APPLICATION OF PROJECT MANAGEMENT METHODS IN MUNICIPAL PROJECT

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Abstract

Concept of project management is often used in business environment. Using of exact mathematical and statistical methods in regional projects could be interesting application of the concept. In the paper is briefly described method of network analysis, which is possible to use in project management. The article contains case study of the municipal environmental project with the goal of minimum time required to complete the project and identification of critical activities and time reserves.

Key words: Project management, municipal project, network analysis, CPM.

JEL Classification: C44

1 Introduction

In the developed market economies project management represents verified set of methods of guide-lining, initiation and synchronization of activities and resources, required for project execution with satisfaction of all participating persons. It is inventive application of principles and procedures of general management on management of projects specific life-cycle phases, from their beginning to the end [1].

Interesting research area is application of mathematical and statistical methods in project planning, which enables effective output and evaluation. In the end of 50th (20.century) appear in USA methods for project planning, which became to be base of project planning (e.g. CPM). They are applied for planning, coordination and control of complex tasks in various areas of economic activities, mostly in construction investments, research and development, technical development, in complex administrative tasks, drafting plans and others.

2 Methods and techniques of project management

In project management, which consists of precisely defined activities (human resource management, management of costs, risk management, ...), is possible to use different methods, which were used in practice primarily in other types of activities.

The basic instrument for planning and management is network analysis, particularly its most commonly used methods CPM (Critical Path Method), PERT (Program Evaluation and Review Technique) and MPM (Metra Potential Method). Network analysis methods are intended for planning of time, costs and resources. As a new is enforced critical chain method, based on theory of constrains. In project management are used another standard methods e.g. logical framework method, Management by Objectives (MBO), SWOT analysis and Gantt diagrams for charting of activities time flows. In investigation of potential barriers of project success is possible to apply selected procedures for risk analysis adopted from the field of risk engineering as for example RIPRAB (Risk Project Analysis) and FRAP (Facility Risk Analysis Process), in investigation of project success support is suitable method CSFA (Critical Success Factor Analysis) and technique of Ishikawa diagrams. For project state evaluation and prediction of its development is used the method of SSD graphs (Structure Status-Deviation) [2].
For planning of project economic indicators are used different modifications of value analysis and cost controlling known from financial and economic analysis of company e.g. analysis of project's net value, ROI (Return on Investment), CBA (Cost/Benefit Analysis) etc. Further commonly used methods in project management are methods for decision support, process modeling, computer simulation of project and others.

2.1 Network analysis methods - CPM

There exist more methods of network analysis, from which the well-known and mostly used are above mentioned methods CPM and PERT. Theoretical base of both methods is theory of oriented graphs [3].
The essential technique for using CPM is to construct a model of the project that includes the following [4]:

1. A list of all activities required to complete the project,
2. The time (duration) that each activity will take to completion, and
3. The dependencies between the activities.

Using these values, CPM calculates the longest path of planned activities to the end of the project, and the earliest and latest that each activity can start and finish without making the project longer. This process determines which activities are "critical" (i.e., on the longest path) and which have "total float" (i.e., can be delayed without making the project longer). In project management, a critical path is the sequence of project network activities which add up to the longest overall duration. This determines the shortest time possible to complete the project. Any delay of an activity on the critical path directly impacts the planned project completion date (i.e. there is no float on the critical path). A project can have several, parallel, near critical paths. An additional parallel path through the network with the total durations shorter than the critical path is called a sub-critical or non-critical path [4].
These results allow managers to prioritize activities for the effective management of project completion, and to shorten the planned critical path of a project by pruning critical path activities, by "fast tracking" (i.e., performing more activities in parallel), and/or by "crashing the critical path" (i.e., shortening the durations of critical path activities by adding resources) [4].

3 Case study of CPM application in municipal project planning

3.1 Time graph of waste water treatment preparation and execution works

In the case study we deal with the project of waste water treatment (WWT) construction. In our case the first step in project planning was identification of particular activities, which are necessary for project realization, determination of their duration and also the costs level for the durations. After these basic findings we can use described method for calculations.
For the preparation and execution works of WWT and sewage connector are necessary following activities (Tab. 1, 2).

