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SEI TSP Symposium 2007

A Quantitative Method for Preventing Defect Injection in PSP/TSP

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Contents

Introduction & Background

Better quality and productivity is required for every project.

Every engineer is required skills necessary to meet the project goal.

What method should be used to ensure that the objectives are achievable?

Introduction & Background – cont.

PSP trained students often state that

the planning and design are determinant

- for quality and productivity performance,
- to later phases of code and test.

What method should be used to "estimate" these? Is it similar to PROBE?

Challenges

Questions here, as examples to be answered:

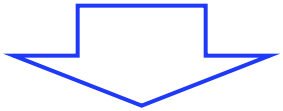
- How does engineer determine if it can meet an achievable improved-quality and productivity objectives required by project?
- What are risks associated with engineers to be team members?
- What must an organization know about its engineers in order to be a high capable or maturity organization?

Strategy

Engineers are trained with same process (PSP for Engineers.)

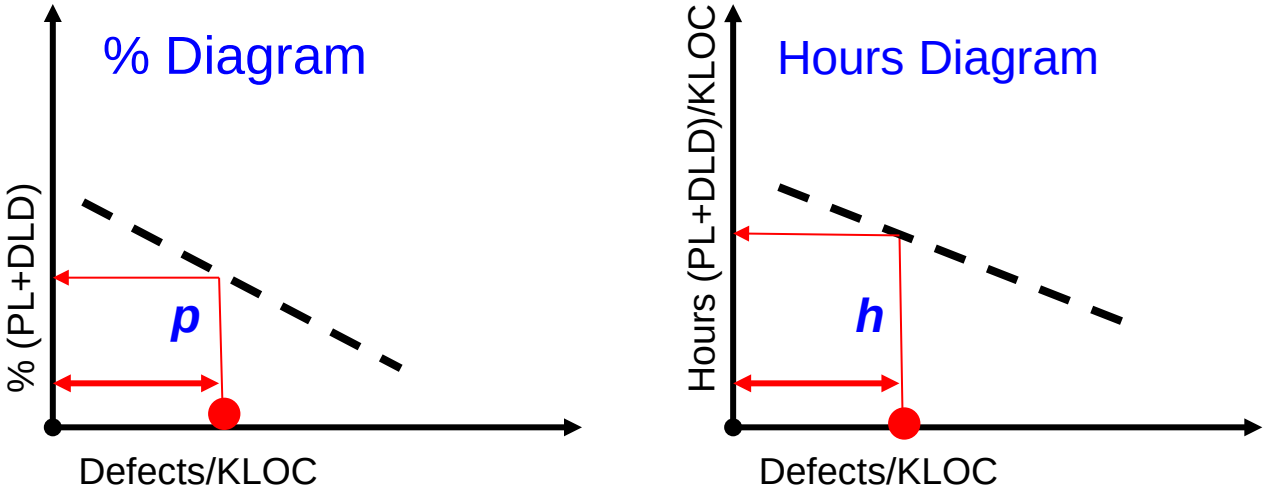
Engineer recognizes its improvement based on the defined process and measured data.

Understanding how quality and productivity are related with project size and time is essential.



PSP data must show the aspect of engineer's performance trend, i.e., work for benchmarking.

Approach – basic formula 1



We measure

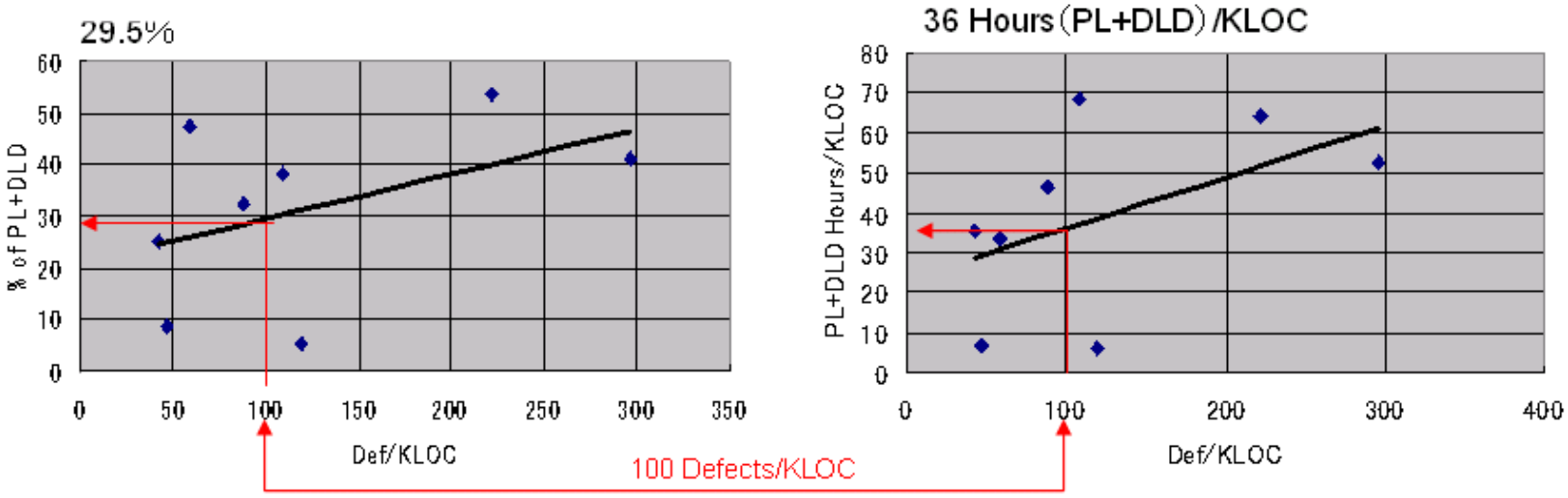
Hours(PL+DLD)/Total Project Hours ≡ ***p*** = %(PL+DLD),

