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ADVANCE ESTIMATE EXPENSES FOR PROJECT EXECUTION TIME

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Abstract: The introduction of the PERT algorithm for industrial projects and not only therefore, has led to accurate estimation of the cost implicated for the realization of this projects. This paper presents the application way of the PERT algorithm at one of the strongest economical European company like BMW. The right estimation of the involved values of this calculation brought several significant savings of project realization costs. A general analysis over the obtained result shows the efficiency and the necessity for using of this algorithm for estimate the project execution time.

1. INTRODUCTION

Once with the emergence of computers in 1949 (**E**lectronic **D**elay **S**torage **A**utomatic **C**alculator based on Van **Neumann's** stored-program principle) there were implemented some data/computing algorithms used for the elaboration and the deployment of projects. Therefore the PERT Project (Project Evaluation and Review Technique) has been born in 1957 as the fist of its kind and has been commenced and developed under the American „Polaris Missile" Project. Once with the occurrence of this algorithm, for the first time there has been demonstrated the dependence of the costs of the project from its execution time. This procedure has been used for many years for the perquisite batch costing of a project, though the algorithm has shown also a series of flaws. For example, by combining this algorithm and some presumable risk factors, there can be achieved a more precise system of evaluation for the execution time of a project.

1.1. Hang-Up/Problem analysis

The purpose of PERT is to determine the most precise accomplishing time possible of a project and to shorten it. The evaluation of the time of a project should contain also the following constituents:

- The span of time not directly involved with the running project, but which are interacting with this;
- An accurate split-up into subprojects and a most exact sizing of the work packages;
- The interpretation and the reckoning of the diversity of the obtained result;
- The abilities of the involved staff.

1.2. The object of the paper

The object of the paper is to apply an algorithm of realistic estimation on the execution time of a project, which can be used as a basis/milestone in valuating the costs of a project, as also as an instrument in establishing the reliability of the implementation of the projects.

2. METHODOLOGY

2.1. The beta distribution

To find an algorithm of realistic estimation of the execution time of a project, which should also include a confidence level in achieving the project, has been a permanent pursuit of the specialists in this domain.

One of the methods used for proving and implementing the PERT algorithm is the distribution of the time probability of a process or of a task/working package. For the probability function is used as basis the beta distribution:

$$f(Dt) = k(Dt - a)^{\propto}(b - Dt)^{\gamma} \quad (1)$$

where Dt stands for duration, „a” is the optimal time value (VO – as the most recent dating) in which the project could be realized, and „b” is the least profitable value of accomplishing the project (VP – is the latest date), „m” is the average value (VA). The moderates $\propto$ and γ stand for variation factors.

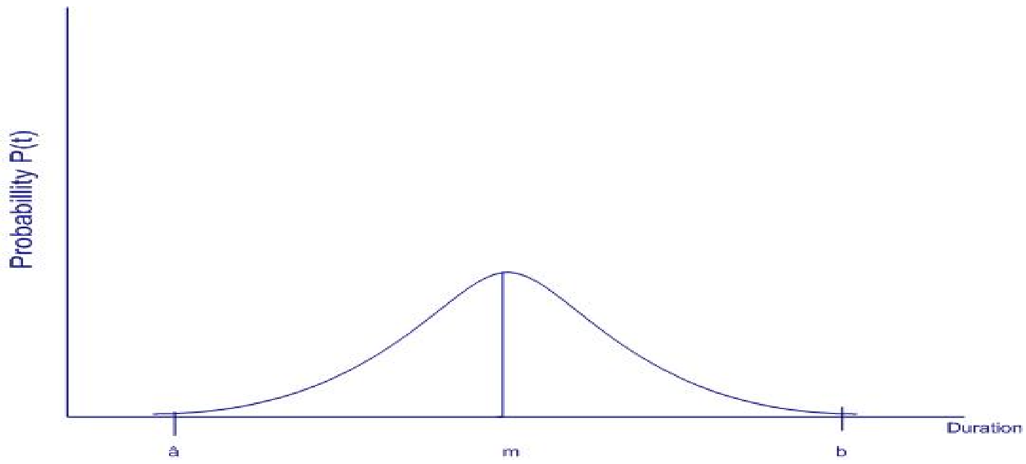

Fig.*1. *Beta Distribution

The average value (VA) could be interpreted as following:

$$VA = \frac{a + 4m + b}{6} \quad (2)$$

The validity of this value can be verified with help of the study of deviation (D). The deviation of the average value can be calculated with help of the following formula:

$$D = \left(\frac{b - a}{6}\right)^2 \quad (3)$$

This deviation is not a criterion for the analysis of the safety of the project; it is only an indicator towards taking notice, in order to supervise and reckon with greater care the accomplished work package. The estimate of all deviations of the packages, display the deviation of the entire project.

The greater the deviation, the estimated value becomes the more remote from reality.

2.2. The level of safety (risk) in finishing the projects

In order to be able to estimate the safety in accomplishing a project one may cipher the standard deviation (DS).

$$DS = \sqrt{D} \quad (4)$$

In a similar way, for the standard deviation there will be used the same interpretation as with the deflection. The higher its value, the safety of the project becomes more insecure. Therefore the standard deviation is a value, which can indicate the confidence level in executing a project in a determined period of time.

Often the projects have already been started before an evaluation of the case, the due-date (DD) having already been established. As some case-studies and practical experiments show, one can cipher the **p**robability of the **e**xecution of the **p**roject (PEP) by the time, which was already established.
Therefore the following steps need to be crossed:

- The PERT value needs to be calculated in order to obtain all the terms of the algorithm and all the risk factors of the project.
- The due-date will be referred to as the most recent date possible in which the project could be accomplished (VA).
- With these two terms there will be used a normal distribution or the distribution of Gauss (DG):

$$DG = [DD - VA] / DS \quad (5)$$

Example:

- The established final due-date: 30.04.2008
- from the PERT calculus, VA follows: 07.05.2008
- from the PERT calculus, DS = 14 days
- DG = (30.04.2008 – 07.05.2008) / 14, follows DG = - 0,5

In the chart of Gauss the value - 0,5 represents 31%. Therefore the project will be executable by a probability of PEP = 31%.

3. PRACTICAL APPLICATION IN REAL INSTANCES

3.1. Analyses of the offer

As an example we will consider the measurements taken by the BMW Company in evaluating the offer of an associated company in executing some projects in the domain of data exchange and data conversion. These data transfers happen between BMW and other partner companies, like: Bosch, Continental, Siemens, Federal Mogul, Magna Steyr etc.

Using the method of the triple constrain, the BMW Company has analysed each project, has splitted each into subprojects and has estimated them in terms of time and costs. The following chart exemplifies an actual project; project No. 14: „The import and the export of FMSTUELI data”. In the first table one can observe the split-up of the project into work packages as well as the evaluation of the VN and the VP times, which were calculated in terms of their specific risk factors, which are likely to emerge during the executing of the project. Then these values have been discussed and accepted together with the bidding company X.

The other complementary projects of FMSTUELI have also been analyzed and reckoned, using the PERT algorithm and the time values established by this algorithm, the result being reflected in the 2nd table, and has been accepted by the X bidding company.

Resource, time and costs evaluation										
Project Name	The import and the export of FMSTUELI data									
Version Date	01.02.2006									
Work Package (WP)	Number Employees	Rep.	Time[h] VO	VN	VP	VA	Total	Deviation	Dificulty Level	Costs (Euro)
Import of FMSTUELI data										
• the definition of the process	1,0		4	4	4	4,0	4,0	0,0	3	656
• the attainment of the concept	1,0		8	12	12	11,3	11,3	0,4	3	1853,2
• the crosschecking and the approval of the concept	1,0		2	2	4	2,3	2,3	0,1	2	213,9
• the reconfiguration of the general carry-out process	1,0		8	10	12	10,0	10,0	0,4	2	930
• the implementation of the programs	1,0		16	20	24	20,0	20,0	1,8	3	3280
• the testing	1,0		8	12	16	12,0	12,0	1,8	2	1116
• the documentation of the software package	1,0		8	9	10	9,0	9,0	0,1	3	1476
• the installation	1,0		8	9	10	9,0	9,0	0,1	2	837
Export of FMSTUELI data										
• the definition of the process	1,0		4	4	4	4,0	4,0	0,0	3	656
• the attainment of the concept	1,0		8	12	12	11,3	11,3	0,4	3	1853,2
• the crosschecking and the approval of the concept	1,0		2	2	4	2,3	2,3	0,1	2	213,9
• the reconfiguration of the general carry-out process	1,0		8	10	12	10,0	10,0	0,4	2	930
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• the documentation of the software package	1,0		8	9	10	9,0	9,0	0,1	3	1476
• the installation	1,0		8	9	10	9,0	9,0	0,1	2	837
TOTAL			124	156	184	155,3	155,3	9,6		20724,2

