



## TSP Symposium 2014

An extension of the PSP PROBE process to help student for more reliable estimates in early stage of the PSP training

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# Next Process Institute Ltd.

NPI is a SEI TSP Strategic Partner since Feb. 2010 and provides:

- PSP Instructor training
  - TSP coach training
  - PSP Developer Exam
  - Training for engineers
- All SEI PSP/TSP authorized courses
- Coaching for software teams
  - Mentoring for TSP coach candidates

As a CMMI Partner, we provide:

- “Introduction to CMMI for Development” course

# Contents

1. Problems I notices...
2. An extending the the PROBE method for faster reaching proper estimates
3. Introducing the two concpets “Work Volume” and “Quality Performance Index (QPI)”
4. PSP data exercises
5. For Future Measurement Framework
5. Conclusions

# PROBE Script – current

Step	Activities	Description
1	Conceptual Design	Review the requirements and produce a conceptual design.
2	Parts Additions	Follow the Size Estimating Template instructions to estimate the parts additions and the new reusable parts sizes.
3	Base Parts and Reused Parts	<ul style="list-style-type: none"> <li>For the base program, estimate the size of the base, deleted, modified, and added code.</li> <li>Measure and/or estimate the size of the parts to be reused.</li> </ul>
4	Size Estimating Procedure	<ul style="list-style-type: none"> <li>If you have sufficient estimated proxy size and actual added and modified size data (three or more points that correlate), use procedure 4A.</li> <li>If you do not have sufficient estimated data but have sufficient plan added and modified and actual added and modified size data (three or more points that correlate), use procedure 4B.</li> <li>If you have insufficient data or they do not correlate, use procedure 4C.</li> <li>If you have no historical data, use procedure 4D.</li> </ul>
4A	Size Estimating Procedure 4A	<ul style="list-style-type: none"> <li>Using the linear-regression method, calculate the <math>\beta_0</math> and <math>\beta_1</math> parameters from the estimated proxy size and actual added and modified size data.</li> <li>If the absolute value of <math>\beta_0</math> is not near 0 (less than about 25% of the expected size of the new program), or <math>\beta_1</math> is not near 1.0 (between about 0.5 and 2.0), use procedure 4B.</li> </ul>
4B	Size Estimating Procedure 4B	<ul style="list-style-type: none"> <li>Using the linear-regression method, calculate the <math>\beta_0</math> and <math>\beta_1</math> parameters from the plan added and modified size and actual added and modified size data.</li> <li>If the absolute value of <math>\beta_0</math> is not near 0 (less than about 25% of the expected size of the new program), or <math>\beta_1</math> is not near 1.0 (between about 0.5 and 2.0), use procedure 4C.</li> </ul>
4C	Size Estimating Procedure 4C	If you have any data on plan added and modified size and actual added and modified size, set $\beta_0 = 0$ and $\beta_1 = (\text{actual total added and modified size to date/plan total added and modified size to date})$ .
4D	Size Estimating Procedure 4D	If you have no historical data, use your judgment to estimate added and modified size.

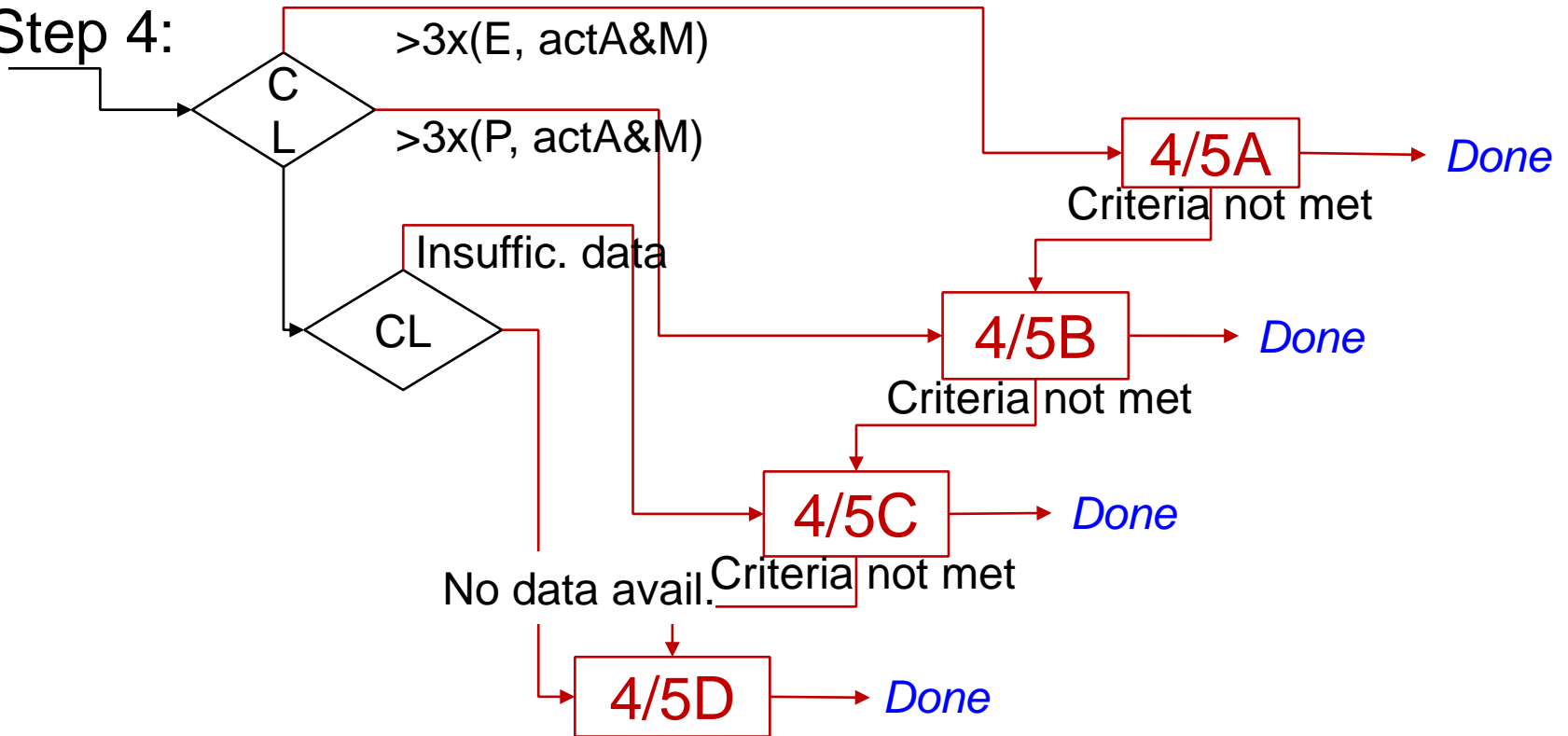
(continued)