Total hours spent in PLAN and DLD ≡ ***h*** = Hours(PL+DLD)/KLOC,

Productivity = 1000 x p / h.

Note: LOC measure is given by "Added and Modified."

Approach – basic formula 2



Student plan summary data shows

(A+M) = 452LOC and total defects injected = 47 ➔ 104 def/KLOC

Workload needed to develop 1000LOC = *h/p* = 115 hours

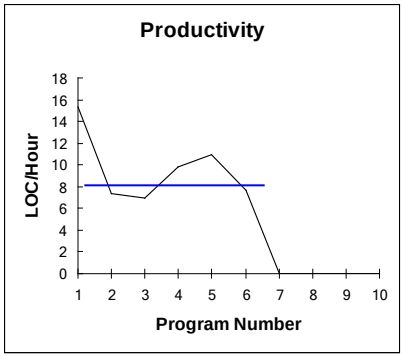
Productivity = *1000 x p/h* = 1000 / 115 = 8.67LOC/Hr.

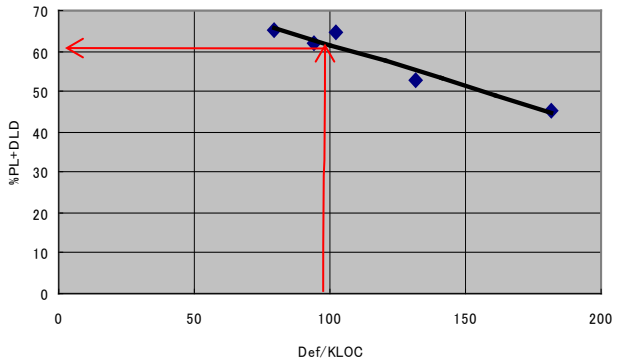
Approach – case 1

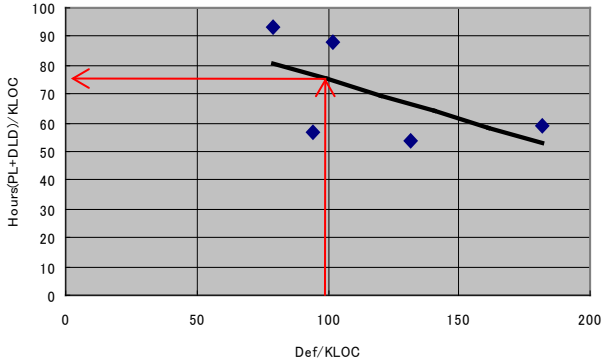
Approximation Effectiveness

Student_2

Plan Summary
- Total N&C = 242 lines
- Defects injected = 24
- ➔ Defect Density = 99.2 Def/KLOC







➔61% PL+DLD hours

➔76 Hours PL+DLD time

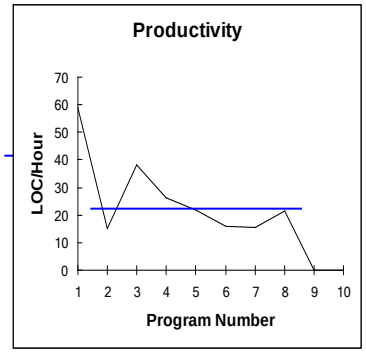
Total Hours = 124.6 Hours/KLOC, Productivity = 8.03 LOC/Hour