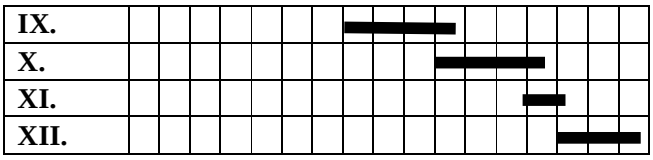
Table 1: Project activities

Activity	i	j	Activity name	Financial resources (thousand EUR)	Duration (days)
1.	1	2	Proposal and approval of WWT	1,66	15
2.	2	3	Project of WWT, construction permission	13,28	60
3.	3	4	Abridged EIA(Ministry of Environment SR)	3,32	90
4.	3	5	Land-use and construction procedure		90
5.	5	6	Execution project of WWT	2,66	20
6.	6	7	Groundwork	3,32	10
7.	4	7	Material delivery	116,18	31
8.	6	8	Technology delivery	177,52	61
9.	7	8	Construction works	49,79	90
10.	8	9	WWT assembly	33,19	91
11.	9	10	Start of WWT – measurements + complex examinations (inspections, examinations of tightness and electro-equipments)	4,98	31
12.	10	11	WWT inspection		60

Source: [5]

Table 2 Proposed time graph of WWT preparation and execution works

Activity	Duration
I.	
II.	
III.	
IV.	
V.	
VI.	
VII.	
VIII.	



Remark: Width of a column adequate to 30 days time period.

3. 2 CPM – Determination of project duration

For the calculations of the minimum time required to complete the project and for setting the critical path we used network graph (Graph 1) with calculations based on Earliest Event Time Algorithm and Latest Event Time Algorithm.

In the calculations we used TMi - the earliest possible time, at which each event i, in the network can occur and TPj - the latest possible time, at which each event j in the network can occur, given the desired completion time of the project,

Earliest Event Time Algorithm

We let TM1 = 0 (TM1 is the starting event „Proposal and approval of WWT“)

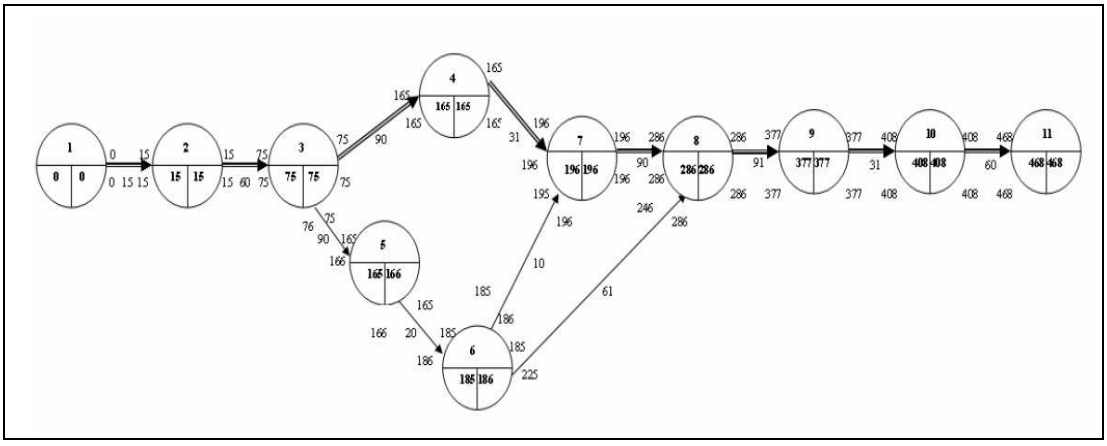
Then we count for j = 2,3,...,n (where n is the last event), TMj = maximum (TMi + tij) where the maximum is computed over all activities (i,j) that have j as the ending event.

Counted TMn is the minimum time required to complete the project.

Latest Event Time Algorithm

We let TPn equal the required completion time of the project TMn.

Then we count for i = n-1, n-2, ..., 1, TPi = minimum (TPj - tij) where the minimum is computed over all activities (i,j) that have i as the starting event.



Graph 1: Network graph

Through the arrangement and calculations of network graph we determinate minimum time required to complete the project and critical activities. From the network graph follow that minimum time required to complete the project (in regular activity durations) is 468 days. The critical activities are activities 1-2, 2-3, 3-4, 4-7, 7-8, 8-9, 9-10 and 10-11. Activity 6-8 has total reserve 40 days and activity 3-5, 5-6 and 6-7 has total reserve 1 day.

4 Conclusion

Formed network graph of CPM enables to display time flow of particular activities in project and to identify relations between activities. It provides review of project scope, of relationship and conditionality of partial activities and also of activities which can run simultaneously. It represents preventive tool, which eliminates the possibility of important activities releasing. The method could be used also for project cost or resource variants and not only for project time flow (as indicated in our case study).

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