Step	Activities	Description
5	Time Estimating Procedure	<ul style="list-style-type: none"> <li>If you have sufficient estimated proxy size and actual development time data (three or more points that correlate), use procedure 5A.</li> <li>If you do not have sufficient estimated size data but have sufficient plan added and modified size and actual development time data (three or more points that correlate), use procedure 5B.</li> <li>If you have insufficient data or they do not correlate, use procedure 5C.</li> <li>If you have no historical data, use procedure 5D.</li> </ul>
5A	Time Estimating Procedure 5A	<ul style="list-style-type: none"> <li>Using the linear-regression method, calculate the <math>\beta_0</math> and <math>\beta_1</math> parameters from the estimated proxy size and actual total development time data.</li> <li>If <math>\beta_0</math> is not near 0 (substantially smaller than the expected development time for the new program), or <math>\beta_1</math> is not within 50% of 1/(historical productivity), use procedure 5B.</li> </ul>
5B	Time Estimating Procedure 5B	<ul style="list-style-type: none"> <li>Using the linear-regression method, calculate the <math>\beta_0</math> and <math>\beta_1</math> regression parameters from the plan added and modified size and actual total development time data.</li> <li>If <math>\beta_0</math> is not near 0 (substantially smaller than the expected development time for the new program), or <math>\beta_1</math> is not within 50% of 1/(historical productivity), use procedure 5C.</li> </ul>
5C	Time Estimating Procedure 5C	<ul style="list-style-type: none"> <li>If you have data on estimated – added and modified size and actual development time, set <math>\beta_0 = 0</math> and <math>\beta_1 = (\text{actual total development time to date/estimated – total added and modified size to date})</math>.</li> <li>If you have data on plan – added and modified size and actual development time, set <math>\beta_0 = 0</math> and <math>\beta_1 = (\text{actual total development time to date/plan total added and modified size to date})</math>.</li> <li>If you only have actual time and size data, set <math>\beta_0 = 0</math> and <math>\beta_1 = (\text{actual total development time to date/actual total added and modified size to date})</math>.</li> </ul>
5D	Time Estimating Procedure 5D	If you have no historical data, use your judgment to estimate the development time from the estimated added and modified size.
6	Time and Size Prediction Intervals	<ul style="list-style-type: none"> <li>If you used regression method A or B, calculate the 70% prediction intervals for the time and size estimates.</li> <li>If you did not use the regression method or do not know how to calculate the prediction interval, calculate the minimum and maximum development time estimate limits from your historical maximum and minimum productivity for the programs written to date.</li> </ul>

# PROBE Script – current flow

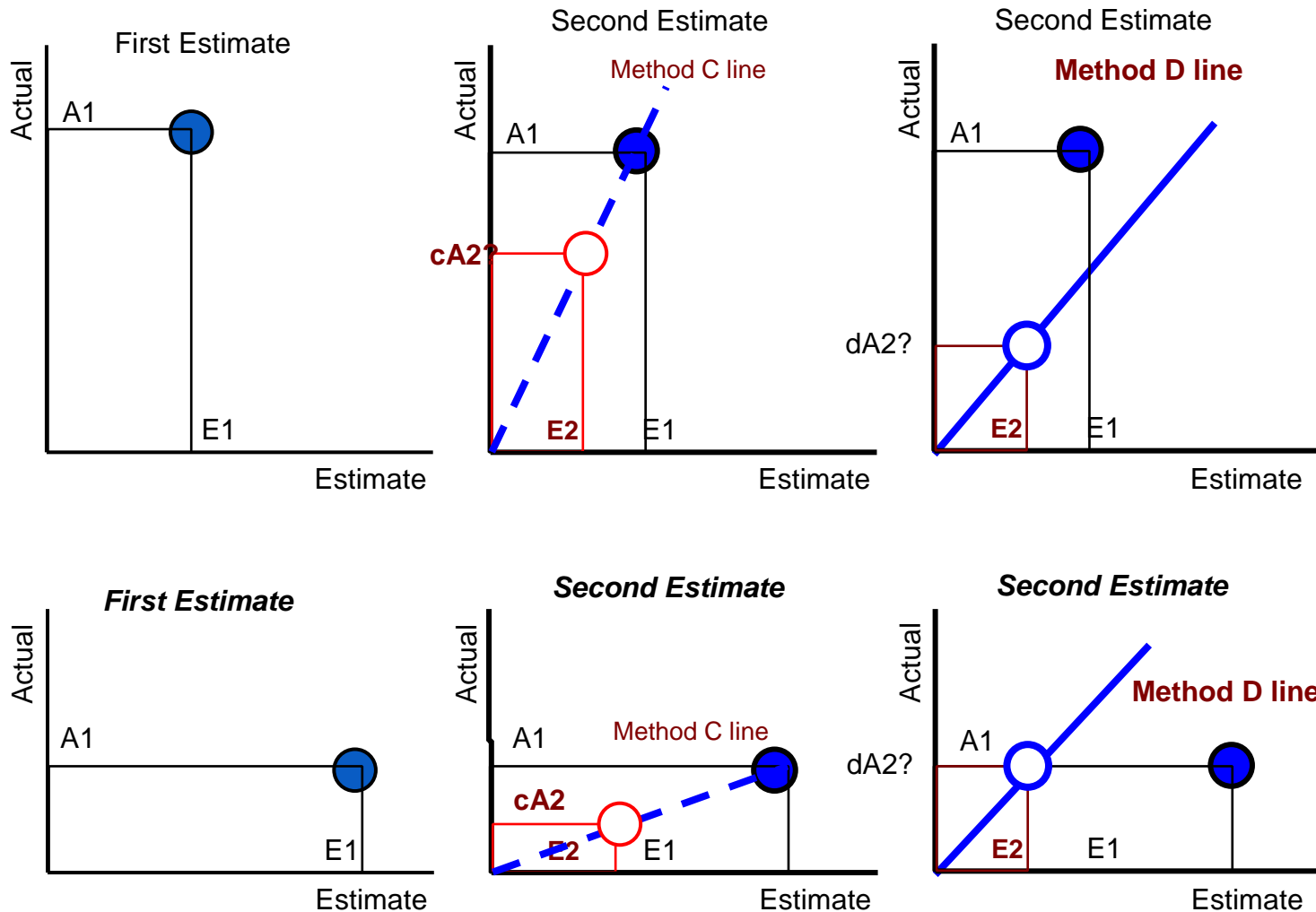
1. Step1 – 3: Obtain the estimated size using the SET template

2. Step 4:



"A single path between the start to a *Done*."