Tab.1. The evaluation of the project „ The import and the export of FMSTUELI data"

PROJECT NAME	NR. of Hours	Price (Euro)
the import of EFA data for the navigation systems	138,8	19873
the conversion of the CAD data ProE in CATIA V5	104	16076
the Update of ProIntralink 3.3 -> 3.4	124	11532
the development of a toolkit for data conveying from ProE in CATIA and HPGL	196	30867,6
the import of PSN data	87	8091
the import and the export of Synergy data	228	35932
the development of the REGVCA project	114,8	17827,8
the import of TIFF data through CAA API methods	98,2	16104
the development of the AUTOEXPORT project	86	7998
the rollout Update	113,7	8934
the development of the PICANT CATIA V5 project	389	61796
the import and the export of data from CATIA V5 into new formats: PRISMA 5H, V5N	180	16368
the import and the export of GRIVAD data	36	3102
the import and the export of FMSTUELI data	155,3	20724,2
TOTAL	**2052,8 h / 256,6 days**	**275225,6**

Tab.2. The results obtained by BMW by using the PERT algorithm in evaluating the projects

3.2. The rendering of the results

By means of the analysis made by the BMW Company one can observe, that relevant results, in comparison to the evaluation of the project as a whole, can only be obtained by apportion of the projects in sub-packages. At the same time, by comparing the supply of costs and time of an X company and the casts made by the beneficiary BMW on the same factors, one can notice the savings of costs and time (observation: there is one single difference in favour of the bidder concerning the time and cost factors)

Project Name	Nr. of hour Company X	Costs Company X	Nr. of hour BMW	Costs BMW
Import of EFA data for navigation system	144	23616	138,8	19873
Data conversion from CAD System ProE to CATIA V5	104	17056	104	16076
Update Prointralink 3.3 -> 3.4	136	12648	124	11532
Realization of ProE Toolkit for data coversion from ProE to CATIA and HPGL	240	39360	196	30867,6
PSN Data Import	104	9672	87	8091
Import and export of Synergy data	236	38704	236	35932
Implementing the project REGVCA	176	28864	114,8	17827,8
Import of TIFF data with CAA API Methods	104	17056	98,2	16104
Realization of project AUTOEXPORT	80	7440	80	7998
Update rollout	128	11904	113,7	8934
Realization of project PICANT CATIA V5	416	68224	389	61796
Import/export of data from CATIA V5 in new format PRISMA 5H, V5N	176	16368	180	16368
Import/export GRIVAD data	48	4464	36	3102
Import/Export FMSTUELI data	200	32800	155,3	20724,2
TOTAL	2292	328176	2052,8	275225,6

Tab.3. The rendering of the results

The next chart highlights the differences in time between demand and offer:

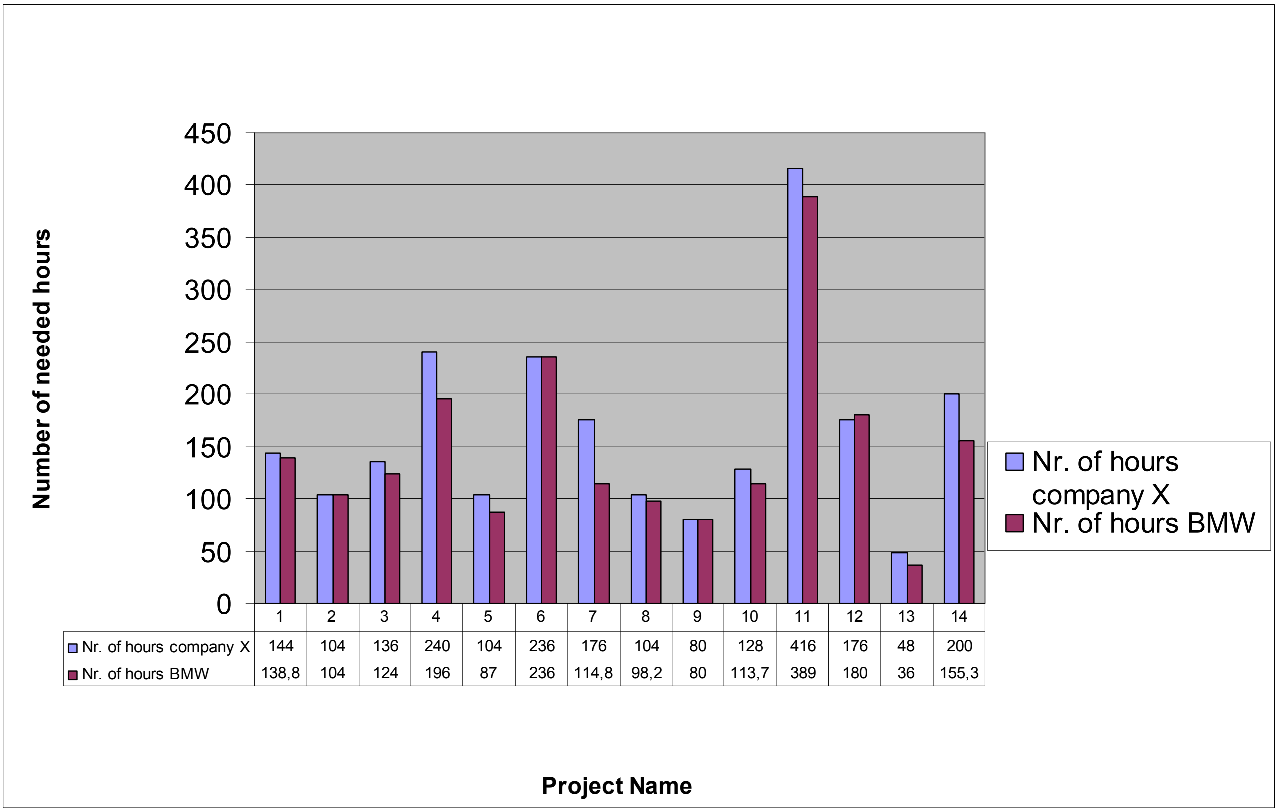
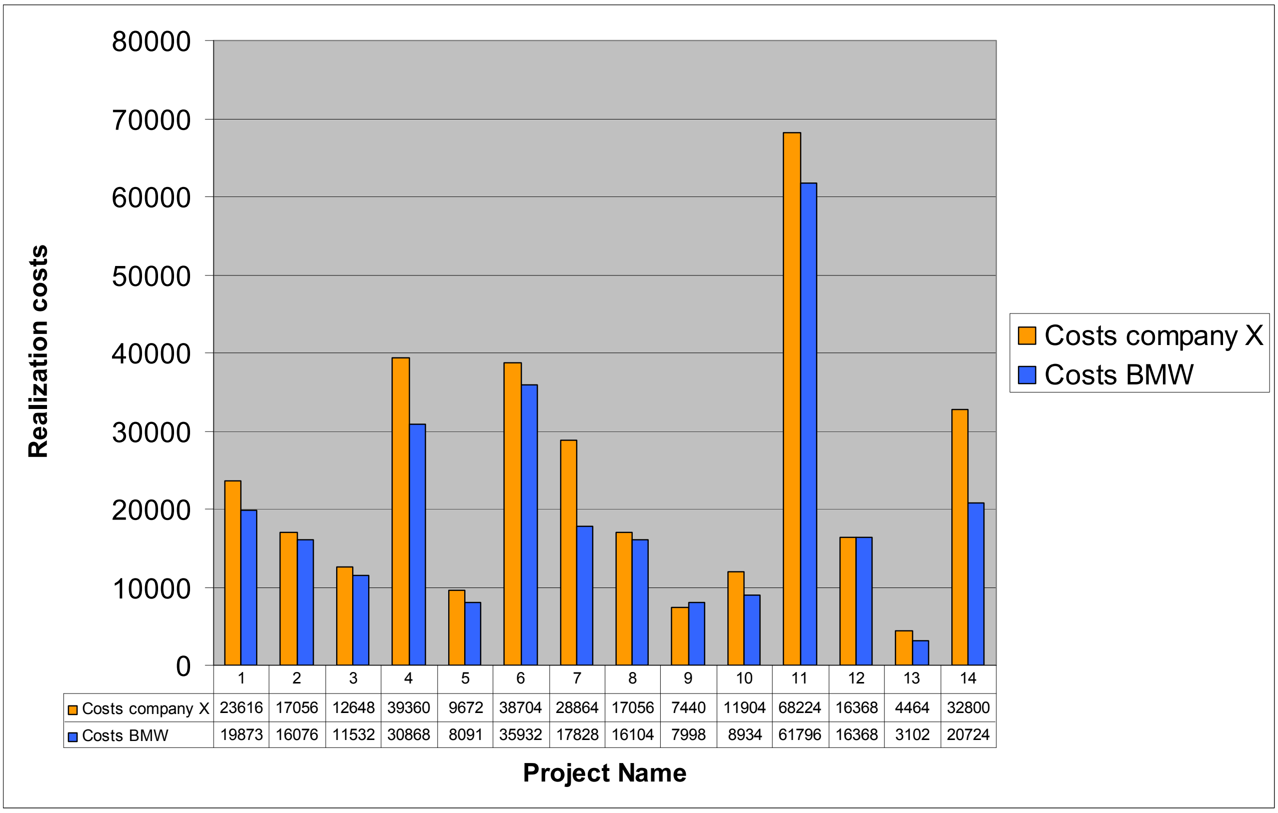