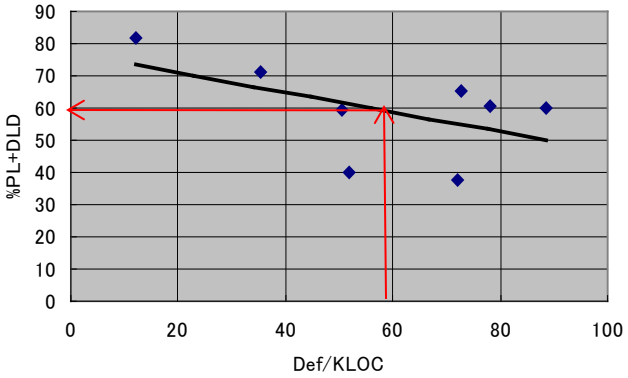
Approach – case 2

Approximation Effectiveness

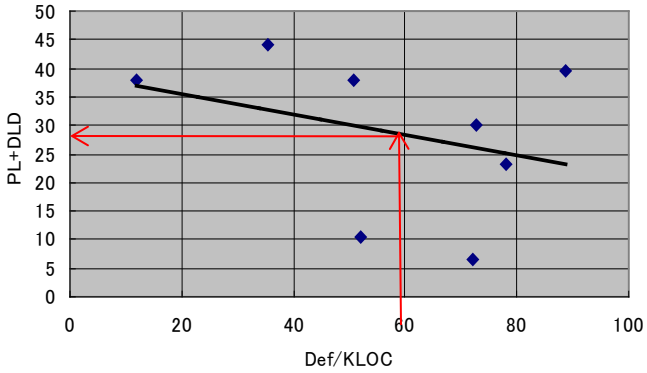
Student_3

Plan Summary
- Total N&C = 1050 lines
- Defects injected = 60
- ➔ Defect Density = 57.14 Def/KLOC





➔60% PL+DLD hours



➔29 Hours PL+DLD time

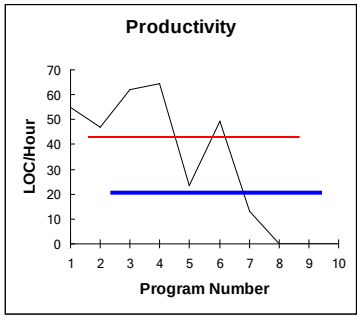
Total Hours = 48.3 Hours/KLOC, Productivity = 20.68 LOC/Hour

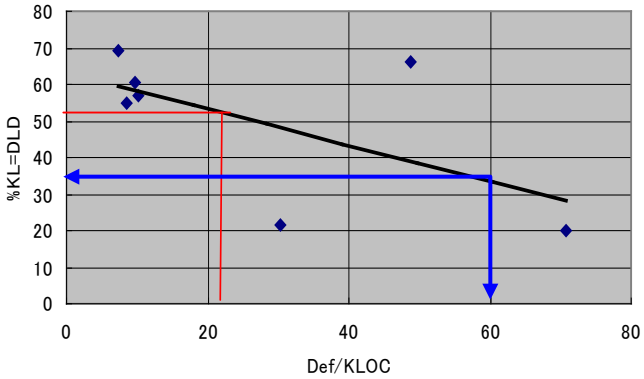
Approach – case 3

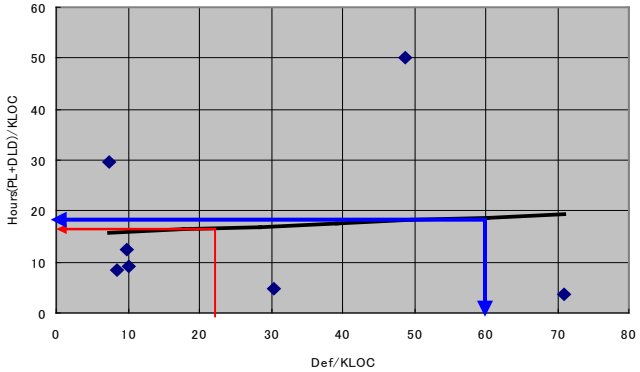
Approximation Effectiveness

Student_5

Plan Summary
- Total N&C = 2423 lines
- Defects injected = 54
- ➔ Defect Density = 22.29 Def/KLOC







➔52% PL+DLD hours

➔16 Hours PL+DLD time

Total Hours = 30.8 Hours/KLOC, Productivity = 32.5 LOC/Hour

Productivity = 18 LOC/Hour

Identify Productivity Needed for Higher Quality Objective 1

High quality product requires every component must be high quality.

➔Question (Example):

- Current defect injection ratio is **50 defects/KLOC**.
- If project's required quality is **25 defects/KLOC**, what is the productivity necessary for the new project?

