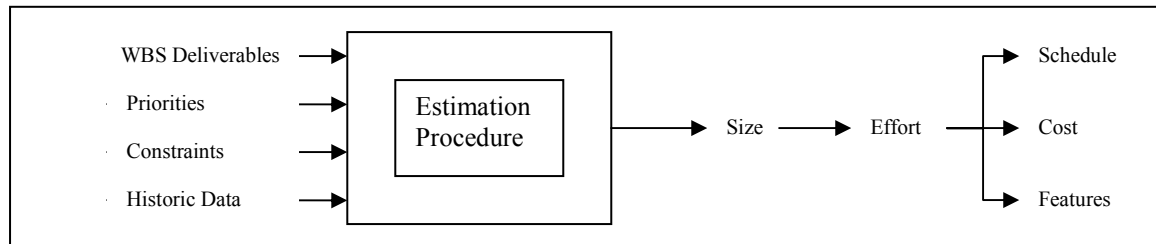


## Effort Estimation – Notes for Cracker Barrel

**Targets vs Estimates** – project Sponsor often has a cost figure formed in their mind for a given project. This should be treated as a *cost target* during the Planning Phase. The *Estimation Process* should validate or not how feasible it is to deliver the planned scope to the target.



**Estimate Negotiations** - It is sometimes possible to deliver the planned scope at the target cost, often it is not. This guide recommends against reverse engineering the estimate to fit the target. If meeting the target is a business imperative then the convergence of target and estimate should be achieved through attenuation of planned scope.

Principle 1:

Don't debate the output of an estimate. Take the output as given. Change the output only by changing the inputs and re-computing the impact on the estimate.

Principle 2:

Focus on estimating size first. Then compute effort, schedule, and cost (including risk response costs) from the size estimate.

Principle 3:

Always include the cost of Risk Response Plan in your estimates.

Principle 4:

Re-estimate. Re-estimation doesn't mean doing the same estimate work again. Re-estimation is performed to improve the accuracy of the estimate as the project progresses.

### **Estimation Wisdom**

1. Industry experience shows that 'counting size, bottom up' is the most reliable way to estimate, 'expert opinion' is the least reliable! Count Function Points, Lines-of-Code,
2. Use relevant, historic data or industry guidelines – e.g. construction sector – or internal experience data.
3. Let those who will build and deliver perform the estimation.
4. Estimates without accompanying confidence limits are statistically meaningless.

**THE INTERPRETATION OF THE CONFIDENCE LIMIT IS CRUCIAL. A PROJECT ESTIMATE WITH A CONFIDENCE LIMIT OF 70% MEANS THAT WE HAVE 70% CONFIDENCE THAT THE ACTUAL OUTCOME WILL BE THE PROJECT ESTIMATE OR LESS. YOU CAN PRODUCE AN ENTIRE RANGE OF PROJECT ESTIMATE VALUES ASSOCIATED WITH A UNIQUE CONFIDENCE LIMIT THAT IS RELEVANT TO THE ESTIMATION MODEL. THIS IS THE MAIN REASON WHY IT IS SUSPICIOUS WHEN AN "ESTIMATE" IS QUOTED WITHOUT A CONFIDENCE LIMIT – IT IS NOT POSSIBLE TO INTERPRET THE IMPLICATION OF THE ESTIMATE WITHOUT ITS CONFIDENCE LIMIT.**

### **Effort Estimation by "Three-Point" Method**

It is the responsibility of the Project Manager to ensure that the WBS deliverables for the entire project are present in the deliverables list. The statistical relevance of this method depends on decomposing the project to at least 10 deliverables. 20 + deliverables is much better.

The project team then proceeds to estimate three values for each deliverable.

1. **Likely estimate,  $e_L$**  – This is the estimate that the project thinks will be the effort spent. In a single-point-estimation approach this value would be 'the estimate'

2. **Optimistic estimate, e<sub>O</sub>** – The best case estimate for the deliverable – this is a smaller number than the Likely estimate.
3. **Pessimistic estimate, e<sub>P</sub>** – The estimator often has a good idea of what/where/how unfavorable situations can occur during the construction and implementation of a deliverable. The estimator visualizes how Murphy’s Law might come into play. The Pessimistic estimate must reflect the level of uncertainty, doubt and fear that surrounds the Likely estimate.

