Estimating Activity Durations

After the resource estimates are established for each of the activities, it’s time to assign duration estimates. The activity duration estimating process assigns the number of work periods that are needed to complete schedule activities. Each estimate assumes that the necessary resources are available to be applied to the work package when needed.

There are eight activity duration estimation techniques, of which the main five are listed below. These techniques can be combined to provide more accurate estimates.

- Expert Judgment
- Analogous Estimating
- Parametric Estimating
- Three Point Estimating
- Bottoms up Estimating

**Expert Judgment**
Whenever possible, the project management team should include experts with the best experience in estimating project activity durations while planning time management.

**Analogous Estimating**
This technique draws on the experience of the person estimating and compares the new activities with duration figures from similar activities from past projects. For example, if it took you 12 hours to paint 120 square meters of walls from an earlier project, then it might take you about 10 hours to paint 100 square meters of walls in a new project.

**Parametric Estimating**
This technique calculates duration estimates by multiplying the amount of work by how long it takes to do a part of it. This technique works best for standardized, and often repetitive, activities like laying tiles, or painting walls. For example, it takes an average of 1 minute to lay one tile, then it takes about 120 minutes or 2 hours to lay 120 tiles.

**Three-point estimating**
Three-point estimating is useful when there is a lot of uncertainty, risk, or unknowns around a work package. You get three estimates based on the best case, most likely case, and worst-case scenarios.

- **Best case (optimistic):** The work takes only as long as estimated and no ‘risks’ occur. This is represented as o for “optimistic.”

- **Most likely:** The most likely time considers the realities of project life, like inadequate resources, rework, and things not going as planned. This is represented as an m for “most likely.”

- **Worst case (pessimistic):** Assumes longest possible time with too little resources, needing rework, and delays in work getting finished. This is represented as a p for “pessimistic.”

The simplest way is to sum the three estimates and divide by three. Sometimes referred to as a triangular distribution.
A more accurate way, also known as PERT (Program Evaluation and Review Technique) estimating, assumes the most likely estimate has a greater chance of occurring, so the most likely scenario is weighted four times to both the Optimistic and Pessimistic estimates. The most common way of calculating a weighted average is Cost = (1xO + 4xM + 1xP)/6

\[ c = \frac{c_o + 4c_m + c_p}{6} \]

Three Point and PERT estimating is useful when there is a lot of uncertainty and when there are different opinions to time estimates. It can be used at any point time is estimated.

**Bottoms up Estimating**

Here, you will calculate the activities’ duration with the highest level of precision and add them together to get your project duration.

This is the most accurate, most time-consuming, and the costliest technique. It is also known as a “definitive estimate.”

**Resource Optimization Techniques**

Resource Optimization Techniques are used to change the completion dates of projects and adjust when resources are used. It includes scheduling activities and the resources required by those activities while considering the availability of those resources.

The main benefits of Resource Optimization Techniques include:

1. balancing the workload, making sure that resources are neither over-worked nor under-utilized.
2. seeing when or if there may be a shortage of skills.
3. reducing costs and increase productivity. Research has shown that when people are over-worked their productivity goes down, while costs through over-time payments and more accidents due to increased carelessness goes up.
4. evaluating how well your human resources are used on a daily, weekly or monthly basis.

Resource Optimization Techniques includes Resource Levelling and Resource Smoothing.

**Resource Leveling**

Applies resource constraints to the project which could result in a change in project durations. For example, limiting a work week to forty-five hours is a typical resource constraints. In other words, a resource cannot work for more than 45 hours in one week.

**Resource Smoothing**

Resource smoothing is applied after resource leveling. We may find that if we work 45 hours in some weeks, we will have less than 20 hours of work in other weeks, so we adjust the work done most weeks to only 38 hours so that it’s more regular throughout the project. See the illustration below and more information at [https://www.izenbridge.com](https://www.izenbridge.com)
Critical Path
An important topic to understand with respect to project schedules is the critical path. The critical path is the longest path from start to finish. It is therefore, the shortest time possible to complete the project. It is calculated by adding up the durations of all the activities along each path from start to finish. The longest time of all the paths is the critical path. It is called the critical path because any delay (or additional time) of any activity on the critical path causes a delay in the project. It is critical that all activities on this path be completed on schedule.

Below is a precedence diagram showing the critical path of a project at 7 days. All other paths of that project are less than 7 days.

Float or Slack Time
A float or slack time is the amount of time an activity can be delayed. It is calculated by subtracting Early Start from Late Start (LS-ES), or Early Finish from Late Finish (LF-EF).

For example, in the diagram below, we see that the path F – G is the longest path and therefore the Critical Path. There is no difference between the early start and late start or the early finish and late finish for any of the activities on that path and so if we calculate either LS-ES or LF-EF we get zero, or a float of 0.

However, when we calculate either LS-ES or LF-EF on the path A – C – H we get two, or a float of 2. That means that those three activities combined can be delayed for up to two days, so a total float of two days. Notice that activities B and D have a float of 3. Those two
activities together can be delayed by up to 3 days before doing activity. They have a total float of three days.

See the diagram below and more information at [https://www.geeksforgeeks.org/](https://www.geeksforgeeks.org/)
Calculating Critical Path and Float

Let’s make a precedence diagram of a project together and calculate the critical path and float. Below we have details of activities that have already been sequenced.

A has a duration of 3 days and predecessor.
B has a duration of 9 days and A as predecessor.
C has a duration of 4 days and A as predecessor.
D has a duration of 8 days and B as predecessor.
E has a duration of 2 days and B as predecessor.
F has a duration of 4 days and C, D, E as predecessors.

1. First, we add the durations onto the nodes as seen in the diagram below.
2. Then we fill in the Early Start and Early Finish for all the nodes and we can see that activities $A \rightarrow B \rightarrow D \rightarrow F$ is the longest path and therefore the critical path.

3. Now we do a backward sweep, starting with activity F. By going backwards, we can see the Late Finish, and then by subtracting the duration we can get the Early Finish of each activity.
4. By using the formula LS-ES or LF-EF we can calculate the float in each activity as seen below.

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This activity has 6 days free float

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This activity has 13 days of Free float

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