# Continue to use PROBE Method C?



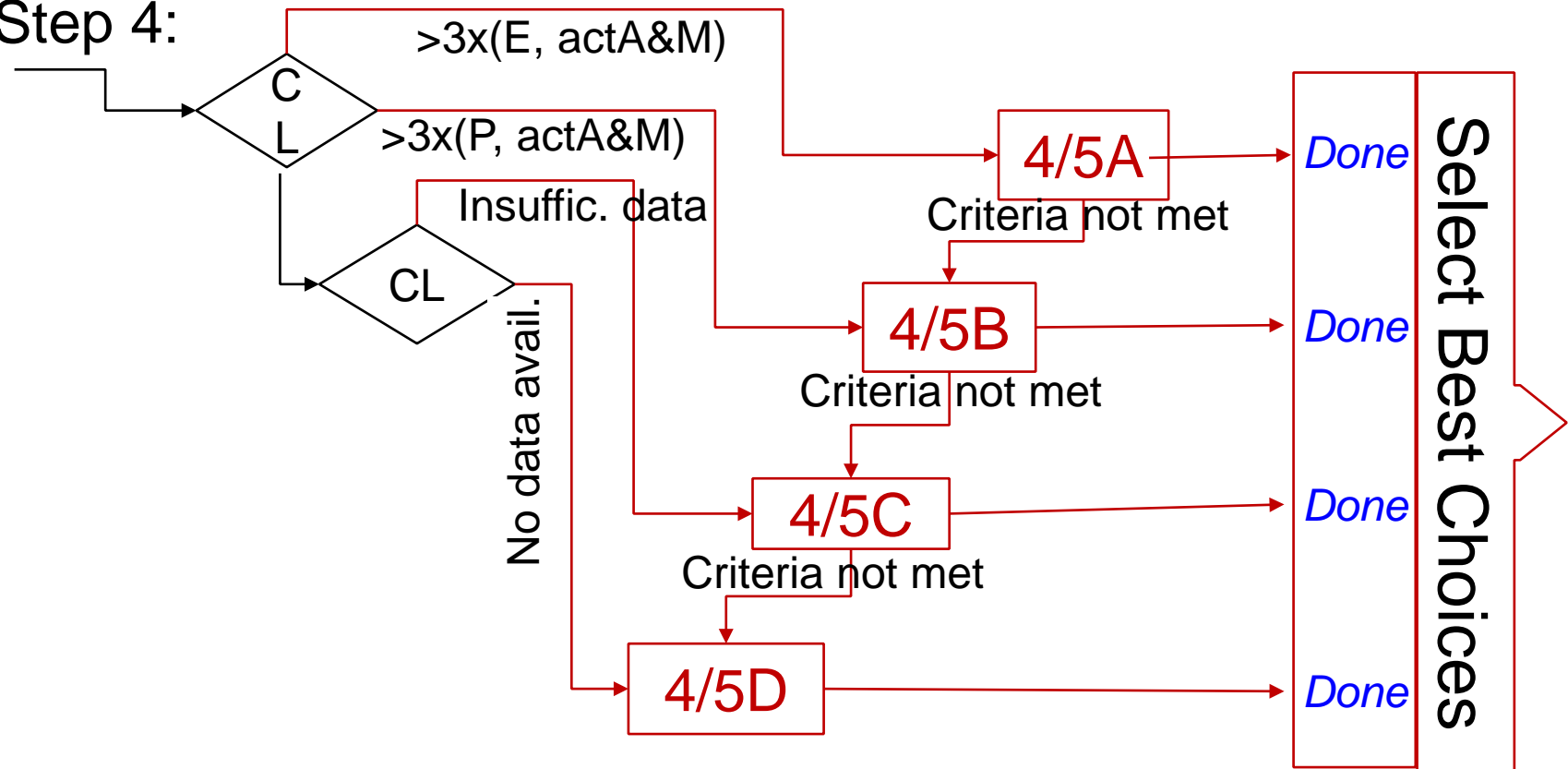
# Early Correction in the Estimation is critical

1. The estimation is about the future activities.
2. To obtain reliable estimates, multiple estimations should be tried and mandated by identifying all possible situations in the future
3. Past experiences of failing an appropriate estimate should not be forgettable.

# PROBE Script flow – Desirable

1. Step1 – 3: Obtain the estimated size using the SET template

2. Step 4:



“Multiple pathes between the start to *Done* box”.



# Students play with the PROBE process

1. Should this way of “teaching the process” be *understandable and acceptable*?
2. Am I teaching the size and time estimating enough?
3. What is all about the PROBE method?

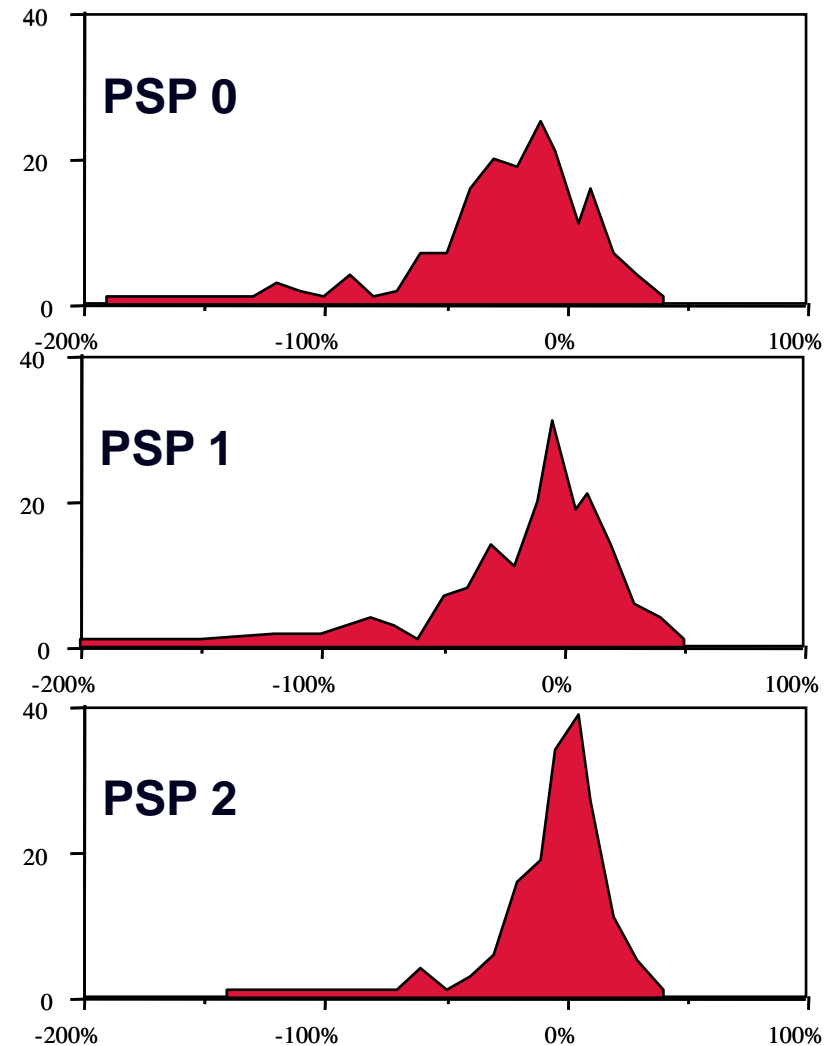
# Does the PROBE method related to these changes?