Calculate the **Expected estimate (e<sub>E</sub>)** for each deliverable with the following equation:

$$e_E = (e_P + 4e_L + e_O) / 6$$

And the **Standard deviation,**

$$\sigma_n = (e_P - e_O) / 2$$

The divisor value chosen in the deliverables SD is a very important selection to be made by the Project Manager. The value chosen must remain constant for the project otherwise statistical validity of the calculations is lost.

The meaning of the divisor value is an *assumption* of the % of WBS deliverable actuals that will come in between the e<sub>P</sub> and e<sub>O</sub> values. A divisor value of 2 assumes that 70% of the actuals will fall between e<sub>P</sub> and e<sub>O</sub>. A value of 6 (six sigma) assumes that 99.75% of the actuals will fall between e<sub>P</sub> and e<sub>O</sub>, which is quite **unrealistic**.

Here is the table of divisor values and “%actuals” assumption that can be chosen.

Percentage of Actual outcomes will fall within the estimation range	Divisor value in the Standard Deviation calculation for individual estimates
10%	0.25
20%	0.51
30%	0.77
40%	1.0
50%	1.4
60%	1.7
70%	2.1
80%	2.6
90%	3.3
99.7%	6.0

The selection of the divisor value depends on the risks associated with factors of a given project such as:

- Maturity and skill level of the estimating individual or team
- Level of knowledge and expertise of team of the scope of project
- Presence of new technology in the scope
- Complexity and size of the client and project organization

Methods of estimation for e<sub>O</sub>, e<sub>L</sub> and e<sub>P</sub>. “Expert opinion” estimation is the least reliable because of the tendency for optimism. Numerical methods such as Function Point Analysis, COCOMO etc utilizing estimation data from past projects yield more consistent estimates.

Calculate the project **Expected estimate:**

$$E_{WBS} = \sum e_E$$

And project **Standard Deviation:**

$$\sigma_{WBS} = \sqrt{(\sum \sigma_n^2)}$$

From the above

$$\text{WBS Estimate, } P_E = E_{WBS} + x\sigma_{WBS}$$

where x represents the **confidence limit** or the confidence factor of the project estimate.

The value of x is derived from the table below.

<b>% confidence limit</b>	<b>P<sub>E</sub> Calculation</b>
2%	$E_{WBS} - (2 \times \sigma_{WBS})$
10%	$E_{WBS} - (1.28 \times \sigma_{WBS})$
16%	$E_{WBS} - (1 \times \sigma_{WBS})$
20%	$E_{WBS} - (0.84 \times \sigma_{WBS})$
25%	$E_{WBS} - (0.67 \times \sigma_{WBS})$
30%	$E_{WBS} - (0.52 \times \sigma_{WBS})$
40%	$E_{WBS} - (0.25 \times \sigma_{WBS})$
50%	$E_{WBS}$
60%	$E_{WBS} + (0.25 \times \sigma_{WBS})$
70%	$E_{WBS} + (0.52 \times \sigma_{WBS})$
75%	$E_{WBS} + (0.67 \times \sigma_{WBS})$
80%	$E_{WBS} + (0.84 \times \sigma_{WBS})$
<b>84%</b>	<b><math>E_{WBS} + (1 \times \sigma_{WBS})</math></b>
90%	$E_{WBS} + (1.28 \times \sigma_{WBS})$
98%	$E_{WBS} + (2 \times \sigma_{WBS})$

Note that what has been calculated are **effort estimates in days or weeks**. Additional work is carried out to translate these to monetary values, depending on the cost of different resource types, materials and costs induced by scheduling and resource constraints – e.g. specific resource constraint causing inefficiencies in the project schedule which inevitably result in higher cost.

Once the Project Cost Estimate is produced, a Confidence Limit Adjustment can be added to it, to reflect the uncertainty associated by the confidence limit of the cost estimates – which should remain constant throughout the estimation process instance. The Confidence Limit Adjustment can be the Project Reserve and managed as such through the project lifecycle.

$$\text{Project Budget} = \text{Project Cost Estimate} + \text{Confidence Limit Adjustment}$$

***A Final Note-***

Three-Point estimation is just one of many methods of estimation. It is widely used and mid-used since the statistical underpinnings are not clearly explained in textbooks.