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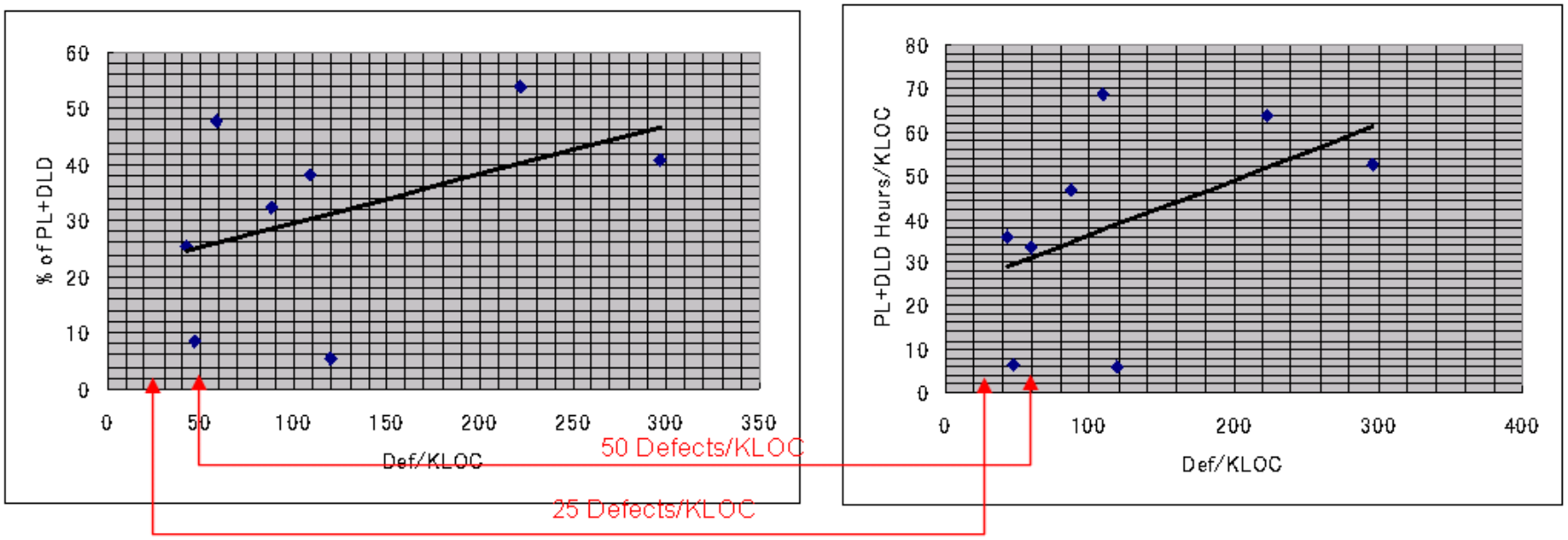
Identify Productivity Needed for Higher Quality Objective 2



(1) Identify the productivity for 50 defects/KLOC => $Prod_{50}$
(2) Identify the productivity for 25 defects/KLOC => $Prod_{25}$
(3) Productivity delta = $Prod_{50} - Prod_{25}$

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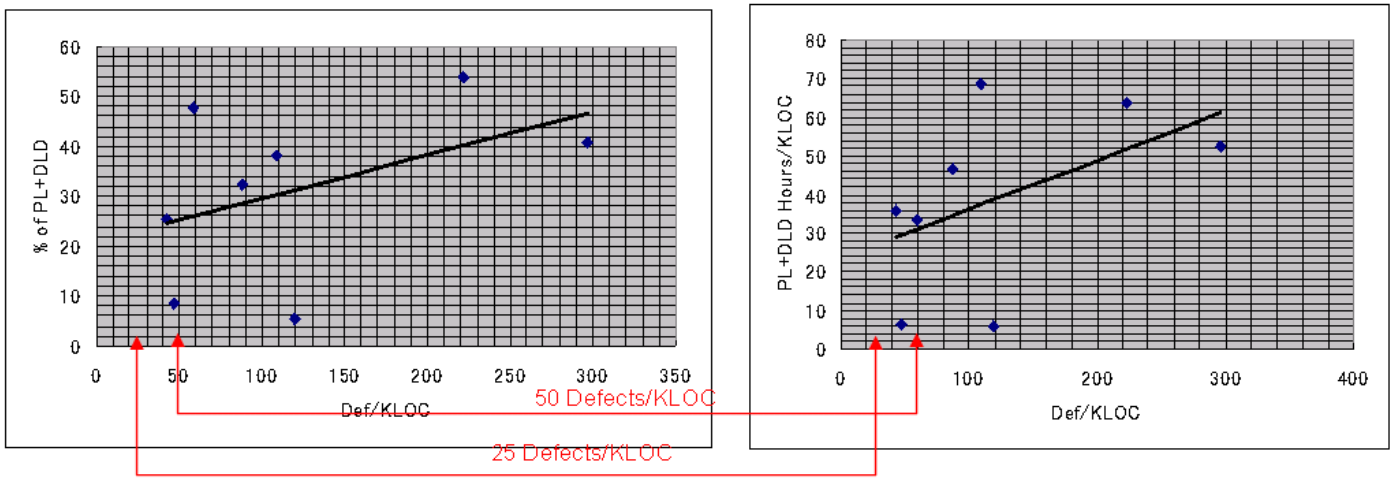
Identify Productivity Needed for Higher Quality Objective 3



For 50 defects/KLOC,
p=0.39, h=13 hours.