1. Majority are under-estimating

1. Balance of over- and under estimates

1. Much tighter balance around zero

Ref. "PSP for Engineers – Planning" lecture



# Two New Fundamental Parameters for Quality

PROBE Method estimates Size (S) and Time (T);

$$\text{Work Volume(WV)} = S \times T$$

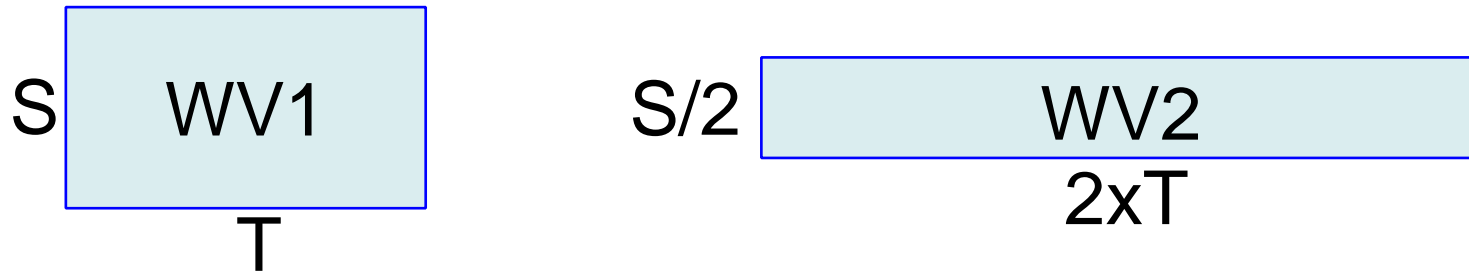
- Size can be LOCS, Pages, Pictures, etc.

Defect (D) is used with these parameters:

$$QPI = D / (S \times T)$$

QPI stands for “Quality Performance Index”.

# Characteristics of WV

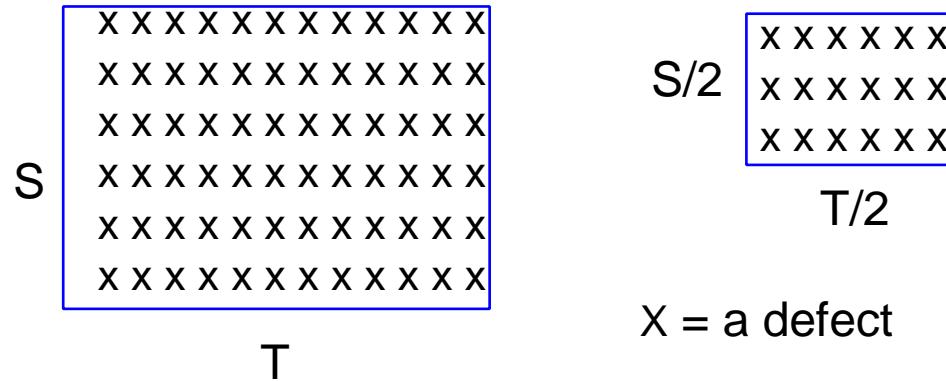


The two WV are the same work volume.

This Work Volume shows the effort to produce the size S product using the time T.

$$\begin{aligned}
 S \times T &= (S/2) \times (T \times 2) = (S/10) \times (T \times 10) = \dots \\
 &= (S/3) \times (T \times 2) + (S/3) \times T = \dots \text{ where } S \text{ has a same size type.}
 \end{aligned}$$

# Characteristics of QPI (Defect Density in WV space)



**QPI measures a Quality Improvement Indicator.**

These two works have the same QPI value.

Ex. 20 The QAPI of the work which injected 20 defects of the product size 100LOC created using 10 Hrs.

$$\Rightarrow \text{QPI} = 20 \text{ Defects} / ((100 \text{ L O C} / 1000) * 10 \text{ Hrs}) = 20 \text{ QPI.}$$

# PSP data case study example – QPI Calculation(1)

	Program #	EstLOC	ActLOC	EstMin	ActMin	EstDef	ActDef
	Formulas			0	0	0	0
	1A	0	0	0	0	0	0
	2A	0	0	0	0	0	0
	3A	0	0	0	0	0	0
	4A	0	0	0	0	0	0
PSP2	5A	104.7529	102	228.7	251.8333	9.1	5
PSP2.1	6A	90.79574	88	151.9479	322.7333	4.450771	2
PSP2.1	7A	131.9401	100	493.1484	553.5	4.86095	6
PSP2.1	8A	109.5703	114	553.0832	512.2667	4.911773	5
	9A			0	0	0	0
	10A			0	0	0	0
	Sum	437.059	404	1426.88	1640.333	23.32349	18

Given by best effort

These data are entered for each project in the next ordet:

5A  
6A  
7A  
8A

Predictable using the other data items ☐

# PSP data case study example – QPI Calculation(2)

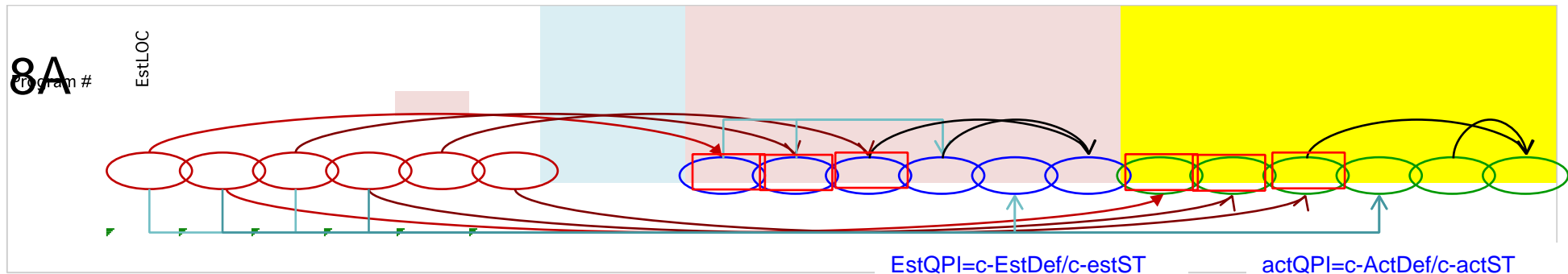
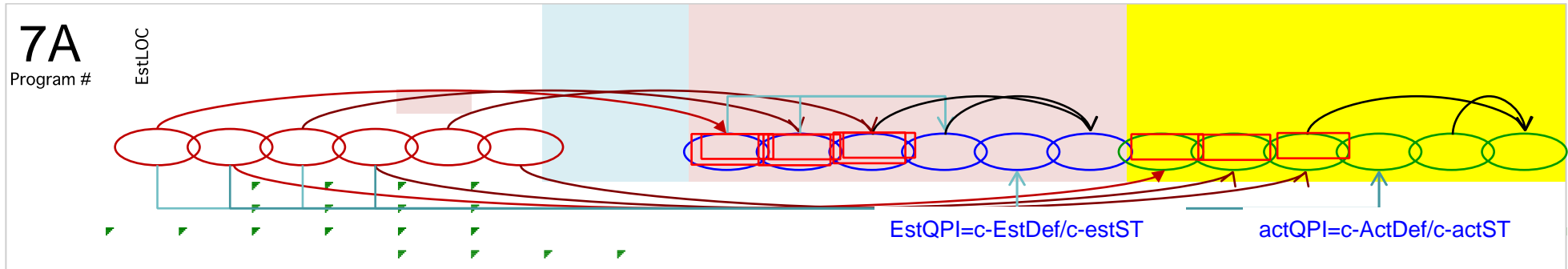
5A	EstLOC	ActLOC	EstMin	ActMin	EstDef	ActDef	est D	est D w/ est QPI	c-EstLOC	c-EstMin	c-EstDef	c-estST	est ST	est QPI	c-ActLOC	c-ActMin	c-ActDef	act ST	c-actST	act QPI
Program #																				
5A	114.8	223.0	493.8	761.0	5	8	n/c	n/c	114.8	493.8	5.0	0.9	0.9	5.3	223.0	761.0	8.0	2.8	2.8	2.8
6A																				
7A																				
8A																				
9A																				
10A																				
Sum	114.8	223	493.8	761	5	8														
					0	0	0	0												

EstQPI=c-EstDef/c-estST      actQPI=c-ActDef/c-actST

6A	EstLOC	ActLOC	EstMin	ActMin	EstDef	ActDef	est D	est D w/ est QPI	c-EstLOC	c-EstMin	c-EstDef	c-estST	est ST	est QPI	c-ActLOC	c-ActMin	c-ActDef	act ST	c-actST	act QPI
Program #																				
5A	114.8	223.0	493.8	761.0	5	8	n/c	n/c	114.8	493.8	5.0	0.9	0.9	5.3	223.0	761.0	8.0	2.8	2.8	2.8
6A	126.2	133	339.6	584.2	4.527	3	2.02	3.78	241	833.4	9.527	3.347	0.714	2.846	356	1345	11	1.295	7.981	1.378
7A																				
8A																				
9A																				
10A																				
Sum	241	356	833.4	1345	9.527	11	2.02	3.78												
					4.527	3														

Adding with the above cell      EstQPI=c-EstDef/c-estST      actQPI=c-ActDef/c-actST

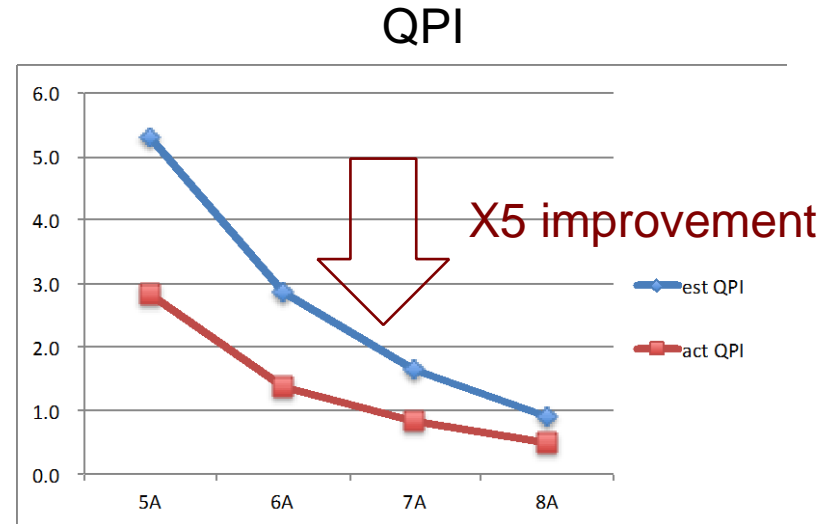
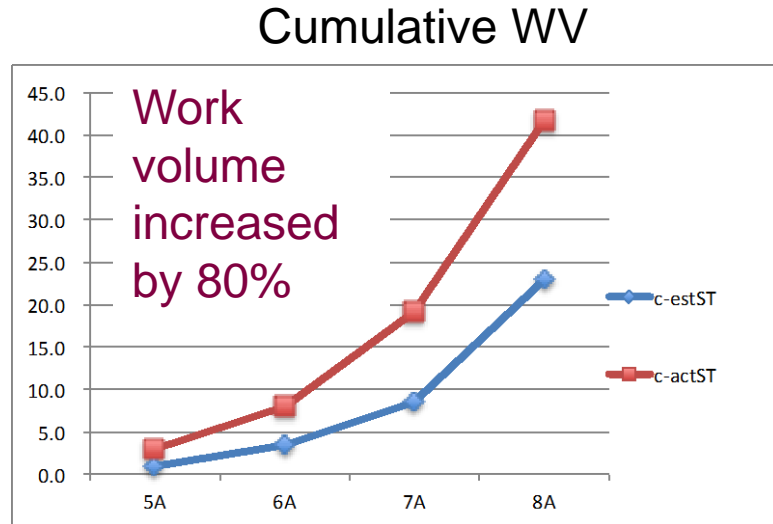
# PSP data case study example – QPI Calculation(3)



Adding with the  
above cell



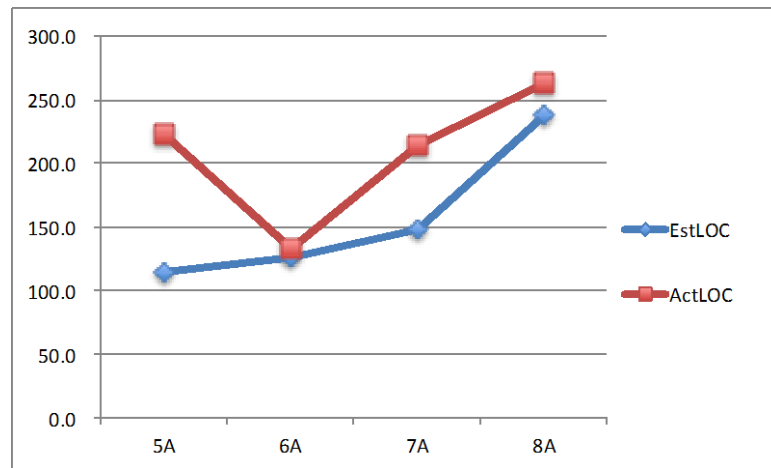
# PSP data case study example – WV and QPI