Fig.1. The time differences resulting by means of a PERT ciphering

The following chart highlights the financial savings as a result of this algorithm:



	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Costs company X	23616	17056	12648	39360	9672	38704	28864	17056	7440	11904	68224	16368	4464	32800
Costs BMW	19873	16076	11532	30868	8091	35932	17828	16104	7998	8934	61796	16368	3102	20724

Fig.2. The financial differences resulting by means of the PERT algorithm

There can be noticed that the usage of the PERT algorithm on industrial projects has lead to a more precise valuation of the costs used to achieve them.

The just usage of the algorithm has lead to the reduction of some high costs involved in the project management. Therefore, as shown in the example above, for the year 2006 in the BMW data-exchange-project, the savings went down to: 239,2 hours of labour and 52950,4 Euros, this being an indubitable argument for the endorsement of the budget and the negotiations with the bidding X company.

Often, practical circumstances have shown that this algorithm could be futile because the due-date of the project is being determined and assigned before any analysis take place. In this paper has been proven the necessity of applying this algorithm even in these cases, in order to be able to underline the means of accomplishment of the projects under safe terms, and to render data, concerning the expectation of executing the project at a given due-date by means of existing resources. In spite of the fact, that the casts shown above prove the possibility of costs reduction, the usage of this algorithm may result in a requirement of increasing the resources, which are needed in order to finalize the project at the given due-date.

In spite of the fact that this algorithm does not reassure a supervision of the functionality of the system during the accomplishment of the project, it is a necessary means, in order to get to know in time the risks, which may occur, while carrying through, as well as getting to know the capacities and the resources, which are needed for executing the project.