➔Productivity = 1000xp/h
= 30LOC/Hour

For 25 defects/KLOC,
p=0.393, h=10.5 hours.

➔Productivity = 1000xp/h
= 37LOC/Hour

24% improvement in productivity.

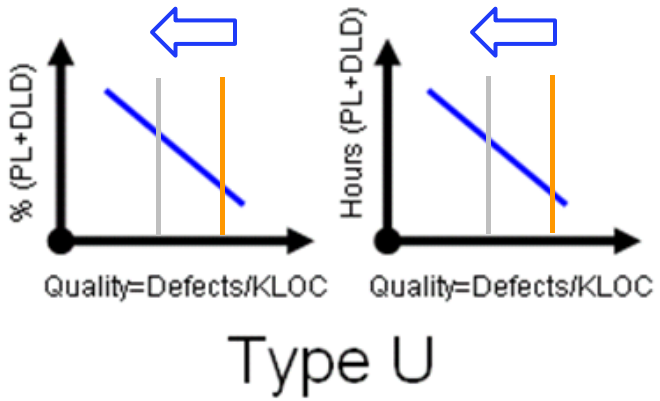
Classification on Quality Measure 1

How are these students quality performance classified?

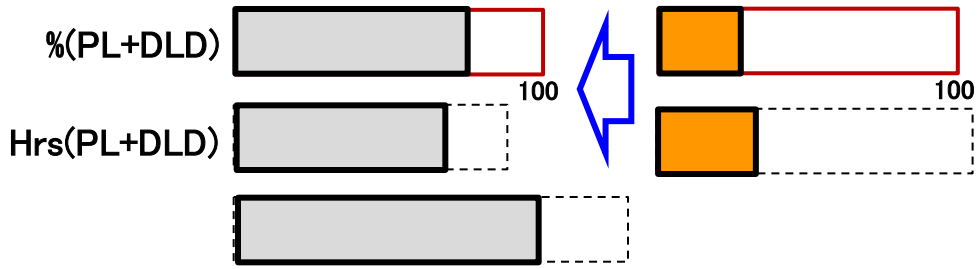
We need to know for

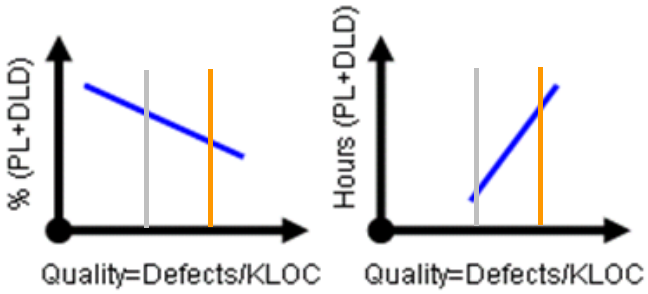
- Understanding its status
- Its possible project assignment
- Its improving capability as needed

