Pert and cpm solved examples pdf

Basically, CPM (Critical Path Method) and PERT (Program Retination Review Technique) are project management techniques, created by the need for Western industrial and military installations to design, plan and control complex projects. 1.1 A brief history of CPM/PERT CPM/PERT or network analysis, as the technique is sometimes called, was developed along two parallel streams, one industrial and the other military. The CPM was the discovery of M.R.Walker of E.I.Du Pont de Nemours & Co. and J.E.Kelly of Remington Rand, circa 1957. The calculation was designed for the UNIVAC-I computer. The first test was in 1958, when the CPM was applied to the construction of a new chemical plant. In March 1959, the method was applied to a maintenance outage at the du Pont projects in Louisville, Kentucky. Non-productive time decreased from 125 to 93 hours. The PERT was designed in 1958 for the POLARIS missile program by the Program Evaluation Branch of the U.S. Navy's Office of Special Projects, with the help of lockheed missile systems department and booz-allen & hamilton consulting firm. The calculations were so neat that they could be carried out on IBM's Naval Decree Research Computer (NORC) in Dahlgren, Virginia. 1.2 Planning, Planning & Control Planning, Planning (or Organization) and Control are considered key Management Functions, and CPM/PERT has rightly taken due consideration in the literature on Operational 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. It turned out to be a great means of communication by which thinkers and designers at one level could share their ideas, doubts and fears on another level. Most importantly, it became a useful tool for evaluating the performance of individuals and groups. There are many CPM/PERT variants that were useful for programming costs, programming manpower and machine time. CPM/PERT can answer the following important questions: How long will it take for the entire project to complete? What are the risks involved? What are the critical project activities or tasks that could delay the entire project if they were not completed on time? Is the project on schedule, behind schedule or earlier than schedule? If the project needs to be completed earlier than planned, what is the best way to do this at the lowest cost? 1.3 The framework for PERT and CPM Essentially, there are six steps in common to both techniques. The procedure is listed below: Define the project and all important activities or of his. The Project (consisting of multiple tasks) should have only one startup activity and one finish activity. Development of relationships between activities. Decide which activities should take precedence and which should follow others. Design the Network that connects all activities. Each Activity should have a unique event event Fake arrows are used where necessary to avoid providing the same numbering in two activities. Assign time and/or cost estimates to each activity Calculate the longest time path over the network. This is called a critical path. Use the Network to plan, schedule, track, and control the project. The basic concept used by CPM/PERT is that a small set of activities, which make up the longest path through the activity network control of the entire project. If these critical activities could be identified and assigned to responsible persons, management resources could be best used by focusing on the few activities that determine the fate of the entire project. Non-critical activities can be reprogrammed, reprogrammed, and resources for them can be redistributed flexibly without affecting the entire project. Five useful questions to ask when preparing a network of activities are: Is this a start-up activity? Is this an expiration activity? What activity precedes this activity? What activity does this follow? What activity is concurrent with this? Some activities are serially linked. The second activity can only start after the first activity is completed. In some cases, activities are simultaneous because they are independent of each other and can start at the same time. This applies in particular to organisations with supervisory resources, so that work can be commissioned to various departments responsible for their activities and completion in accordance with the programme. When tasks are assigned in this way, the need for continuous feedback and coordination becomes an important senior management area before employment. 1.4 Design of the CPM/PERT network Each activity (or subproject) on a PERT/CPM network is represented by an arrow symbol. Each activity is preceded and achieved by an event, represented as a circle and numbered. In Event 3, we need to evaluate two pre-food activities – Activity 1-3 and Activity 2-3, which are both previous activities. Activity 1-3 gives us a first start of 3 weeks in Event 3. However, Activity 2-3 must also be completed before the start of Event 3. Along this path, the first boot will be 4+0=4. The rule is to last the longest (longest) of the two earlier starts. So the earliest start in event 3 is 4. Similarly, in Event 4, we find that we need to evaluate two prerequisite activities – activity 2-4 and activity 3-4. Along the activity the first start in event 4 will be 10 wks, but along activity 3-4, the earliest start in event 4 would be 11 wks. Since 11 wks is greater than 10 wks, we choose it as the earliest start in event 4.We have now found the longest route through the network. It will take 11 weeks along activities 1-2, 2-3 and 3-4. This is the critical route. 