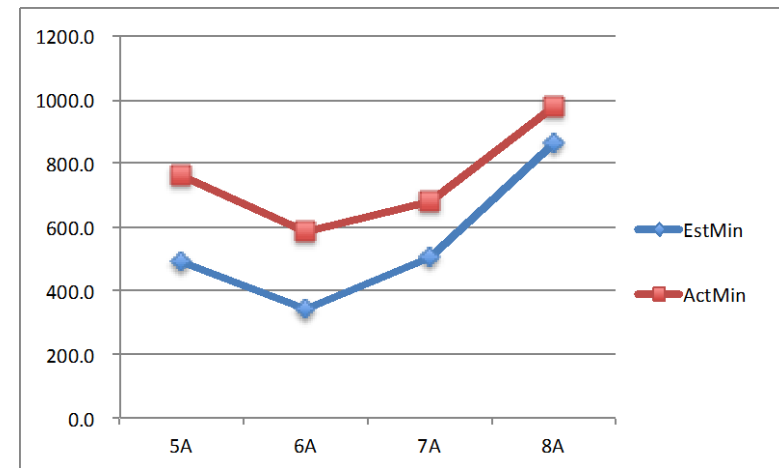
- The work volume of the efforts was spent 80% more to the plan.
- The quality of work is improved 5x.

