

# **Implementation Of Critical Path Method And Project Evaluation And Review Technique**

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## **Abstract**

Because of the growing effects of the globalization in various business environments, the manufacturing industry is expected to be effective and yet efficient. According to this, in

planning, scheduling and controlling a project, which is a combination of various activities, project management techniques (PERT and CPM) are used. Therefore, the research question is How will the implementation of CPM and PERT influence the effectiveness and efficiency of furniture company "Dallas"? The answer to this question is relevant in order to point out the importance of those methods in reducing the project completion time and costs. The data are taken from the furniture company "Dallas" and it will be combined with literature reviews. The research study is fueled by the following objectives: First is to determine the activities that are involved in the manufacturing process in selected company. Second is to demonstrate the benefits, as well as the drawbacks that those methods might create in the organization. And third is to demonstrate the influence of CPM and PERT in the entire furniture industry and its competitiveness. Implications of this research paper are evaluation of the project completion time and control of the resources, in order to see that the project is completed within the planned time and cost by using mentioned methods. At the end of the study, the result is expected to help all the individuals as well as the companies to understand more the concept of CPM and PERT methods in reducing the project completion time and costs.

**Keywords :** CPM, PERT, Furniture Company, Optimization

## **1.INTRODUCTION**

Planning, Scheduling (or organising) and Control are considered to be basic Managerial functions, and CPM/PERT has been rightfully accorded due importance in the literature on Operations Research and Quantitative Analysis. Far more than the technical benefits, it was found that PERT/CPM provided a focus around which managers could brain-storm and put their ideas together. Most important, it became a useful tool for evaluating the performance of individuals and teams. The research study is fueled by the following objectives: First is to determine the activities that are involved in the manufacturing process in selected company. Second is to demonstrate the benefits, as well as the drawbacks that those methods might create in the organization. And third is to demonstrate the influence of CPM and PERT in the entire furniture industry and its competitiveness. This paper comprises the possibility to generate importance of CPM and PERT methods in reducing the project completion time and costs in furniture industry. The study can gain advantages that are helpful in the continuous progress of the investigation. One of those advantages is to cover the literature gaps concerning the past studies related to the same subject. In addition, through the collection of information, the study can emphasize the idea about the methods applied in production process in furniture industry.

### **1.1.Previous Literature Review In This Field**

Since the development of CPM and PERT during the 1950s, the techniques have been the subject of hundreds of research papers, but little work has been done in the area of the time-cost problem in furniture industry. Research has generally been focused on PERT, since

the deterministic CPM presents few problems of interest. Feng, Liu, & Burns, (2000) presented a hybrid approach that combines simulation techniques with a genetic algorithm to solve the time-cost trade-off problem under uncertainty. Lu and Li (2003) suggest that redundant relationships be removed before the backward pass, but they do not provide a procedure as to how to remove them. In response to some shortcomings of the CPM model, Kuchta (2002) proposed a fuzzy method to measure the criticality of project activities and the whole project. In another study, Jassbi (2008) proposed a fuzzy inference system to determine activities' criticality in deterministic networks. Mota (2009) presented a model for supporting project managers to focus on the main tasks of a project. They used a multiple criteria decision aid (MCDA) approach and considered several points of view in their study.

## **2.MATHEMATICAL PROGRAMMING**

Mathematical Programming (MP) is the use of mathematical models, particularly optimizing models, to assist in taking decisions. The term 'Programming' antedates computers and means 'preparing a schedule of activities'. Mathematical Programming is more restrictive in what it can represent than other techniques and it is very suitable for problems involving blending, continuous flow processing, production and distribution, and strategic planning.

### **2.1.Critical Path Method**

CPM is for projects that are made up of a number of individual "activities." If some of the activities require other activities to finish before they can start, then the project becomes a complex web of activities. Risk analysis modules can be used as an enhancement of CPM. In such case, the assumption is that deterministic analysis can provide a solid basic schedule and budget unless risk events interfere. Either way, potential risk events, their likelihoods, and their anticipated effects are listed in a risk register.

