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NETWORK PLANNING [1/]

Criteria for computer use and programme specifications

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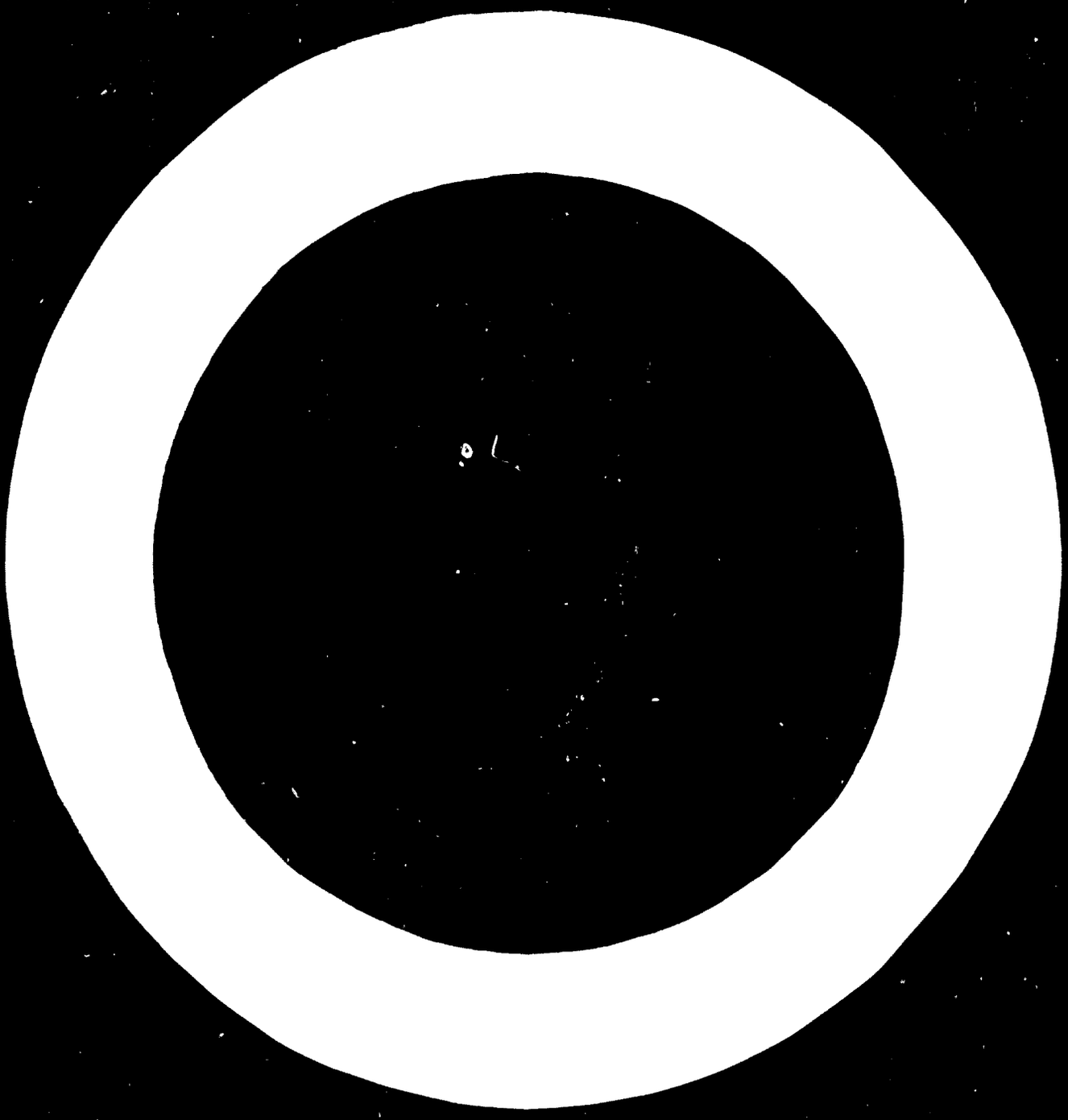


1. INTRODUCTION

When to use a computer for network planning is an important question in many project-type situations. With the advent of third generation equipment and third generation application thinking, it is worthwhile to reconsider the above-mentioned question. This is done in the following paragraph.

Third generation application thinking can have a big influence on programme design. In the field of network planning, it turns out that the specifications between second and third generation programmes are rather different. The specifications of a third generation network planning programme are outlined in the last paragraph.

2. PROJECT PLANNING AND COMPUTER

Project planning by network analysis may be distinguished in two parts:

- Planning phase
- Progress control phase.