4. CONCLUSIONS

There can be observed that this algorithm leads to higher time and costs savings compared to the savings made only by the simple division of the project into subprojects and labour packages (observe: Tudor,N., Dumitrascu,D. -" The Benefits of Project structuring in sub-projects and work packages", Scientific session IMT Oradea 2008)

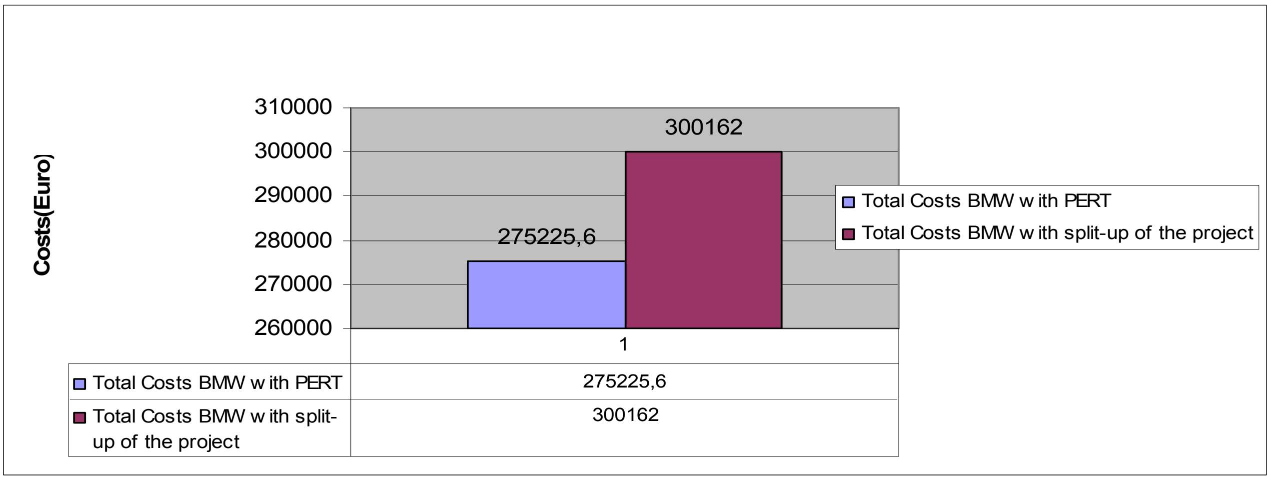


Fig.3. Costing differences ciphered by means of the PERT Method and the split-up of the project

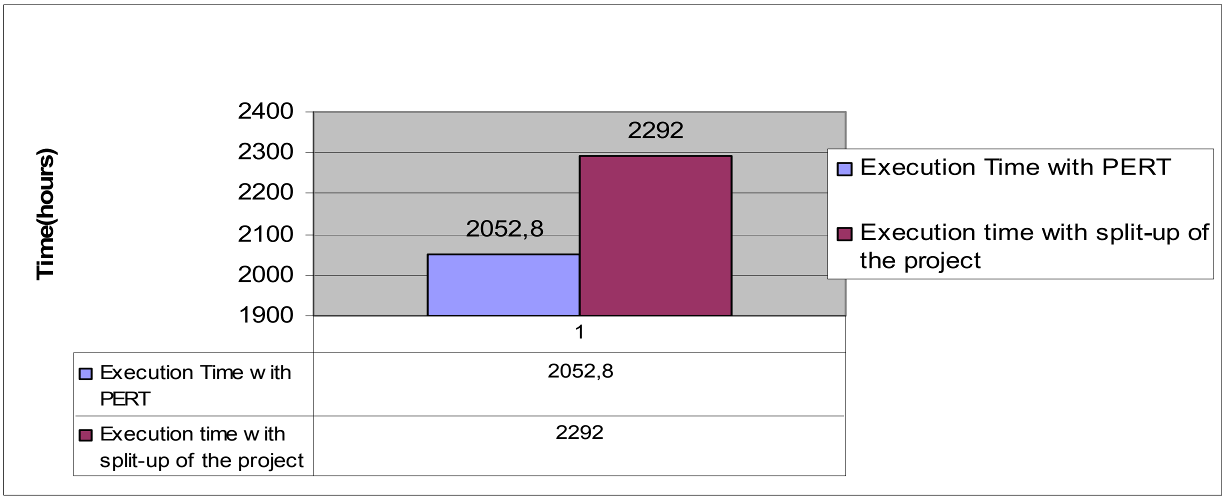


Fig.4. Time differences by means of the PERT Method and the split-up of the project

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