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ANALIZA DRUMULUI CRITIC

(Critical Path Analysis)

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The development of cybernetics, of electronic computers and of applied mathematics have allowed to approach the complex problems of conducting projects on the basis of scientific prediction, planning and control procedures. In this soaring accumulation rate of information, Simion Lazăr's work enriches the documentary wealth with a valuable addition.

Employing rich documentary material and turning to account the experience of the Romanian research workers, the author successfully presents the most widespread methods of critical path analysis which have appeared and progressed on a world scale starting from 1957 and which, frequently applied in practice in production control and programming, have led to positive economic effects.

Thus, after presenting as an introduction some general problems such as: the object of CPA (Critical Path Analysis), the connections between CPA, OR (Operations Research) and MS (Management Science), the structure of projects, the parameters of activities, the managing diagram of a project through CPA, the classifying of CPA procedures and a brief history of its development, there follows a description of the CPM (Critical Path Method) principles. The reader is gradually acquainted with the respective notions and procedures. He first finds a general description of each procedure and then the specification of a series of strictly specialty details linked to the technique of CPM application, such as: preparation of initial data CPM program drawing up and updating, as well as a series of CPM variants and developments. On this occasion the author expounds in a clear form the more subtle problems of the critical path, laying particular stress on topics such as: computation of a CPM program by means of linear programming or by the CPM algorithm of the activity terms, programming with pre-established intermediate terms, properties of scheduled CPM networks, integration and condensation of CPM networks, and programming designs with repetitive features or with partly overlapping activities.

The idea of going into details over the more refined CPM procedures is an inspired one, since these are supposed to be less mastered by most specialists. Worth noticing is the attention granted to the MPM (Metra Potential Method) thought out by M. Roy, which is widespread in France. The author shows the manner in which the network is drawn up, the computation of critical distance and of programs, the setting up of scheduled MPM networks, the integration and condensation of MPM networks, as well as the programming of repetitive designs. The author also draws a parallel between CPM and MPM and rightly concludes that MPM is a generalization which comprises the CPM procedure, included in it as a particular case.

Careful concern is given to the PERT (Program Evaluation and Research Task or Program Evaluation and Revue Technique) method which is very widespread in the U.S.A. and is actually rousing an ever greater interest among the Romanian specialists. After a few general considerations on the PERT method, the technique of drawing up the PERT networks is described. On granting particular attention to the basic relationships established within the PERT method, the author shows that, on the basis of practical experience, it has been admitted that the duration of an activity has a beta distribution, three characteristic values having to be estimated by the specialists: optimistic duration (a_{ij}), most probable duration (m_{ij}) and pessimistic duration (b_{ij}). Computing relations are given, accompanied by examples, in order to find the duration mean and the duration dispersion on the basis of these three estimations. In view of strenghtening the theoretical knowledge, the computing procedure of a PERT program is further described. Finally, the problem of the truthfulness of the PERT method hypotheses is dwelt upon, the way of estimating the errors at the level of activities or at the level of the entire newtwork being shown.

Some up-to-date trends of the CPA development, such as the probabilistic and decision-making methods have not been neglected by the author. Particular attention was granted to the CPA probabilistic methods which allow setting up more extensive models than the PERT method. In the framework of the CPA/TIME probabilistic theory complex problems are approached such as: determining total duration by the Monte-Carlo method, duration of a design in a random universe and Fulkerson's CPA algorithm. The comprehensive presentation of the generalized networks follows, i.e. of the networks with decision events, viz.: Eisner type networks and Elmaghraby networks. In order to give a clearer idea of this group of methods, the author describes the GERT (Graphical Evaluation and Review Technique), used in the analysis of stochastic networks.

Among the problems related to the economic analysis in agreement with the CPA, worth noticing are the ones concerning the design cost optimizing. The following procedures are presented for minimizing design cost: CPM/Cost, Meyer-Schaffer, Berman, approximate CPM/COST and Orkand-Moder-Phillips.

Cost control and programming, as well as the corresponding procedures: Gantt graph, scheduled cost program and scheduled program of cumulated costs are also dealt with. The PERT/COST system is further treated as a development of PERT/TIME system.

In this respect, worth mentioning are the judicious recommendations made by the author. Thus, instead of accounting by kind of expenses, the cumulation of costs by batches, groups of batches or sub-designs is suggested, thus forming the PERT/COST accounting system which allows an easier updating of the program. In order to update the duration cost, the re-estimating relation is given, which allows computing the new estimate in the cost of one batch (Latest Revised Estimate). The content of the PERT/COST forms used for follow-up is shown, such as: Activity Time Status Report, Project Function

Bar Chart, Milestone Report, Management Summary Report, Program Project Status Report, Financial Plan and Status Report and Manpower Loading Report.

From the practical viewpoint, the presentation of the analyzing methods concerning the resources of a design such as: financial resources, manpower, equipment, materials, etc., is particularly useful. The author then states the problems related to the compatibility between the working program and the restrictions required by the available resources: Resource Levelling, Resource Scheduling, and Resource Allocation. The resource analyzing methods are classified in four main categories: analog, functional, linear programming and heuristic procedures. Among the procedures expounded, the following may be mentioned: T. L. Pascoe's experiment for measuring the efficiency of the various heuristic procedures of resource analysis, Burgess-Killebrew's levelling procedure, serial procedures based on Kelley's works, J. D. Wist's SPAR (Scheduling Program for Allocation of Resources) procedure, and the RAMPS (Resource Allocation and Multi-Project Scheduling) method created by the C.E.I.R. consulting firm.

In order to acquaint the reader with various utilitarian programs, meant for production planning, wide space is devoted to the use of electronic computers for critical path analysis. A classification of the CPA computing programs in families or categories is given, such as: PERT/TIME, CPM/TIME, MPM, PERT/COST, CPM/COST, and resource allocation. Further, the features of more particular programs are enumerated such as, for instance: the PERT/COST 7090 CP-OIX program for the IBM 7090/94 computer, the ROC 8001 program worked out by the Richfield Oil Corporation, used in the case of designs with limited (labour) resources, the CONCORD (Conception et Coordonation de l'Ordonancement) program for the 3600 Control Data computer, the IBM 1630/360 Project Control System, the PPS (Project Planning System) and the GRASP (General Resource Allocation and Scheduling Program) for the IBM computer.

In order that persons studying the critical path method may check the assimilated knowledge, practical problems to be solved are given at the end of some chapters and their correct solutions are presented in the Appendix. The reader has thus the possibility to compare the solution found with the corect one and to realize the extent to which he has assimilated the method.

Some notions required to understand the work are presented in the Appendix: elements of the graph theory, the optimality principle and the critical path algorithm in a network, and the beta distribution, as well as a glossary of definitions of the main notions connected with CPA.

Simion Lazăr's work makes use of numerous reference books and stands out by an inspired classification of the problems expounded. Its style is clear and the course of ideas can easily be followed.

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