The great majority of the actual literature on project planning by network analysis places too much emphasis on the planning aspect. One of the results is that too little attention has been paid to the progress control. Many publications also put too much stress on the theoretical aspects of project planning by network analysis. It is also desirable to put some emphasis on the fact that project planning by network analysis may be a useful tool for everyday control.

The observations mentioned above have some consequences for the question: why engage a computer? Since most publications give the answer: in order to calculate the critical path in extensive networks, the computer's assistance is indispensable. In this answer the main emphasis is clearly on the faultless calculation of the earliest possible and latest permissible activity dates.

If one wishes to answer the question: why engage a computer? from the viewpoint of the overall field of project planning by network analysis, i.e. with respect to both planning phase and progress control phase, we will get a different answer. The introduction of a computer is determined by the following factors:

- the extent to which project planning by network analysis is used for everyday project control;
- the extent to which project planning by network analysis is used for department control;
- the size of the networks (number of activities);
- the extent of integration with the administration.

2.1. Project planning by network analysis for everyday project control

If project planning by network analysis is used for everyday project control, calculation is important only with extensive networks for the subject "project planning by network analysis and the computer". With small networks it would be more economical to do so manually. However, if one wishes to give all people involved in the project a survey of the situation at the beginning of, for instance, each week, then the processing of progress information and the proper dissemination of the information (most people need only part of the total information, a subset of the total network), as well as putting the activities in a desired sequence, constitute such a job that one will immediately consider processing it by computer.

We will assume for the further discussion that one may use a programme through which progress control information is easy to process. Furthermore, the user of such a programme should be able to instruct the computer in a simple way which subset he wants to see, for what people, and in which sequence the activities should be put on paper. With this procedure one profits from the additional advantage (which is not for that reason a small advantage) that one may use the obtained progress information for other purposes also, from a mechanically legible form.

2.2. Project planning by network analysis for department control

In most cases a firm consists of a number of departments, and all departments are working on one project, sometimes on a great number of projects. The work of the departments is (to put it rather extremely)

dictated by the projects. If one uses one or other form of analysis for determining the throughput times of the projects, and one wishes to use these project data as the basis for department control, a first demand for proper decision making is a clear survey of the data per department and period of time. Collecting the project data per department and period of time is a job "made to order" for the computer, since once the basic data have been input into the computer, it is rather easy to make a survey of these data from any point of view. It is for that reason we assume that the good programmes of today have facilities allowing for indicating, via a punched card, the department of which one wishes to have a survey, sometimes even with the possibility of indicating that in the case of a certain overflow or underflow the programme automatically uses the available free float or other information in order to have improved occupation (this is what is called allocation in the literature).

2.3. The size of the networks

Networks with a great number of activities are big in two respects:

- number of calculations
- quantity of data.

The calculations for the primary setting up of a network with 100 activities may be well done "manually". With a network having 1,000 activities this is feasible in principle. Practice, however, shows that errors are usually committed in great numbers.

In case progress information should be processed each week, after the first time the network has been set up, then a computer should be used to calculate a network of 100 activities. Calculating a network of 1,000 activities each week clearly calls for the use of a computer.

With the use of project planning by network analysis as a tool for everyday control, it is desirable to insert all sorts of data on the activities. This may include:

- identification
- name
- required quantity of production resources
- responsible department
- executing department
- special data, e.g. interruptable, etc.

In the case of networks with a vast quantity of activities, the number of data increases so much that it is obvious to consider using a computer for the storing and processing of changes. Drawing up selective reports (which are so urgently needed with everyday control) from this great quantity of data calls for the same solution.

2.4. The extent of integration with the administration

Data on activities, such as number of production resources, starting data, etc., are usually inserted and processed in the administration in some way or another. With firms of some size, it is not remarkable to note that the administration is mechanized or automated. In such a case the collection of the input information for network planning is considerably less expensive than when it is collected separately for the purpose of project planning by network analysis. The use of the same information by the administration, the planning department, and the executive department has a very pleasant consequence in practice. In the case of non-integration one often notes a disagreement between the various departments on the differences in information, which actually cannot exist. One often loses quite some time in solving these problems of differing information. When using the same basic data, these problems are prevented for the greater part.

3. SPECIFICATIONS FOR PROJECT PLANNING BY NETWORK ANALYSIS PROGRAMME AS A TOOL FOR EVERYDAY CONTROL

A computer programme for project planning by network analysis as everyday control should have other, and more, characteristic features than most programmes currently in use.

A comparison between CPM and Precedence shows that the activity-on-node technique, in particular with project planning by network analysis as a tool for everyday control, offers many advantages.

Advantages of the activity-on-node representation are:

1. activity-on-node is a representation which is commonly used in many fields;
2. activity-on-node requires no dummies;
3. with activity-on-node, changes are quite easily introduced;

4. inserting a change in the network never causes a change in record identification with the activity-on-node technique, which is an important point for the integration with the administration;
5. the activity-on-node technique can be more easily instructed;
6. more complex situations can be represented with the activity-on-node technique.

