments, moment 0 (start) and moment τ (finish). During the operational program, the section system will pass from condition S_0 characterizing it at moment 0 to condition S_τ corresponding to moment τ, by successively covering conditions $S_1, S_2, \ldots, S_{\tau-1}$.

Corresponding to state S_0, the decision-making body of the section must take measures for the proper administration of the section. The orientation of all these measures represents an initial strategy.

In order to obtain each production operational program, the initial strategy will contain various constraints resulting from the objective evolution of the section or from necessities for a uniform employment of the staff.

The final strategy contains the measures taken by the section's managerial body for bringing the system to state S_τ defined by the operational program.

There is a multitude of final strategies of the section which can be explained by the fact that the solving method can take over the modifications appearing in time, in the system's evolution.

3. ORGANIZATION OF THE INPUT AND WORKING DATA

To obtain the solution of the model in a concrete form, data are necessary on the number of active elements, the time period, the limits within which the assortments must be produced (imposed by the technological aspects of the section and by the demands for delivery to the end-users), the necessary raw materials, etc. Part of these data is contained in the solution of the section's global model which synthetically describes the inter-actions at the level of the entire system, between the subsystems making it up. For the production section considered in the analysis, the global model achieves the distribution of the production targets on groups of active elements by specifying the order of production of the assortments.

In order to obtain the solution, all these data which are input data for the management model will be adequately organized for their subsequent stocking and exploration, Thus, lists and arrays are drawn up, organized in keeping whith the demands of the algorithm of obtaining the solution. For the beginning, a list called LIST will be drawn up, containing data on the number of active elements N, the number of phases H, the number of assortments M, level B_0 and input B of the Ω type resource. Further, we pass to the construction of the structured array called MSST which contains data for defining the main characteristics of each assortment. These characteristics must include: consumption of raw materials for the obtaining of a charge $Q_{\xi hj}$, the means and dispersions of durations d^h_{lvj}, the planned quantities α_j^{sup}, α_j^{inf}.

For the duration $(0, \tau)$ of the production operational program, the data contained in LIST, MSST respectively, are not changed.

Certain work data through which the evolution is followed in interval $(0, \tau)$ of the active elements in the section system are also organized. Thus, the ELAC array is constructed, each column containing data about an active

element concerning the final moments of the finishing of phase h, $h = 0, 1, ..., H$, the number of cycles ν of the active element, the state of the active element l, the assortment j.

To outline the way in which the production targets are carried out during the operational program by indicating the number of charges of each assortment, the list REZ, made up of M components, is drawn up.

Another list named CICL, with a variable number of components, contains the necessary Ω type resource, used during a cycle. The level of the Ω type resource in the interval of the operational program is contained in the list RGAM.

4. FORMS OF THE SOLUTION OF THE MODEL

In keeping with the user's options, the operational program can be presented in several forms. Thus, the operational program containing the maximum production achieved in the interval $(0, \tau)$, the graph of the evolution of the Ω type resource, the analysis of the occupation of the active elements during the operational program can be obtained.

The solution of the model, respectively the production operational program contains those data which allow for the establishment of the basic actions which should be taken at any moment, by the section's managerial body.

The sequences of the production operational program have incorporated into their content the previous background of the section system, namely any sequence start is marked and thus it depends on the way in which the system has developed in the previous period or periods.

The operational program is obtained in the form of sequences resulting from the exchange of data between the model and the system which takes place at equal time intervals.

The operational program is used as a document with a double functionality, as it registers both the likely evolutions of the active elements and their real evolutions.

On one hand, this program contains information leing at the bases of managing the section processes and on the other hand, it contains input information on whose base a new sequence of the program will be obtained.

Updating of a sequence from model's solution has as a base the deviations recorded in the evolution of section system as against the previous sequence from the operational program.

All deviations into the updated sequence will be taken into consideration, the interactions of the systems being directed to getting the objectives contained in the solution of the overall model.

The updated sequences as a whole aim at diminishing deviations so that the production targets are fulfilled according to assortments, delivery terms, batching requirements, correlation with the storing and transportation capacities of the finished products gradually obtained in interval $(0, \tau)$.

5. THE BASIC ALGORITHM FOR OBTAINING THE SOLUTION

To obtain the solution of the section management model a basic algorithm is used from which secondary algorithms may derive by changing some sections.

The basic algorithm is made up of stages, each stage consisting of several steps.

Stage A.

1. Creating the primary data stock, called the S type data stock concerning the evolution for a time period (sufficiently big) of the section system.
2. Estimating the parameters and the probability law for each random variable d^h_{lvj}.
3. Assigning, in keeping with the real situation, constant values to list LIST and to the array MSST.
4. Establishing the limits for covering lists REZ, RGAM.
5. Initializing array ELAC for the reflection of the previous evolutions of the active elements influencing the carrying out of the production operational program.

Stage B.

1. Changing the elements in the array MSST referring to the means and dispersions of variables d^h_{lvj} into abstract * simulation units.
2. Distributing the consumption of resource $Q_{\xi hj}$ per simulation unit in the array MSST.

Stage C.

