ASSIGNMENT-4
CS 587: Software Project Management
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Given work size is 53 KLOC.

		Defect Origin								
		Requirement	Analysis	Design	Coding	Unit Testing	Integration Testing	System Testing	Field	Total
Where Found	Requirement	90								90
	Analysis	75	47							122
	Design	67	37	103						207
	Coding	34	43	61	279					417
	Unit Testing	39	51	71	87	5				253
	Integration Testing	29	7	41	28	-	7			112
	System Testing	5	7	3	18	-	-	5		38
	Field	1	1	2	7	-	-	-	2	13
	Total	340	193	281	419	5	7	5	2	1252

1. DEFECT REMOVAL RATE:
Defect Removal Rate = (Defects Removed / Lines of Code)

Phase	Defects Removed	Lines of Code (KLOC)	Defect Removal (per KLOC)
Requirements	90	53	1.6981
Analysis	122	53	2.3018
Design	207	53	3.9056

Coding	417	53	7.8679
Unit Testing	253	53	4.7735
Integration testing	112	53	2.1132
System testing	38	53	0.7169
Field	13	53	0.2452

2. DEFECT INJECTION RATE:

Defect Injection Rate = (Defects Injected / Lines of Code)

Phase	Defects Injected	Lines of Code(KLOC)	Defect Injection Rate (Per KLOC)
Requirements	340	53	6.4150
Analysis	193	53	3.6415
Design	281	53	5.3018
Coding	419	53	7.9056
Unit Testing	5	53	0.0943
Integration testing	7	53	0.1320
System testing	5	53	0.0943
Field	2	53	0.0377

3. DEFECT ESCAPE RATE:

Defect Escape Rate = (Defects Escape / Lines of Code)

Phase	Defects Injected (Cumulative)	Defects Removed (Cumulative)	Defects Escaped	Defects Escaped/KLOC	Defect Escape Rate
Requirements	340	90	250	250/53	4.7169
Analysis	533	212	321	321/53	6.0566

Design	814	419	395	395/53	7.4528
Coding	1233	836	397	397/53	7.4905
Unit Testing	1238	1089	149	149/53	2.8113
Integration Testing	1245	1201	44	44/53	0.8301
System testing	1250	1239	11	11/53	0.2075
Field	1252	1252	0	0/53	0

4. OVERALL DEFECT REMOVAL EFFECTIVENESS

Overall defect removal Effectiveness: (1 – (Defects in field /total defects found)) * 100 %

Overall defect removal Effectiveness = (1 – (13 / 1252)) * 100 = **98.96%**

5. DEFECT REMOVAL EFFECTIVENESS:

To find out which phase is the most effective in removing defects, we need to calculate using Dunn's formula or Jone's second formula.

We can also use,

Defect removal effectiveness:

Effectiveness = (Defects removed at current phase / (Defects removed at current phase + Defects removed at following phases)) * 100%

Dunn's Formula = Defect Removal rate for testing phases:

Dunn's Formula = Number of Defects found by activity/ (Number of Defects found by activity + Number of defects found by subsequent activities) * 100%

Phase	Defects removed at this phase	Defects existing on step entry	Defects injected in current phase	Defect Removal Effectiveness	Defect Removal Effectiveness * 100%
Requirement Phase	90	0	340	90/ (0+340) = 0.2647	26.47%
Analysis	122	340-90 = 250	193	122/(250+193)= 0.2753	27.53%
Design	207	340+193 – 90-122 = 321	281	207/(321+281)= 0.3438	34.38%
Coding	417	340+193+281-90-122-207 = 395	419	417/(395+419) =0.5122	51.22%
Unit Testing	253	340+193+281+419-90-122-207-417 = 397	5	253/(397+5) = 0.6293 Dunn's formula: 253 / (253+112+38+13) = 0.6081	62.93% Dunn's formula: 60.81%
Integration Testing	112	340+193+281+419+5-90-122-207-417-253 = 149	7	112/(149+7) =0.7179 Dunn's formula: 112 / (112+38+13) =0.6871	71.79% Dunn's formula: 68.71%
System Testing	38	340+193+281+419+5+7-90-122-207-417-253-112 = 44	5	38/(44+5) = 0.7755 Dunn's formula: 38 /(38+13) = 0.7450	77.55% Dunn's formula: 74.5%
Field	13	340+193+281+419+5+7+5-90-122-207-417-253-112-38 = 11	2	13/(11+2) = 1	100%

As per the table, the column with the heading 'Defect Removal Effectiveness' is calculated for each of the phases. And also for the testing phases like Unit Testing, Integration Testing and System testing, the Defect Removal Effectiveness is calculated using the Dunn's formula.