Float (slack) - amount of time that a task can be delayed without causing a delay to:  
subsequent tasks (free float)  
project completion date (total float)

Critical path is the sequence of activities which add up to the longest overall duration. It is the shortest time possible to complete the project. Any delay of an activity on the critical path directly impacts the planned project completion date (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.

Critical activity – activity with zero float .

## **2.2. Project Evaluation and Review Technique**

Program (Project) Evaluation and Review Technique (PERT) is a project management tool used to schedule, organize, and coordinate tasks within a project. It is basically a method to analyze the tasks involved in completing a given project, especially the time needed to complete each task, and to identify the minimum time needed to complete the total project. PERT assumes a beta probability distribution for the time estimates. For a beta distribution, the expected time for each activity can be approximated using the following weighted average:

$$\text{Expected time} = (\text{Optimistic} + 4 \times \text{Most likely} + \text{Pessimistic}) / 6$$

This expected time may be displayed on the network diagram. To calculate the variance for each activity completion time, if three standard deviation times were selected for the optimistic and pessimistic times, then there are six standard deviations between them, so the variance is given by:  $[(\text{Pessimistic} - \text{Optimistic}) / 6]^2$

The variance in the project completion time can be calculated by summing the variances in the completion times of the activities in the critical path. Given this variance, one can calculate the probability that the project will be completed by the certain date assuming a normal probability distribution for the critical path.

## **3. FURNITURE INDUSTRY**

The furniture industry is essentially an assembling industry, which employs various raw materials to manufacture its products. They range from wood and wood based panels to metals, plastics, textile, leather and glass. The European furniture sector comprises around 150,000 companies, generates a turnover of almost €126 billion and an added value of €38 billion and employs around 1.4 million people (EU27, 2006). From 2005 production volumes increased slightly but in 2008 this positive trend was reversed and production dropped again. Major factors of competitiveness for the sector consist of research and innovation, skills and quality, design and added value, knowledge and know-how, together with better access to third country markets.

### **3.1. Current trends in Bosnia**

A major trend is taking a page from the past and giving it a fresh new look. Old furnishings are looking new again, adding features and new tricks of the trade to give them an updated look that is perfect for today's homes. After years of dulled hues and beige, walls are coming alive with colors. Some are even adopting an extremely bright palette to rid their home of the bland colors associated with bland economic times. Others are adding just a splash of color to make a room really pop. Another current trend is adding décor that is influenced by the music scene. Furniture is all about comfort, too. Look for large, overstuffed pieces and ergonomic designs that welcome you to relax and recharge. Modular furniture is

still popular, since it allows those on a budget to mix and match furnishings. This style is especially popular in urban communities, which tend to also gravitate toward modern and contemporary furniture, which by the way never seems to go out of style.

### **3.2.Manufacturing Process**

Before start of manufacturing of any furniture product a desired design is selected. Selection of elegant design is important to ensure attractive finished product. The seasoned wood blocks are cut into desired shape and slices according to the requirement of design. The slices of wood are molded into the desired shape according to the design. Carving means different elegant pattern carved in the wood. Quality of carving depends on the skills of the labor. Once the different pieces are carved & molded than these parts/pieces are assembled or fixed together to give the shape to the final product. Assembled product is grind to make the surface smooth. Once the surface is smooth, finishing material is applied to make the surface ready for paint or polish. After the base is prepared final finishing is applied depending on requirement in term of paint/polish. Upholstery of fabric is carried out according requirement of design.

## **4.IMPLEMENTATION OF CPM AND PERT (Example)**

This paper describes the implementation of the traditional PERT/CPM algorithm for finding the critical path in a project network. An example of manufacturing furniture with various activities will be used. The completion time of each activity is not known with certainty; only estimates are available. It is expected that final, quantitative results will point out the importance of implementing those methods in planning, scheduling and controlling a project in terms of providing effectiveness and efficiency of furniture company.