1. Initializing the components in array MSST referring to

$$\sum_{h=0}^{\tau} X^H_{hj},\ j = 1, 2, \ldots, M.$$

2. Creating the arrays AMPR containing the copies (the prints) of all arrays one operates with in the algorithm, at equal time intervals.

Stage D.

1. Constructing the values of list RGAM by using $\widetilde{Q}_i$.
2. Initializing ν, t^h_{lvj}, k, l, j.
3. Testing the finalization of the cycle for obtaining a charge per active element l, within the state chain ν for assortment j; if the test's condition is fulfilled go to step 4, otherwise, to step 10.

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* It is known from simulation that the simulation unit is that component which can be put in correspondence with a certain time unit. It is selected in concordance with the average durations d^h_{evj} and/or with the time period $(0, \tau)$.

4. Generating line d^h_{lvj}.

5. Calculating line t^h_{lvj}, a virtual cycle being thus created.

6. Testing the existence of the necessary resources for obtaining a cycle both of the Ω type resources and of those of type Λ; if the conditions required by the test are fulfilled, go to step 7; otherwise go to step 13.

7. Testing the fulfilment of the production targets per assortments:

$$\sum_{k=0}^{\tau} X^H_{kj} > \alpha^{sup}_j ;$$

if the condition is checked, go to step 15; otherwise go to step 8.

8. Ascribing to the Ω and Λ type resources the charge which was generated on the basis of the virtual cycle.

9. Ascribing the line t^h_{lvj} to the active element in the ELAC array; afterwards go to step 13.

10. Testing the stage of the evolution of the active element l; if the final of the cycle associated with this element is marked, go to step 11; otherwise, go to step 13.

11. Printing the values l and t^h_{lvj}, obtaining a line of the sequence of the production operational threshold; completing the S data stock.

12. Increasing by one unit the number of cycles obtained per active element ν and the adequate registering of the assortment on the REZ list.

13. Testing the analysis limit of the active elements; if $l < N$ the analysis is continued by reiterating the algorithm at step 3; otherwise go to step 14.

14. Testing the attaining of the time period; if $k < \tau$ and if τ modulo y is equal to 0 (where y represents a number of simulation units, considered as the step of prints) a component of the list of arrays AMPR is initialized, after which go to step 2; if only $k < \tau$, the algorithm is reiterated from step 2; otherwise go to step 15.

15. Printing the final results on the fulfilment of the plan, the degree of utilization of the active elements.

Stage E.

1. Constructing the ACT data list, containing the deviations between the real evolution of the section system and the probable evolution contained in the operational program .

2. Retrieving a component in the list of AMPR arrays which corresponds to the moment in relation to which the obtaining of a new sequence of the operational program is defined.

3. Making the transfer of data belonging to the components identified at step 2, by arrays MSST, ELAC and by the LIST, REZ lists.

Stage F.

1. Extracting from the production operational program the lines d^h_{lvj} resulting from the real evolution, thus creating the $\tilde{S}$ data stock.

2. Creating and partly using elements of the S data stock and of stock $\tilde{S}$, of the series containing both d^h_{lvj} of the probable and real evolutions of the system.

3. Applying statistical methods for outlining the significance of errors; if the errors have a significant character which is not due to changes in the structure of the section's technological processes, the S data stock is changed by partly taking over the content of stock $\tilde{S}$, after which the algorithm is repeated from stage A, step 2; otherwise, the algorithm is repeated from stage E.

6. CONCLUSIONS

The proposed model represents part of an integrated management system of a section's production process; in this system, it interacts with the subsystems of market analysis, production contracting and planning, stock administration, marketing, delivery and transportation to the end-users.

The operational program aims to minimize the inactivity intervals of the active elements in the section; by adding supplementary constraints, the model may lead to the obtaining of a solution which should also achieve the uniform use of manpower existing in the section.

The basic algorithm for obtaining the solution of the management model of the section's production processes is characterized by the fact that the reiteration of the stages mainly depends on the conditions of the section's evolution in time. There is a permanent exchange of information between the section and the operator of this algorithm.

Stage F allows for the continuous improvement of the model's performances. By adding some steps in the basic algorithm, different variants of solutions can be obtained which allow for a study of the existent resources in the section starting with the establishment of the production capacity in conditions in which changes are made in technologies and ending with the problems of optimal dimensionings of the section. The solution of the model is obtained by constructing a system of programs.

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METHODES DE RESOLUTION POUR LE MODELE DE DIRECTION D'UNE SECTION PRODUCTIVE

On présente une méthode de résolution pour le modèle de direction, dont l'analyse a été déjà faite dans un article antérieur.

La complexité du modèle a requis l'utilisation d'une méthode spéciale de résolution, qui consiste dans la détermination d'un paquet de procédures opérationnelles.

МЕТОДЫ РЕШЕНИЯ ДЛЯ МОДЕЛИ УПРАВЛЕНИЯ ПРОИЗВОДСТВЕННЫМ ЦЕХОМ

В работе показан метод решения модели управления, анализированной в ранее опубликованной статье [1]. Сложность модели потребовала нахождения специального метода решения, состоящего из определения пакета операционных процедур.

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