

MODEL FOR PROJECT DURATION ASSESSMENT BASED ON CLARK'S EQUATIONS

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ABSTRACT

This work suggests project duration assessment model based on theoretical assumptions and usage of standard project management software. Research would show meaning of this kind of model and this work presents all characteristics of suggested research: goal, sample, tools, techniques and meaning of the research.

Keywords: project time management, project duration assessment, model for project duration assessment

1. INTRODUCTION

As the project duration influences on its realisation in the scope of defined time and costs, successfulness of methods is very important for its determination. Also, solving of this problem is very complex and it can't be done using one standard algoritam. It demands applying of different tools and techniques, starting with analogy, project simulation, using decision trees and expert judgments. The fact that in some cases is not possible to apply most of the above mentioned tools and techniques, implies the necessity of standardisation of determination of project duration, i.e. defining the appropriate model.

Since functioning of standard softwares for project management is based on network planning techniques, they enable project duration assessment according to project baseline. This could be used for preliminary project duration assessments in cases when expert judgments are not available.

This work considers project duration assessment for network diagram with two parallel paths: critical and subcritical, which can be considered as general case in practise. To determine project duration it is used analitical method based on Clark's equations for parallel paths solving, on the basis of central limit theorem for sequential paths solving.

Theoretical model defined in this way is used through one of the standard softwares for project management. Research about model evaluation has also been presented.

2. STANDARD METHODOLOGY FOR PROJECT DURATION MANAGEMENT

Project duration assessment is one of the basic parts of project time management. Stadarnd methodology used for that purpose is based on:

- Network diagramming methods: *Precedence diagraming method* (PDM), *Arrow diagramming method* (ADM) and *Conditional diagramming method*¹. There can be used also networks templates for whole project or some of its parts. As a result of their application we get project network diagram;
- Necessary data for project duration assessment are: activity list, set of constraints and assumptions, resource pool and database of former projects.
- Techniques for activity duration assessment: expert judgment, analogy and simulation. [1]

¹ Those methods are *Graphical Evaluation and Review Technique* (GERT), System Dynamics and others which enable representing of conditional branching and loops in network diagram.

As the functioning of standard project management softwares is based on network planning techniques, they enable project duration assessment according to defined project baseline. This can be used for preliminary project duration assessment in cases when expert judgment is not available. As above mentioned, it is one of the guidelines that influenced on defining model for project duration assessment in this case.

3. MODEL FOR PROJECT DURATION ASSESSMENT

Theoretical assumption of model for project duration assessment is based on critical path analysis considering general case in which are identified two parallel paths: critical and subcritical. For project duration assessment is used analytical method with Clark's equations for the parallel paths solving, on the basis of the central limit theorem, for ordinal paths solving. In this analysis is supposed the normal distribution of path endings with the average (mean) values characteristics and appropriate time deviations of their realization (project duration). Figure 1. shows flow network with above-mentioned paths, their parameters and also flow network with resulting (superponed) path.

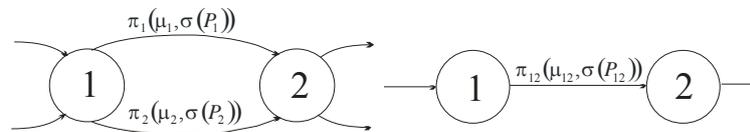


Figure 1. The flow network with critical and subcritical path and the resulting – superponed path [2]

The mean superponed values: duration and variance are calculated according to Clark's equations (1 and 2) based on data for every path.

$$\mu_{1,2} = \mu_1 \Phi(\xi_{1,2}) + \mu_2 \Phi(-\xi_{1,2}) + \lambda_{1,2} \Psi(\xi_{1,2}) \quad (1)$$

$$\sigma^2(P_{1,2}) = (\mu_1^2 + \sigma^2(P_1)) \Phi(\xi_{1,2}) + (\mu_2^2 + \sigma^2(P_2)) \Phi(-\xi_{1,2}) + (\mu_1 + \mu_2) \lambda_{1,2} \Phi(\xi_{1,2}) - \mu_{1,2}^2 \quad (2)$$

Where: $\Phi(\xi)$ – Laplace integral, $\Psi(\xi)$ – the density function of the centred normal distribution and $\lambda_{1,2} = \sqrt{\sigma^2(P_1) + \sigma^2(P_2)}$, that is $\xi_{1,2} = \frac{P_1 - P_2}{\lambda_{1,2}}$ – the parameter of Clark's functions. [3]

This method is characteristic for studying different phenomena and processes based upon network models (of activity flows, resources, energies and likes).