# PSP data case study example – Plan vs Actual

## Size Estimation



## Time Estimation

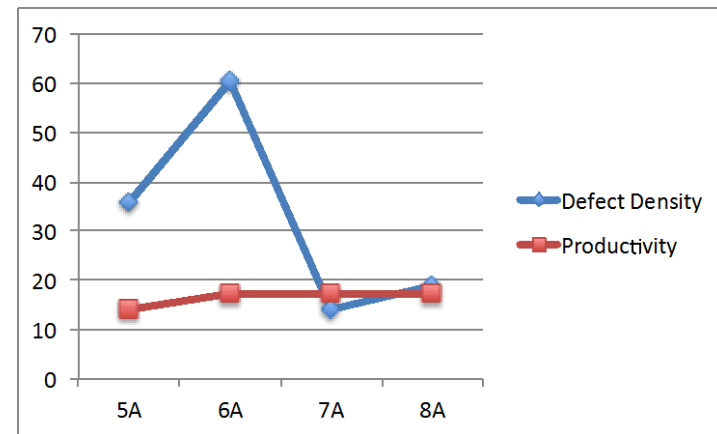


The actual size and time graphs show that

- Actual size - larger than the planned
- Actual time - larger than the planned

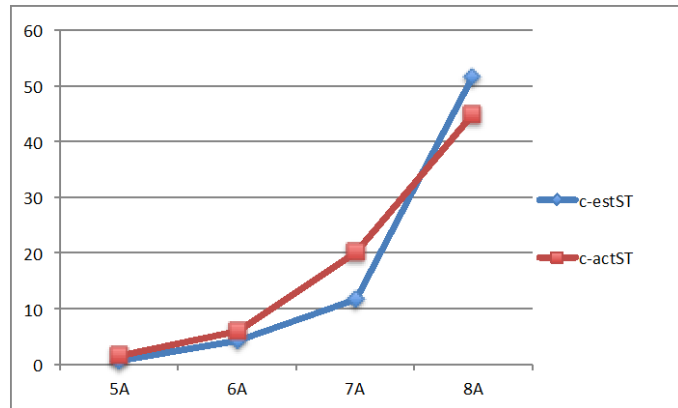
Not clear for the student to figure out

- Quality level of its work
- How much effort it needs to improve

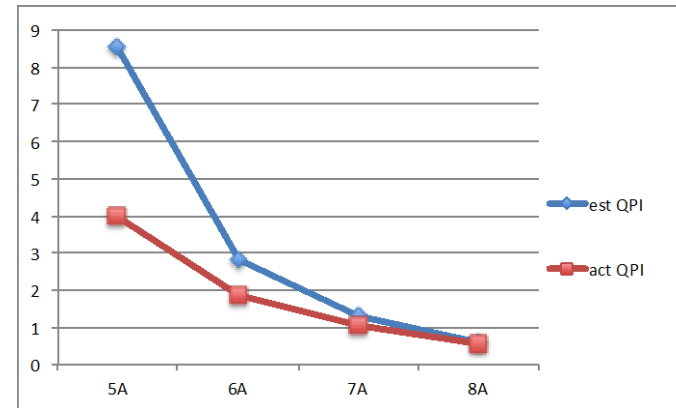


# Engineer -1

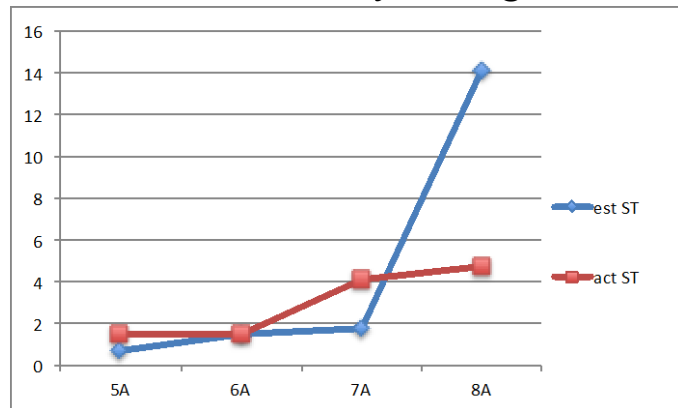
Work Volume



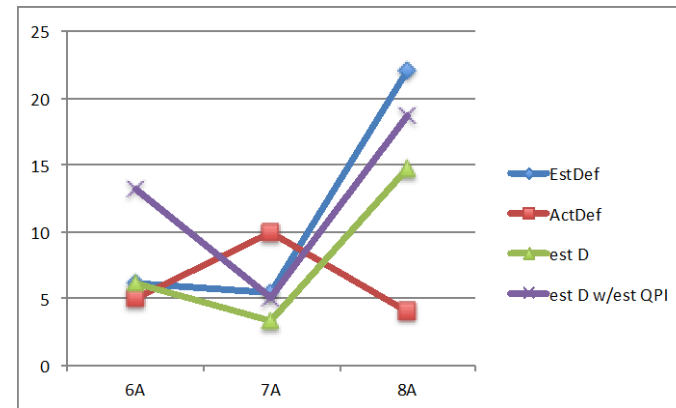
QPI



Work Volume by Assignment

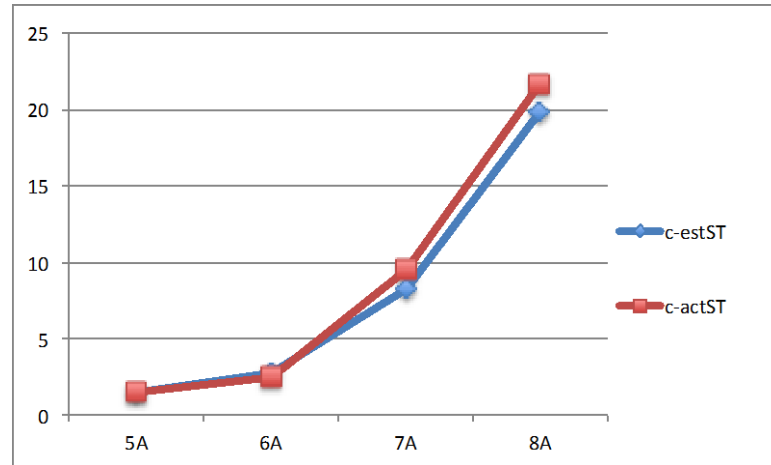


Defects by Assignment

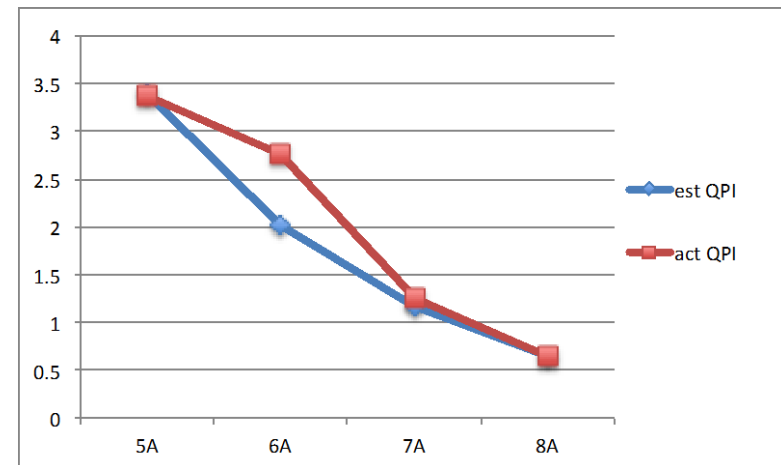


# Engineer -2

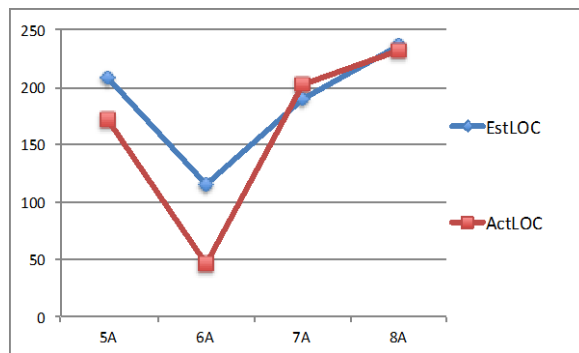
Work Volume



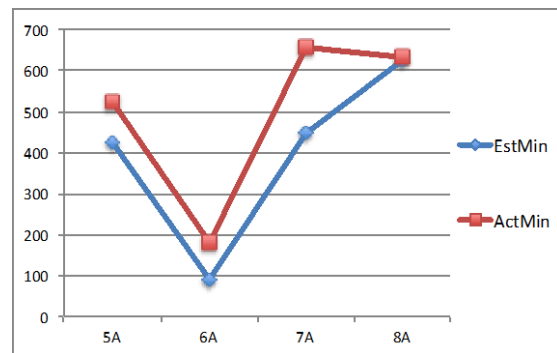
QPI



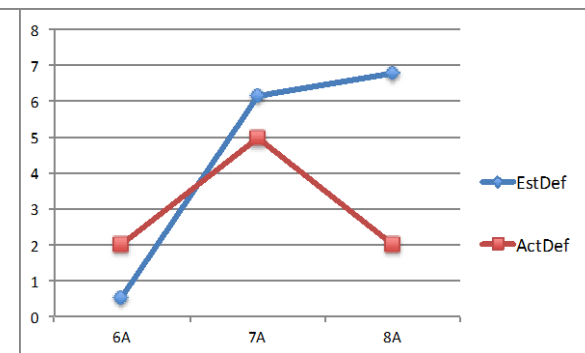
EstLOC - ActLOC



EstMin - ActMin

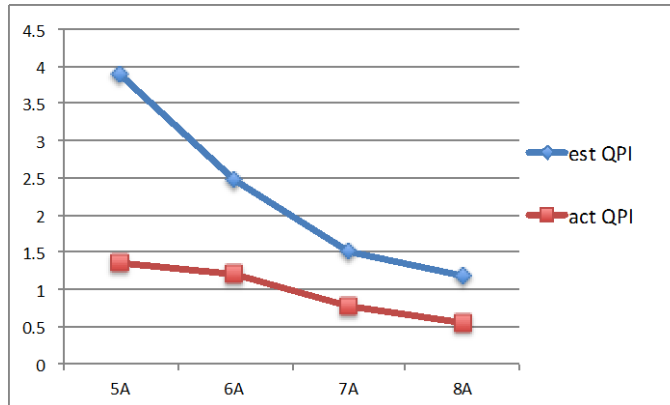


EstDef - ActDef

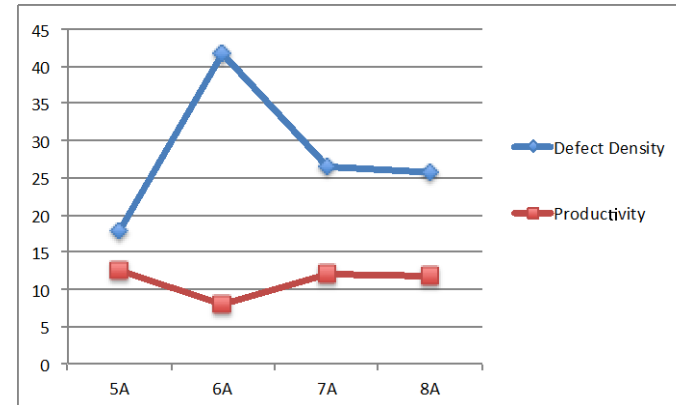


# Engineer-3

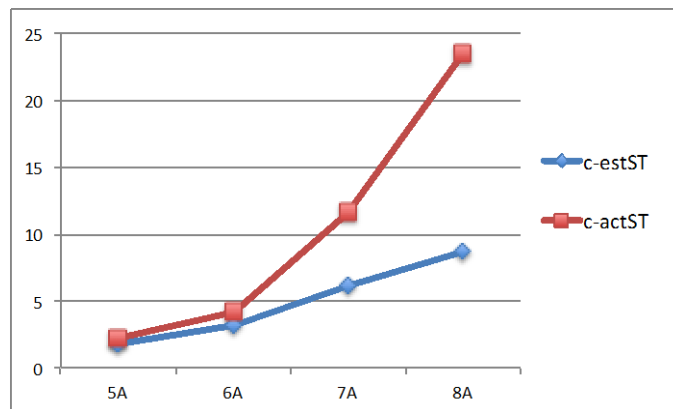
## QPI



## Productivity & Defect Density



## Work Volume



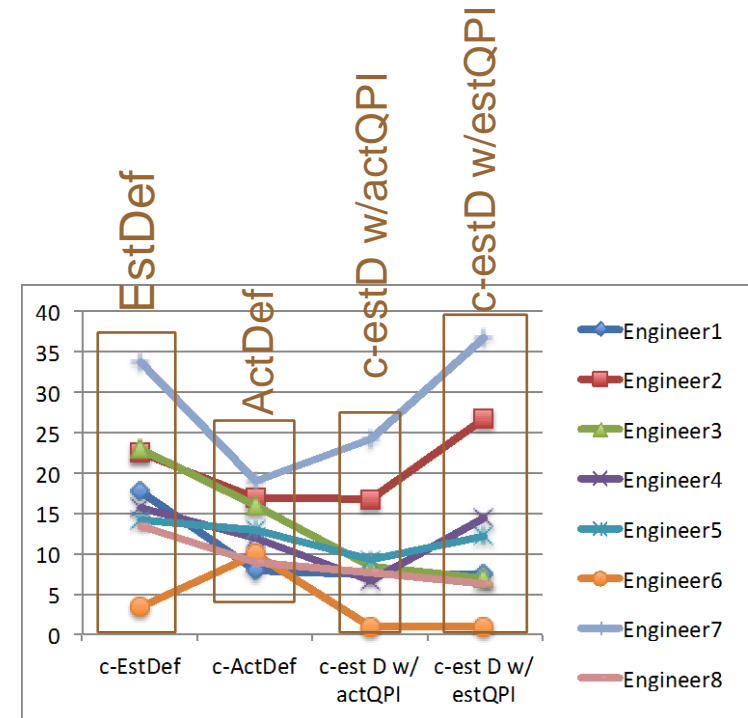
*It is noted that the work volume increased more at Assignment 7&8.*

# Performance on Defect Estimating

## Performance of Estimating the cumulative Defects for A6, 7, and 8

Assumption: the defects estimated for A5 is **equal** to the actual defect number of A5

	Engineers' data		Estimated w/WV & QPI	
	c-EstDef	c-ActDef	c-est D w/ actQPI	c-est D w/ estQPI
Engineer1	17.63920218	8	7.314336207	7.309951975
Engineer2	22.56492625	17	16.77181544	26.63044773
Engineer3	22.84292615	16	8.419851706	6.950683232
Engineer4	15.77624206	12	6.562753753	14.37063826
Engineer5	14.22349387	13	9.265791186	12.10860664
Engineer6	3.360677871	10	0.991650649	0.938439095
Engineer7	33.73006735	19	24.20344839	36.83451232
Engineer8	13.42096562	9	7.603011658	6.281860241



## Performance of Estimating the cumulative Defects for A6, 7, and 8

Assumption: the defects estimated for A5 is **2x** the actual defect number of A5

	Engineers' data		Estimated w/WV & QPI	
	c-EstDef	c-ActDef	c-est D w/ actQPI	c-est D w/ estQPI
Engineer1	17.63920218	8	7.314336207	13.41353637
Engineer2	22.56492625	17	16.77181544	45.40508891
Engineer3	22.84292615	16	8.419851706	12.74645932
Engineer4	15.77624206	12	6.562753753	26.52713578
Engineer5	14.22349387	13	9.265791186	20.41751019
Engineer6	3.360677871	10	0.991650649	1.810456347