Classification on Quality Measure 2

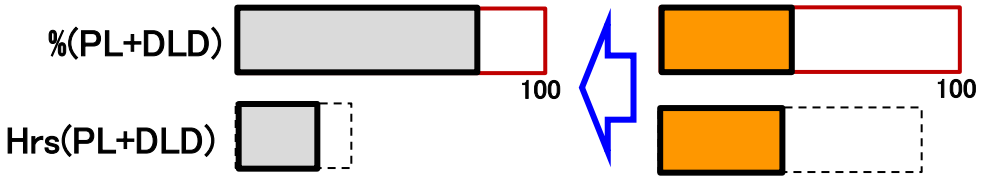


Type U

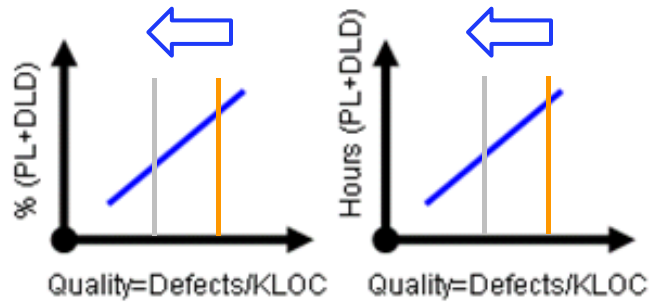




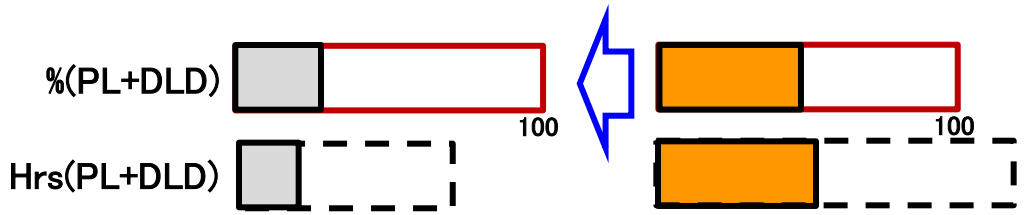
Type V

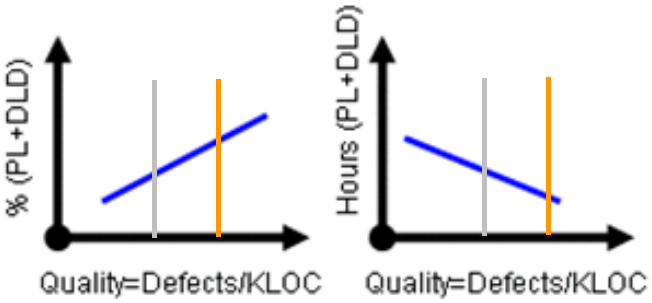


Classification on Quality Measure 3

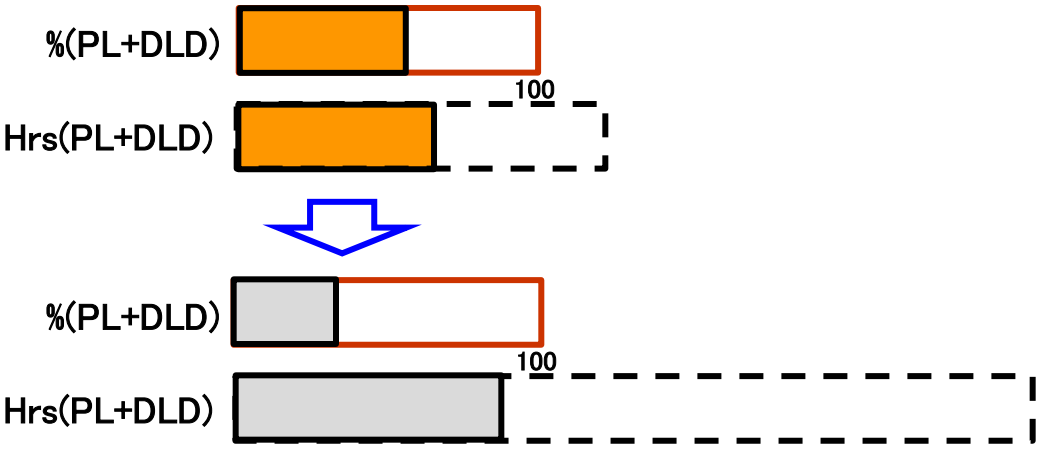


Type D



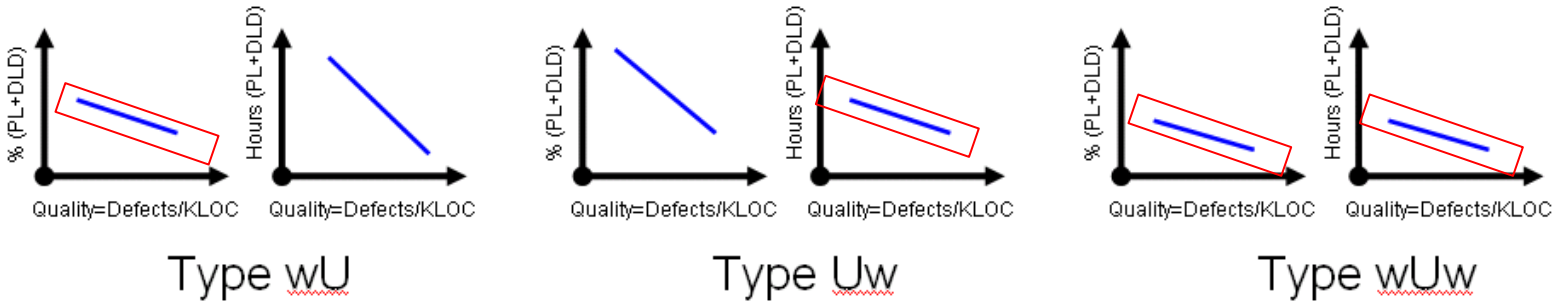


Type A



Classification on Quality Measure 4

Sub-typing