1.5.3 The Backward Pass – Latest Finish Time Rule To make the Backward Pass, we start from the sink or the final event and work backwards in the first event. In Event 3 there is only one activity, Activity 3-4 in the back pass, and we find that the value is 11-7 = 4 4 However, in Event 2 we have to evaluate 2 activities, 2-3 and 2-4. We find that the backwards pass through 2-4 gives us a value of 11-6 = 5, while 2-3 gives us 4-0 = 4. We get the lowest value of 4 on the way back. 1.5.4 Tabulation & Activity Analysis We are now ready to calculate the various events and calculate the first and last start and end times. We are also now ready to calculate slack or TOTAL FLOAT, which is defined as the difference between the last start and the first boot. Duration of event(Weeks) Earlier Start Earlier End Last Start Last Start Last End Total Float 1-2 4 0 4 0 4 0 2-3 0 4 4 4 4 0 3-4 7 4 11 4 11 0 1 -3 3 0 3 1 4 1 2-4 6 4 10 5 11 1 The earliest principle is the value in the rectangle near the tail of each activity The earliest finish is = Earliest Start + Duration The last finish is the value in the diamond in the head each activity The last start is = Last Finish – Duration There are two important types of float or slack. These are the Total Float and Free Float. TOTAL FLOAT is the free time available when all previous activities take place as soon as possible and all subsequent activities take place in the last possible hours. Total Float = Last Start – Earlier Start Activities with Zero Total Float is on the critical route FREE FLOAT is free time when all previous activities take place as soon as possible and all subsequent activities occur as soon as possible. When an activity has zero total swing, the free swing will also be zero. There are several other types of float (Independent, Early Free, Early Intervention, Late Free, Late Interfering), and float can also be negative. We will not be going into these situations at the moment for simplicity and we will only be dealing with Total Float for the time being. Having calculated the various parameters of each activity, we are now ready to move on to the programming phase by using a bar chart type known as the Gantt chart. There are several other types of float (Independent, Early Free, Early Intervention, Late Free, Late Interfering), and float can also be negative. We will not be going into these situations at the moment for simplicity and we will only be dealing with Total Float for the time being. Having calculated the various parameters of each activity, we are now ready to move on to the programming phase by using a bar chart type known as the Gantt chart. 1.5.5 Schedule activities using a Gantt chart Once activities are placed along a Gantt chart (See chart below), the concepts of Past Start & End, Last Start & End and Float will very obvious. Activities 1-3 and 2-4 have a total float of 1 week each, represented by the compact schedule beginning at the last beginning and ending at the latest at the end. The difference is the chariot, which gives us the flexibility to plan the activity. For example, we may send staff on leave during this week or give them some other work to do. Or or can choose to start the activity a little later than planned, knowing that we have a week's chariot in hand. We could even break activity in half (if allowed) for a week and divert staff for some other work, or declare a national or holiday festival as required under the National and Festival Holidays Act. These are some of the examples of using the float to schedule an activity. Once all the activities that can be planned are planned for project convenience, which usually reflects resource optimization measures, we can say that the project is planned. 2. Articles of Article 2 Exercise A social project manager is faced with a project with the following activities: Activity-ID Description Duration 1-2 Social Working Group to live in the Village 5 Weeks 1-3 Social Research Group to do research 12 Weeks 3-4 Analysis survey results 5 Weeks 2-4 Establishment Mother & Child Health Program 14 Weeks 3-5 Establish Rural Credit Program 15 Weeks 4-5 Perform Immunization of Under Fives 4 Weeks Draw the Arrow Chart , using the useful numbering of activities, which indicates the following logic: If the Social Work Group does not live in the village, the Mother and Child Health Programme cannot be started due to the ignorance and superstition of the villagers The analysis of the research can obviously be done only after the completion of the survey. Until the agricultural research is completed, the Rural Credit Programme cannot start until the Mother and Child Programme is established, the Immunisation of the Under-Five cannot begin – Calculation of the First and Last Years of Event – Table and Analysis of Activities – Project Planning Using a Gantt 3 Chart. The PERT (probable) approach so far we have talked about projects where there is a lot of certainty about the results of the activities. In other words, cause-and-effect logic is