

# USING THE WINQSB SOFTWARE IN CRITICAL PATH ANALYSIS

## UŽITÍ PROGRAMU WINQSB V ANALÝZE KRITICKÉ CESTY

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### **Abstract**

In the beginning of the paper is briefly introduced the Critical Path Method. This method is also part of the course Theory of systems in both forms of study and therefore the contribution is focused on the usability of the WinQSB in the teaching process of the subject Theory of systems. The paper presents our first experience with its use, as well as the advantages and disadvantages of this product. Using of the software is demonstrated in a case study with the solution of the Critical Path Method.

### **Abstrakt**

V úvodu příspěvku je stručně představena metoda kritické cesty. Tato metoda je také součástí náplně předmětu Teorie systémů v obou formách studia, a proto je příspěvek zaměřen na využitelnost programu WinQSB při výuce předmětu Teorie systémů. V příspěvku jsou prezentovány první zkušenosti s jeho užíváním, dále výhody a nevýhody tohoto produktu. Použití softwaru je demonstrováno na případové studii s využitím řešení pomocí metody kritické cesty.

### **Key words**

CPM, critical path analysis, crisis management, logistics, project

### **Klíčová slova**

CPM, metoda kritické cesty, krizový management, logistika, projekt

## INTRODUCTION

The Critical Path Method (CPM) belong to the basic deterministic network analysis methods. Its aim is to determine the duration of the project on the basis of length called: a critical path, which is a sequence of interdependent activities with the least time to spare. CPM enables to facilitate the effective temporal coordination of each successive project activities.

The critical path is defined as the time-longest possible route from the start point to the end point of the directed graph. Each project has at least one critical path. Each critical path consists of a list of activities which the project manager should be most focus to if he/she wants to ensure the timely completion of the project. The completion date of the last task on the critical path is also the date of completion of the project. The total slack time of the critical tasks equals zero. This means that delays the start of the task or extend its duration will affect the final date of the project. The critical path is reflected into time scheduling and project management and in all phases of the project lifecycle.

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<sup>2</sup> externí doktorand FBI v Žilině

This method can serve as a tool particularly for estimating the duration of the project. Used by linear projects where the duration can be estimated with a high degree of accuracy, e.g. building industry. Duration of the project activities are usually known by past experience and knowledge of data on past projects. Durations of all activities are not statistically determined. The method can also be used in logistics, crisis management and transport. [5]

An educator who teaches students in the combined form of study is required to provide the students with special learning materials that allow study themselves. Not every problem can be easily studied remotely. In the course Theory of systems we solve case studies from practice. Students have to build a mathematical model based on the analysis of the problem. There is the complexity of calculation and time-consuming in the manual solution of this model. It is very inefficient in today's era. [4]

Tasks of this field are challenging. A great tool for calculations is the teaching on computers. We were looking for the software that is not difficult to control and which is not expensive for students. The third criterion was to use the software also in other subjects. And we found WinQSB.

### **WINQSB**

The QSB (Quantitative Systems for Business) is developed and maintains by Yih-Long Chang. This software package contains the most widely used problem-solving algorithms in Operations Research and Management Science (OR/MS). The WinQSB is the Windows version of the QSB software package.

The WinQSB is freely downloadable on the Internet. It contains not only modules for solving linear programming problems, but also modules from other areas of operational research under this breakdown: [4, 6]

- |                                     |                             |
|-------------------------------------|-----------------------------|
| ○ Decision Analysis                 | ○ Network Modeling          |
| ○ Dynaming Programming              | ○ Nonlinear Programming     |
| ○ Facility Location and Layout      | ○ PERT and CPM              |
| ○ Forecasting and Linear Regression | ○ Quality Control Chart     |
| ○ Linear and Integer Programming    | ○ Job Scheduling            |
| ○ Markov Process                    | ○ Queuing Analysis          |
| ○ Material Requirements Planning    | ○ Queuing System Simulation |

Like every freeware has WinQSB its advantages and disadvantages. The following table summarizes the most important ones.

**Table 5 Main advantages and disadvantages of using WinQSB**

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• it is free to use,</li> <li>• very easy to handle,</li> <li>• automatic solutions,</li> <li>• quite wide spectrum of methods and processes</li> <li>• lots of videos about WinQSB on YouTube.</li> </ul>	<ul style="list-style-type: none"> <li>• limited methods to use,</li> <li>• limited with Windows XP Mode,</li> <li>• quite old (limited color palette),</li> <li>• no upgrades and improvements,</li> <li>• graphical outputs could not be affected.</li> </ul>

Source: own.