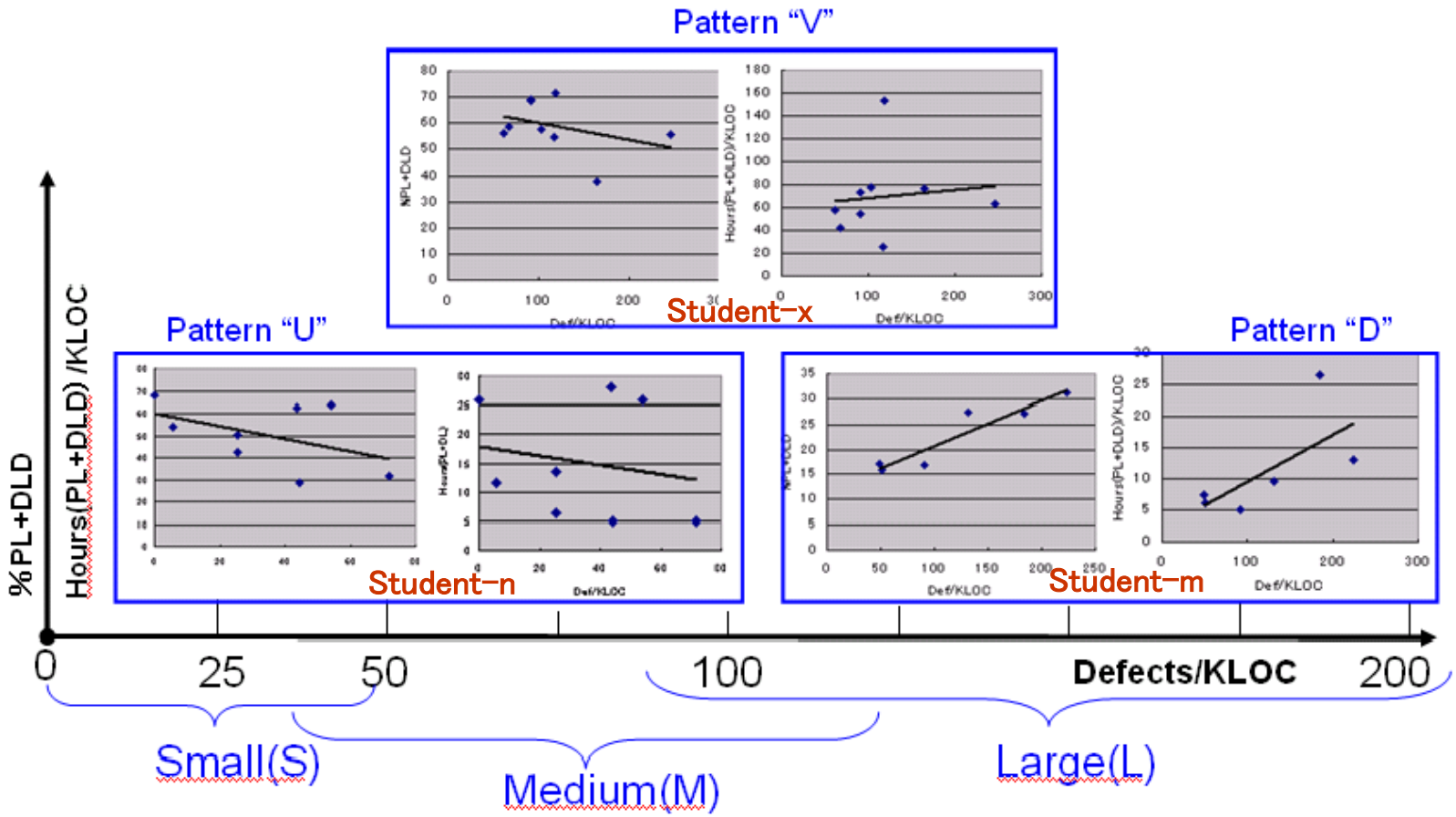


Example – **Type U** is sub-categorized into the above four subtypes:

- If %(PL+DLD) has smaller slope ➔ **wU**
- If Hours(PL+DLD) has smaller slope ➔ **Uw**
- If both % and Hours of PL+DL has smaller slops ➔ **wUw**

For the other types **V, D**, and **A,** same schema are defined respectively.

Performance Variation of PSP Class 1



This graph is not convenient to show many student data in a glance.