### **4.1.About the Dallas Company**

Dallas is a family company with twenty years tradition in producing upholstery and with more than 1000 employees. The company works in two countries, Serbia and Federation of Bosnia and Herzegovina. In its rapid progression, the Company has developed its own retail network with department-store chain in all bigger towns of Serbia, Bosnia and Hercegovina, and Montenegro. Dallas strategy is to expand in European and overseas markets on long terms, to win them with its quality, design and popular prices. The company management is turned towards future, because Dallas is the name that inspires confidence and security, whose business background is based on customers' satisfaction. For more, visit <http://www.dalas.rs/> .

#### **4.2. Collecting and processing data**

The applied method in the study is the processing of primary data as a result of direct interview with an expert team in furniture company. In primary data collection, qualitative and quantitative methods can be used, as primarily quantitative study may use qualitative results to help interpret or explain the quantitative findings. The key point here is that the collected data are unique to this research and, until it is published, no one else has access to it. It is important to know in advance what questions to ask/areas to cover – they are ‘imposed’. When all needed data are provided, then the steps of CPM and PERT can be followed.

#### **4.3. Research Question**

The following is the basic question of research paper: How will the implementation of CPM and PERT influence the effectiveness and efficiency of furniture company "Dallas"?

If there is a single critical path, there is still only a 50% probability of the project being completed by the target date, since mean activity times are used to calculate the completion time of the project. If there are numerous possible critical paths the probability may be much less than 50%. This may be costly if there are penalties for late completion of the project. The complete distribution of project completion time needs to be considered when crashing. Since there may be numerous possible critical paths, crashing a given activity by one time period will not necessarily reduce the completion time of the project by one time period. The expected reduction in project completion time must be considered in addition to the time/cost slope when selecting an activity to be crashed.

#### **4.4. Defining Problem**

To answer to research question, six products from different product lines have been selected. In order to define ‘critical path’, project duration and cumulative project costs for all of these products, time and cost of all activities in production process need to be presented in table. The obtained findings are expected to show that these techniques considerably reduce the project completion time. All findings will be compared with previous data of the company (project duration and cumulative project costs of selected products). This paper will help to all managers in furniture industry to implement CPM and PERT to their projects, and by doing that, they will improve effectiveness and efficiency of their organizations. Furthermore, it may challenge other researchers to fulfill gaps in literature reviews related to this topic.

#### **4.5. Study Restriction**

PERT is a probabilistic tool used with three and its basically a tool for planning while CPM is a deterministic tool and also allows an explicit estimate of and control of time. PERT is more suitable for R&D related while CPM is best suited for routine and those projects where the project is performed for projects where time and cost estimates can be

first time and the estimate of duration be accurately calculated. The probability factor is major in PERT while in CPM the deterministic factor is more so values outcomes may not be exact.

## **5.RESULT**

CPM and PERT considerably reduce the project completion time in furniture company Dallas. At the end of the study, the result is expected to help all the individuals as well as the companies to understand more the concept of CPM and PERT methods in reducing the project completion time and costs. Apparently, as it is expected the final, quantitative results point out the importance of implementing those methods in planning, scheduling and controlling a project in terms of providing effectiveness and efficiency of furniture company. The same routine have been done on six selected products and obtained findings showed that these techniques considerably reduce the project completion time. All findings are compared with previous data of the company (project duration and cumulative project costs of selected products). Because it confirms the hypothesis, this paper will help to all managers in furniture industry to implement CPM and PERT to their projects, and by doing that, they will improve effectiveness and efficiency of their organizations.

## **6.CONCLUSION**

One of the most challenging jobs that any manager in furniture companies can take on is the management of a large-scale project that requires coordinating numerous activities throughout the process of making the final product. A myriad of details must be considered in planning how to coordinate all these activities, in developing a realistic schedule, and then in monitoring the progress of the project. Fortunately, two closely related operations research techniques, PERT (program evaluation and review technique) and CPM (critical path method), are available to assist the project manager in carrying out these responsibilities. These techniques make heavy use of networks to help plan and display the coordination of all the activities. They also normally use a software package to deal with all the data needed to develop schedule information and then to monitor the progress of the project. Project management software, such as MS Project in your OR Courseware, now is widely available for these purposes.

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