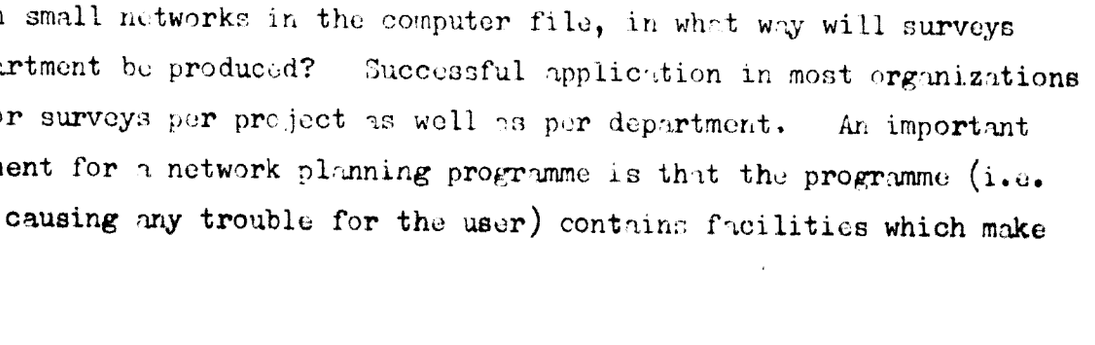
Advantages of activity-on-arrow are:

1. activity-on-arrow is commonly known;
2. activity-on-arrow requires about 10% less computer input;
3. many computer programmes are available based on activity-on-arrow.

Hence our statement that the first requirement for specification should be that the programme is based on the activity-on-node technique.

Although this requirement is almost indispensable for the successful introduction of project planning by network analysis, it is not sufficient. The specification requirements which will be defined further in this paper, have the general characteristic feature that successful practical application is a point of primary importance.

One of the most important requirements concerns cost. The expenditure for the use of a programme should be small. Costs per activity depend on the size of the network. The relation of almost all computer programmes is as follows:



Such cost relation will often make the processing of small networks too expensive (between the cost per activity of a 25-activities network and a 500-activities network lies a factor 5). However, if one does not bring in small networks in the computer file, in what way will surveys per department be produced? Successful application in most organizations calls for surveys per project as well as per department. An important requirement for a network planning programme is that the programme (i.e. without causing any trouble for the user) contains facilities which make

it possible to keep the costs per activity for small networks (~25) only 10-20% higher, instead of 500%. If this requirement is fulfilled, project planning by network analysis may be used for all orders, with all the advantages involved.

Information on the networks should be so stored that data are input only once. File maintenance should not be onerous to the user. For a file of some thousands of activities, this means storing the information on magnetic tape or disc, since the corresponding numbers of punched cards become rather great.

With most current programmes the input data should be submitted in a certain sequence. Sometimes special cards have to be inserted in order to separate specific card categories. These cards have no meaning for the user, and therefore they are just a nuisance. With the application of project planning by network analysis as a tool for everyday control, information originates at arbitrary moments. This information also originates in various departments. In the multi-project situation information originates for various projects. If one demands that the user submits the information per project, that he orders the information for each project according to card category, and inserts separating cards between these categories, one is really asking for trouble. Another set of requirements for a good programme therefore consists of:

- input data of various projects
- no sequence for the input data
- no separating cards.

The data for project planning by network analysis may contain all kinds of errors. Errors may occur during all phases, e.g. punching errors, writing errors, structure errors, etc. A good programme should state the error in clear language which every user can understand. In other words, the statement "Error e016 in network 112" is definitely not sufficient, since the user will have to look up the meaning of e016 in a book. This is rather trying. This example should read: "You wanted to add data in network 112 to activity 1050. This activity is not included in the file."

A good programme should contain, in addition to reports with a list of activities, surveys in the form of bar charts.

Sequencing the output data is important for surveyability. This is not the same thing to all users. A programme should enable the user to submit each possible sequence of data as output.

Lately one can note a general trend towards selective output of computer programmes for business control. An often-heard complaint from users of computer programmes for business control is the (too) big quantity of output data, an over-abundance of irrelevant data. This complaint has contributed to the recent development of facilities that are inserted in the computer programmes for business control - at least in the good ones - via which the user may select the output data which is relevant for him. The possibilities of this selection may contribute considerably to successful introduction of automation in business control. The possibilities for selection also play a very important part with project planning by network analysis. A facility for many flexible selection possibilities is certainly a part of the specifications for project planning by network analysis programme for everyday control.

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