Engineer7	33.73006735	19	24.20344839	36.83451232
Engineer8	13.42096562	9	7.603011658	10.92175164

## Performance of Estimating the cumulative Defects for A6, 7, and 8

Assumption: the defects estimated for A5 is **0.5x** the actual defect number of A5

	Engineers' data		Estimated w/WV & QPI	
	c-EstDef	c-ActDef	c-est D w/ actQPI	c-est D w/ estQPI
Engineer1	17.63920218	8	7.314336207	4.258159777
Engineer2	22.56492625	17	16.77181544	17.24312714
Engineer3	22.84292615	16	8.419851706	4.05279519
Engineer4	15.77624206	12	6.562753753	8.292389506
Engineer5	14.22349387	13	9.265791186	7.954154869
Engineer6	3.360677871	10	0.991650649	0.50243047
Engineer7	33.73006735	19	24.20344839	25.39752746
Engineer8	13.42096562	9	7.603011658	3.961914543

## Performance on Defect Estimating(2)

The PROBE approach with the Work Volume and QPI enables

- Defect estimation with narrower ranges.

WV x estQPI

WV x actQPI

where  $\text{estQPI} = c - \frac{\text{estD}}{\text{cumulated estimated WV}}$ ,

$\text{actQPI} = c - \frac{\text{actD}}{\text{cumulated actual WV}}$

- Defect estimation with less sensitive to the initial estimate  
(allowing the initial defect estimate more flexible)

## A Possible Extension of the PROBE Process

1. All PROBE Methods A, B, C, and D should be tried in parallel to obtain the estimates which are then evaluated for selecting the best choice. If necessary, two or more choices should be allowed.
2. The estimating defect process could be extended with the two concepts: “work volume” and “Quality Performance Index (QPI).” Three options may be provided:
  - Option 1: Current computation
  - Option 2: Using actQPI (computed with actual data)
  - Option 3: Using estQPI (computed with estimated data)
3. With these, several important graphics can be added.



# For Future PSP/TSP Measurement and Planning Framework

1. The current PSP/TSP measurement and data analysis cover the basic improvement framework.
2. The analysis results and presentations may not quantitatively suggest engineers and management on what action each engineer needs to take to meet its goals
3. The concepts “Work Volume” and “Quality Performance Index” can help them objectively in finding
  - where its quality work stands
  - how much of work volumes are left for future

# Thank you for your patience.

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Note: The NPI home page will be opened by Jan. 22<sup>nd</sup>, 2014.