### FINDING A CRITICAL PATH

There is thus a large number of publications in which this method is clearly and distinctly described (e.g. [2], [3]). Given the focus of the article and space limitations, it is appropriate to recall the fundamental elements of the CPM. In applying the CPM, there are several steps that can be summarized as follows:

1. Define the required tasks and put them down in an ordered (sequenced) list.
2. Create a flowchart or other diagram showing each task in relation to the others.
3. Identify the critical and non-critical relationships (paths) among tasks.
4. Determine the expected completion or execution time for each task.
5. Locate or devise alternatives (backups) for the most critical paths.

In general, there are two basic methods of solution. The first is to use only directed graph and calculate the required variables directly in this graph. The critical path is often shown in a different color (often red). Although this process is rapid, but the representation is not always legible. An alternative is to use tables, which enumerate to any desired value. It's difficult to calculate, but the representation is more readable. Both of the above described procedures allows the WinQSB (compare Fig. 1 and Fig. 2).

Both methods, however, have a common Gantt chart as the final presentation of the found solutions. For the CPM is the most important finding critical paths and activities on them. But it is needed to look for that activities of the project, which are not on the critical paths. These activities, we should not forget and focus in their commentaries on them also, because of the possible optimization of individual project activities (Fig. 4). It is quite challenging to legibly construct a Gantt chart and if we could use some recovery programs we work on this issue much easier.

### CASE STUDY

An Assignment can be seen in the following table. This is an opening of the new branch of the company. All activities are described in the table and you can also find durations and sequences of the activities.

An input table in the WinQSB is absolutely identical with Tab. 2, but we do not need to input the names all activities. We just need write abbreviations, sequences and time allotments of the activities. By double clicking the mouse the program solves and finds a critical path, without having to render a directed graph. After that we get a table (Fig. 1) with all necessary

variables and with the solutions whether the activities are on the critical path. Of course we will know the number of critical paths in our problem.

**Table 6 An assignment**

	<b>Name of activity</b>	<b>Abbreviation</b>	<b>Sequence</b>	<b>Time in weeks</b>
1	Identify a suitable country	A	-	4
2	Find a site	B	A	4
3	Get trade permit	C	A	2
4	Buy a site	D	B, C	10
5	Modify buildings	E	D	8
6	Find local suppliers of furniture	F	D	2
7	Purchase furniture	G	F	2
8	Recruit local manager	H	B	4
9	Recruit local staff	I	H	4
10	Install furniture	J	E, G	2
11	Advertise the product	K	C	4
12	Open for business	L	I, J, K	4

Source: <https://www.youtube.com/watch?v=dDetfOCCMqo>.

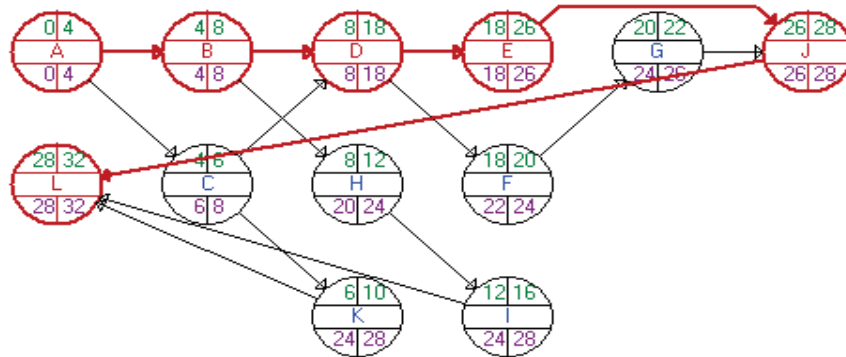
**Figure 1 The solution in WinQSB**

09-26-2014 14:16:27	<b>Activity Name</b>	<b>On Critical Path</b>	<b>Activity Time</b>	<b>Earliest Start</b>	<b>Earliest Finish</b>	<b>Latest Start</b>	<b>Latest Finish</b>	<b>Slack (LS-ES)</b>	
	1	A	Yes	4	0	4	0	4	0
	2	B	Yes	4	4	8	4	8	0
	3	C	no	2	4	6	6	8	2
	4	D	Yes	10	8	18	8	18	0
	5	E	Yes	8	18	26	18	26	0
	6	F	no	2	18	20	22	24	4
	7	G	no	2	20	22	24	26	4
	8	H	no	4	8	12	20	24	12
	9	I	no	4	12	16	24	28	12
	10	J	Yes	2	26	28	26	28	0
	11	K	no	4	6	10	24	28	18
	12	L	Yes	4	28	32	28	32	0
	<b>Project</b>	<b>Completion</b>	<b>Time</b>	=	32	<b>weeks</b>			
	<b>Number of</b>	<b>Critical</b>	<b>Path(s)</b>	=	1				