well known. This is particularly true in engineering projects. However, in R&D projects, or in Social Projects defined as Process Projects, where learning is an important result, the cause-and-effect relationship is not so well established. In such cases, the PERT approach is useful because it can cover the variation in the completion times of events, based on the estimates of an expert or a committee of experts. For each activity, three time estimates are taken The more optimistic the more likely the more pessimistic The duration of an activity is calculated using the following formula: Where te is the expected time, is the optimistic time, tm is the most likely activity time and tp is the pessimistic time. It's not to go into the theory behind the guy. Suffice it to know that weights are based on a Beta distribution approach. The standard deviation, which is a good measure of the variability of each activity is calculated from the rather simplified formula: Variance is the square of the standard deviation. 4. PERT calculations for the Social Work in our Social the project manager is no longer so sure that each activity is completed on the basis of the single assessment he has given. There are many assumptions involved in each assessment, and these assumptions are reflected in the three times estimate you would prefer to give to each activity. In Activity 1-3, the time estimates are 3.12 and 21. Using the PERT formula, we get: The standard deviation (s.d.) for this activity is also calculated using the PERT formula We calculate pert event times and other details as below for each activity: 5. Risk assessment Having calculated sd. and variance, we are ready to do some risk analysis. Before that we should be aware of two of the most important assumptions that PERT has made. The Beta distribution is appropriate for calculating the duration of activity. Activities are independent and the time it takes to complete an activity has nothing to do with the completion times of its dependent activities on the network. The validity of this case is questionable considering that in practice, many activities have dependencies. 5.1. The expected duration of a PERT project assumes that the expected duration of a project (or a sequence of independent activities) is simply the sum of their separate expected limits. Thus, the summation of all te along the critical path gives us the duration of the project. Similarly, the variance of a sum of independent activity times is equal to the sum of their individual variances. In our example, the sum of the variance of activity times along the critical path, VT was found to be equal to (9+16) = 25. The square VT root gives us the standard deviation of the length of the project. So, ST=Ö 25=5. The higher the standard deviation, the greater the uncertainty that the project will be completed on the finish date. Although te is randomly distributed, the average or expected Te project length follows about a normal distribution. Since we have a lot of information about a normal distribution, we can make many statistically important conclusions from these calculations. A random variable derived from a normal distribution has a 0.68 probability of falling within a standard deviation of the average distribution. Therefore, there is a 68% chance that the actual duration of the project will be within a standard deviation, ST of the estimated average duration of the project, te. In our case, te = (12+16) = 28 weeks and ST = 5 weeks. Assuming it is distributed normally, we can state that there is a 0.68 probability that the project will be completed within 28 ± 5 weeks, i.e. between 23 and 33 weeks. Since it is known that just over 95% (.954) of the area below a normal distribution falls into two standard we can state that the probability that the project will be completed within 28 ± 10 is very high at 0.95. 5.2. Probability of completion of the project by the end date now, although the project is estimated to be completed within 28 weeks (te=28) of our The director would like to know what the probability is of completing the project within 25 weeks (i.e. finish date or D=25). For this calculation, we use the formula to calculate Z, the number of standard deviations that D is away from te. Looking at the following excerpt from a standard normal table, we see that the probability associated with a Z of -0.6 is 0.274. This means that the probability of completion of the project within 25 weeks instead of the expected 28 weeks is about 2 out of 7. It's not very encouraging. On the other hand, the probability of completion of the project within 33 weeks is calculated as follows: The probability associated with Z= +1 is 0.84134. This is a strong possibility, and shows that the odds are 16 to 3 that the project will be completed by the finish date. If the probability of an event is p, the chances for its occurrence are a to b, where: Select Bibliography Wiest, Jerome D., and Levy, Ferdinand K., A management guide for PERT/CPM, New Delhi: Prentice-Hall of India Private Limited, 1974 Render, Barry and Stair Jr., Ralph M. - Quantitative Analysis for Management, Massachusetts: Allyn & Bacon Inc., 1982, pp. 525-563 Freund, John E., Modern Elementary Statistics, New Delhi: Prentice-Hall of India Private Limited, 1979 1979