Performance Variation of PSP Class 2

Defect Density	ID	Projection Type	Projected Productivity		S_Def/KLOC	Improvement ratio
			50 Defects/KLOC	25 Defects/KLOC		%Pr25-Pr50
L	Student_1	V	13.37	14.88	114.00	11.24
L	Student_2	D	30.00	35.00	49.00	16.67
L	Student_3	U	8.00	7.98	79.00	(0.26)
M	Student_4	wUw	20.45	20.42	35.00	(0.19)
M	Student_5	V	20.00	26.15	35.00	30.77
M	Student_6	V	22.34	24.89	47.00	11.41
M	Student_7	D	13.16	18.40	20.00	39.84
M	Student_8	D	8.33	9.20	42.00	10.40
M	Student_9	U	9.55	10.00	74.00	4.76
M	Student_10	V	16.67	20.75	67.00	24.50
M	Student_11	U	20.67	20.00	12.00	(3.23)
S	Student_12	wUw	23.11	22.45	9.00	(2.86)
S	Student_13	wUw	42.22	40.00	17.00	(5.26)
S	Student_14	U	42.86	42.00	41.00	(2.00)
S	Student_15	Uvw	36.59	48.46	0.00	32.46
S	Student_16	Uvw	25.00	27.03	0.00	8.11
S	Student_17	U	21.88	23.81	0.00	8.84
S	Student_18	vwU	20.91	19.20	19.00	(8.17)
S	Student_19	Vw	21.11	32.19	7.30	52.47
S	Student_20	V	25.00	33.53	9.50	34.12
S	Student_21	wV	13.71	16.33	0.00	19.10
S	Student_22	U	13.18	13.54	25.00	2.73
S	Student_23	U	32.14	32.50	0.00	1.11
S	Student_24	Vw	33.80	43.48	0.00	28.62

Performance Variation of PSP Class 3

Notes-1

- High-quality engineers, indicated by “Small” in Defect Density field, do not necessarily show improved productivity.
- The entries with negative improvement ratio (i.e., productivity degradation) are spread over the table. Such an entry can occur for any quality spectrum—S, M, or L.
- All the projection types D, V, and U are shown across quality spectrums—S, M and L.

development think process ©YA2004

Performance Variation of PSP Class 4

Defect Density	ID	Projection Type	Projected Productivity		S_Def/KLOC	Improvement ratio
			50 Defects/KLOC	25 Defects/KLOC		%Pr25-Pr50
S	Student_18	vwU	20.91	19.20	19.00	(8.17)
S	Student_13	wUw	42.22	40.00	17.00	(5.26)
M	Student_11	U	20.67	20.00	12.00	(3.23)
S	Student_12	wUw	23.11	22.45	9.00	(2.86)
S	Student_14	U	42.86	42.00	41.00	(2.00)
L	Student_3	U	8.00	7.98	79.00	(0.26)
M	Student_4	wUw	20.45	20.42	35.00	(0.19)
S	Student_23	U	32.14	32.50	0.00	1.11
S	Student_22	U	13.18	13.54	25.00	2.73
M	Student_9	U	9.55	10.00	74.00	4.76
S	Student_16	Uvw	25.00	27.03	0.00	8.11
S	Student_17	U	21.88	23.81	0.00	8.84
M	Student_8	D	8.33	9.20	42.00	10.40
L	Student_1	V	13.37	14.88	114.00	11.24
M	Student_6	V	22.34	24.89	47.00	11.41
L	Student_2	D	30.00	35.00	49.00	16.67
S	Student_21	wV	13.71	16.33	0.00	19.10
M	Student_10	V	16.67	20.75	67.00	24.50
S	Student_24	Vw	33.80	43.48	0.00	28.62
M	Student_5	V	20.00	26.15	35.00	30.77
S	Student_15	Uvw	36.59	48.46	0.00	32.46
S	Student_20	V	25.00	33.53	9.50	34.12
M	Student_7	D	13.16	18.40	20.00	39.84
S	Student_19	Vw	21.11	32.19	7.30	52.47

Performance Variation of PSP Class 5

Notes-2

- All entries with negative productivity improvement come from the type U.
- High-quality engineers, indicated by zero S_Def/KLOC (i.e., zero defect for compile and test phases) have the type U and V with no negative productivity improvement.

PSP Helps Organizations for Maturity Improvement 1

1. Individual professional development
   - Type wU engineer may easily be changed to Type wA.
   - Organization can prevent this transition by education, training, and provision of resource
   - Resultant projection type will be type U, V, or D.
2. Project team formation
   - Forming a team of engineers of type U with negative productivity improvement must be avoided if the project is required higher quality products.

PSP Helps Organizations for Maturity Improvement 2

3. Organizational process maturity improvement
   - Maturity may be defined as sufficient potential for growth in its capability to meet customer needs or project activities.
   - %-Hours diagrams of its engineers should show this potential growth in quality and productivity based on their historical data.

Summary

Following method is proposed:

- **%-Hours diagram** with the measures of
  - p = % of PL+DLD to development effort
  - h = Hours of PL+DL
- **1000xp/h** is the derived productivity

- Data of 24 randomly selected PSP engineers examined to validate the method.
- The method should be applied based on historical data in
  - **Identifying achievable objectives** of quality and productivity at individual and project
  - **Determining engineer's capability**
  - **Project formation**
  - **Organizational maturity** established from individual level

[end]

Thank you for your attention and now for questions…

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