Source: own in WinQSB

If you desire for plotting directed graphs then WinQSB can quickly and automatically render it by a single click. Unfortunately the program seeks to found the critical path always a single row. That is the reason why WinQSB moves the activities at the expense of readability. There should be some crossing edges very often. The program does not know dummy activities with the fictive edges. All plotting is based on the activity-node graphs (Fig. 2).

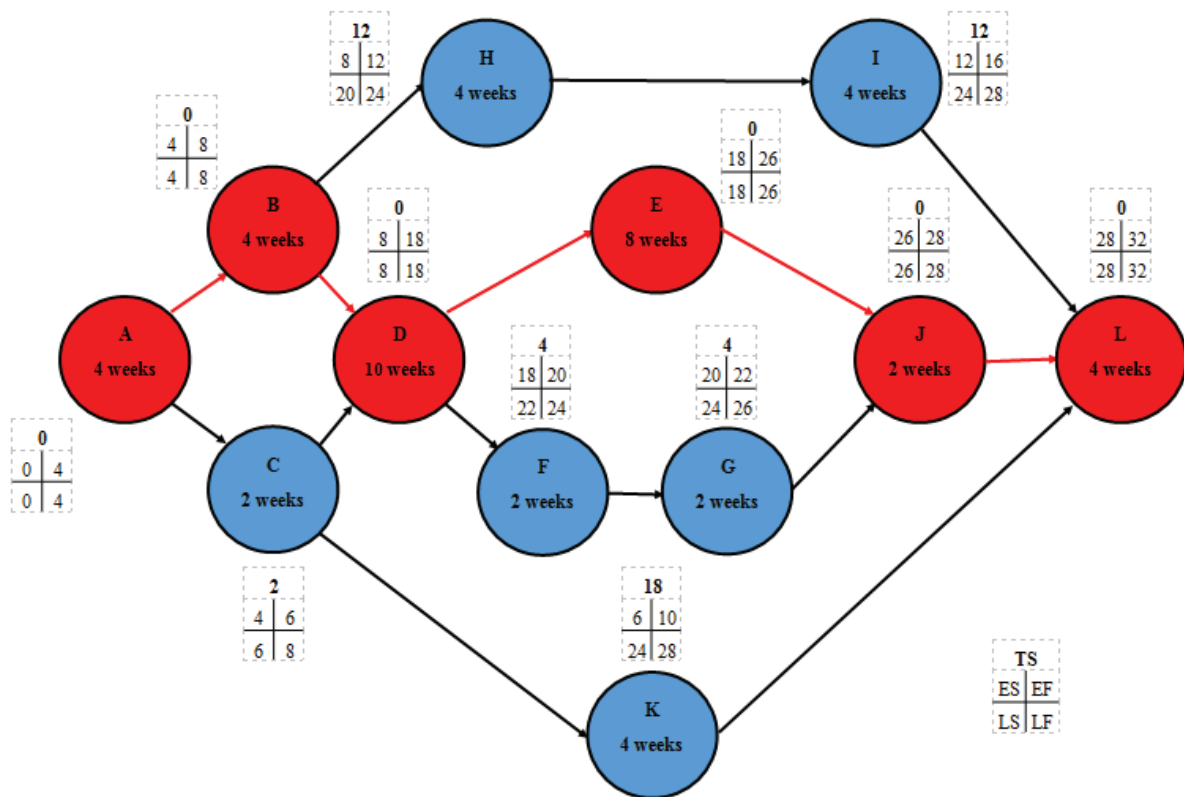
**Figure 2** An automatically generated directed graph with marked critical path (red colour) in WinQSB



Source: own in WinQSB

On the other hand the plotting is very fast and simple. A perceptive user can handle and create a directed graph with no errors manually with the pattern of automatically generated directed graph in WinQSB (Fig. 3).