Above-mentioned theoretical base of model has to have software support and in this case we can use some of the standard softwares for project management.

Using that kind of software demands project baseline defining with necessary elements for project duration calculation. At first, that is activity list with its characteristics (type, duration, dependencies, constraints, etc.), then that is resource pool, also with its characteristics (type, number of units, costs, working time, ect.), and assignments. Secondly, project management softwares enable finding irregularities in baseline, like overallocated resources, cost overbudget, late/overbudget tasks and also resolving of this problems. [4]

For theoretical model application it is necessary to define two versions of baseline, in other words, two scenarios of project realization (for example, Baseline and Baseline1), whose durations would be analogue to the paths we have mentioned. Clark's equations should be set up by defining fields (Customize Fields option), which can be used for project duration estimating of every project baseline that we create. [5]

Figure 2 shows data structure for this kind of model.

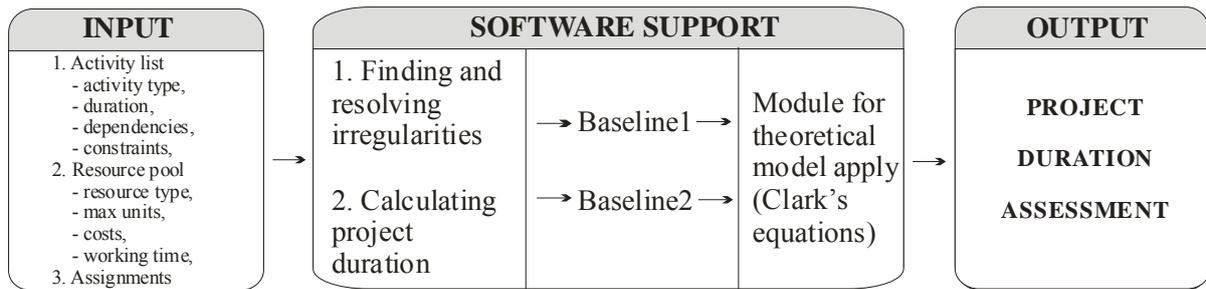


Figure 2. Model for project duration assessment

4. RESEARCH

Research is based on analyses of methodes for project duration assessment. The main goal is to use present theoretical knowledge through software for project management and create model with multiple meaning:

- user friendly interface – as the usual manner of using project management software suggests defining necessary parameters (Baseline1 and Baseline2) for duration assessment, there is no need for additional user training for module application;
- possibility of educational usage – if model is approved through the research it can be used in higher education or even on real projects from different areas for preliminary assessment;
- the standardization of tools for project duration assessment;
- new meaning of present theoretical assumptions.

Research sample includes two kinds of data:

- former project baselines,
- real project duration obtained after their realization.

Due to the fact that this information is historical it is easily accessed. Data collection includes small, medium and big enterprises and all organizations and institutions which are interested in cooperation. Sample representativity depends on its volume, and it needs at least 30 project baselines. Contribution of big enterprises in research sample also improves its representativity. This kind of research sample is intended, but also valuable enough for this research.

Every project baseline from sample has to have data about characteristics listed in INPUT part of suggested model (Figure 2.). Software support of model enables project duration assessment for each plan individually. These assessments of project duration are compared with real duration, that is other data type from the sample.

Hypothesis testing about significance of differences implies on importance of suggested model. If the values obtained from suggested model are the same as ones from the project realization it will approve its significance in all above mentioned aspects. In that way, we have the level of successfulness of model for project duration assessment. On the contrary, research has following meaning:

- theoretical assumption of model based on Clark's equations does not have practical confirmation;
- other tools are necessary for project duration assessment which will enable its standardization.

5. CONCLUSION

Contribution of this work can be seen in defining activities which would enable standardization of project duration assessment through suggested model. The usage of model indicates software for project management application for project baseline defining. Thanks to the module, which is based on theoretical model assumptions, project duration assessment is carried out within the software.

Research enables ratification of model which is defined in this work. Through the research, we compare project baselines of real projects with ones obtained from model for project duration assessment. This comparison enables evaluation of suggested model.

If the research approves model significance, its application would be very important for educational purposes, and also for all those cases in which the lack of standard tools and techniques exists.

On the contrary, research implies on necessity of theoretical assumption of model changing, which would be the subject of further work related to solving of problem of project duration assessment.

6. REFERENCES

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