**Figure 3** A hand-created generated directed graph with marked critical path (red colour)

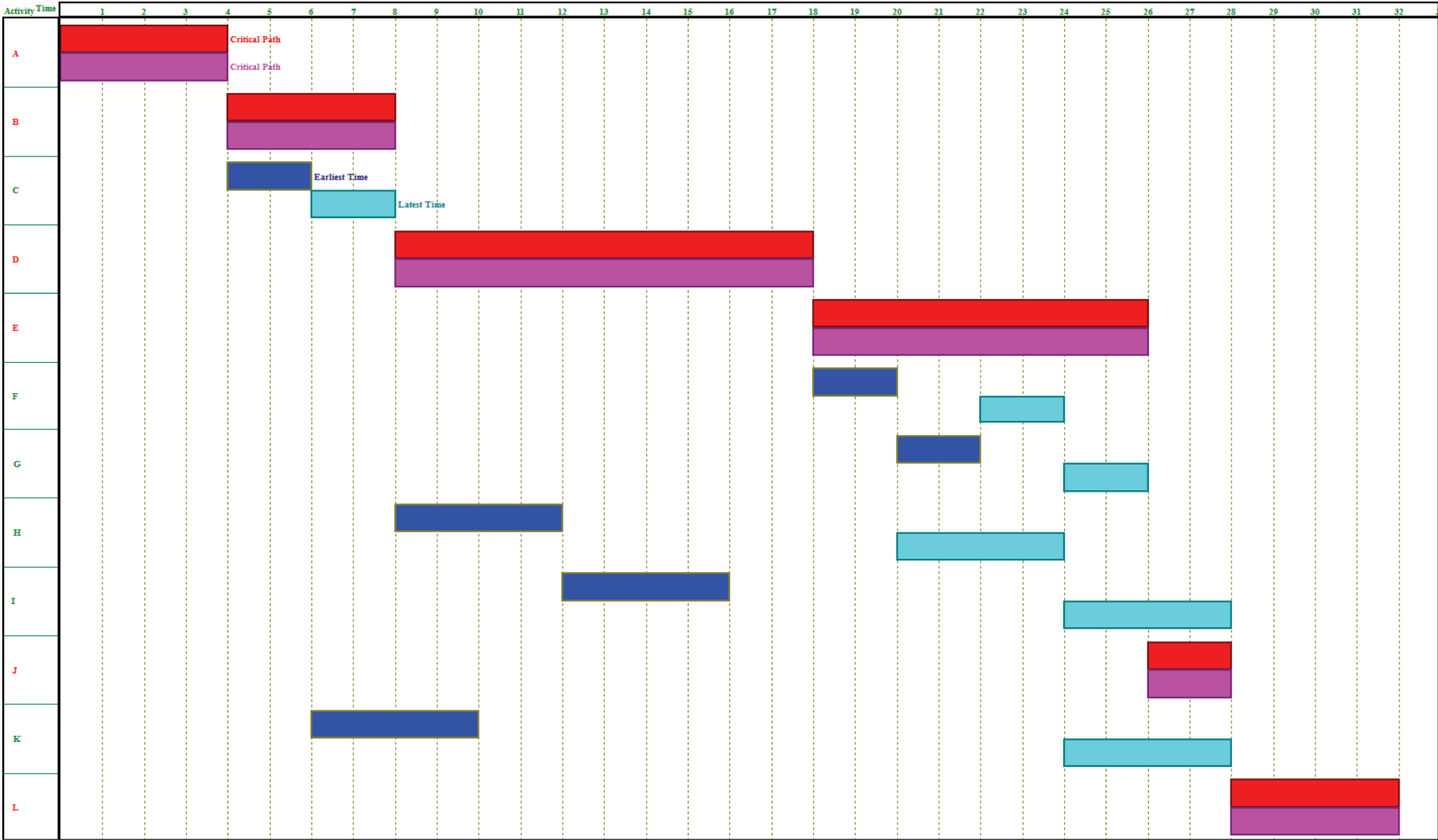


Source: own

## **CONCLUSION**

This article summarizes the basic knowledge concerning the using freeware software of WinQSB. The main sources were my own experiences with this helpful tool in finding solutions of the logistic problems. Working with this program is very simple. Without using a specialized program will be teaching of the subject Theory of systems like a mere demonstration. Using of this program is documented with an example of solved case study. There are also some advantages and disadvantages of using WinQSB in the paper. The main advantage of WinQSB is the complexity. We can use this software in many others subjects. The graphic page is not at a good level but WinQSB is a helpful tool in the solving many problems. If you want to try this software, you can find it on the Internet and download it for free. Hopefully this sample will be beneficial for teachers and other readers who are engaged in operations research (mathematical optimization, simulation, etc.).

Figure 4 The automatically created Gantt chart in WinQSB



Source: own in WinQSB

## LITERATURE

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