Based on the calculation made, Field has 20.63% as Defect Removal Effectiveness – but since field is the phase where the customers start using the software and the bugs/defects are caught by them.

Hence based on the calculations done, from both the formulae we can conclude that Integration Testing phase has the highest defect removal effectiveness that the other phases.

6. Do you think reviews and inspections were effective? Explain.

- Yes, Reviews and inspections were effective in this project as the defects which escaped and propagated to next phases keeps decreasing drastically after Coding phase.
- The number of these defects is observed to be very high as seen in the table in the initial phases.
  EX: 250, 321, 395 and so on
- The defects were caught during the Testing phases like Integration Testing and System Testing where the defects gradually decreased.
- So due to effective testing, the number of defects that got escaped to field is very less and the effectiveness of reviews and inspection for the initial phases is efficient.

7. If the number of defects originated in requirements phase increased by 25% and defects detected in requirements review increased by 25%, do you think that will have a positive or negative impact on the defects originated in the coding phase? Explain your answer in detail (present data to support your answer).

		Defect Origin								
		Requirement	Analysis	Design	Coding	Unit Testing	Integration Testing	System Testing	Field	Total
Where Found	Requirement	112.5								112.5
	Analysis	93.75	47							140.75
	Design	83.75	37	103						223.75
	Coding	42.5	43	61	279					425.5
	Unit Testing	48.75	51	71	87	5				262.75
	Integration Testing	36.25	7	41	28	-	7			119.25
	System Testing	6.25	7	3	18	-	-	5		39.25
	Field	1.25	1	2	7	-	-	-	2	13.25
	Total	425	193	281	419	5	7	5	2	1337

Considering Coding Phase :

Defect Removal Effectiveness:

Defects removed at this phase: 425.5

Defects existing on step entry: (425 + 193 + 281) – (112.5 + 140.75 + 223.75) = 422

Defects injected in current phase: 419

DRE: 425.5 / (422 + 419) * 100 = 50.59 %

So from the above calculation of DRE, we can conclude that there will be no impact on coding phase due to increase in Review at the requirement phase by 25%. This is because the defects existing on step entry and the defects getting removed during the initial table as well as after the increase by 25% to requirement phase are different.

8. If the number of defects originated in design phase increased by 5% and defects (defects escaped from prior phases and injected in current) detected in code inspections increased by 95%, do you think that will have a positive or negative impact on defect removal effectiveness for the testing phases? Explain your answer in detail (present data to support your answer)

		Defect Origin								
Where Found		Requirement	Analysis	Design	Coding	Unit Testing	Integration Testing	System Testing	Field	Total
	Requirement	90								90
	Analysis	75	47							122
	Design	67	37	108.15						212.15
	Coding	66.3	83.85	124.89	544.05					819.09
	Unit Testing	39	51	74.55	87	5				256.55
	Integration Testing	29	7	43.05	28		7			114.05
	System Testing	5	7	3.15	18			5		38.15
	Field	1	1	2.1	7				2	13.1
	Total	372.3	233.85	355.89	684.05	5	7	5	2	1665.09

On calculating the Defect Effectiveness Removal,

Phase	**Defects removed at this phase**	**Defects existing on step entry**	**Defects injected in current phase**	**Defect Removal Effectiveness**	**Defect Removal Effectiveness * 100%**
Unit Testing	256.55	372.3+233.85+355.89+684.05-(90+122+212.15+819.09) = 402.85	5	256.55/(402.85+5) = 0.6290 Dunn's formula: 256.55/ (256.55+114.05+38.15+13.1) = 0.6081	62.90% Dunn's formula: 60.81%
Integration Testing	114.05	372.3+233.85+355.89+684.05+5-(90+122+212.15+819.09+256.55) = 151.3	7	114.05/(151.3+7) =0.7204 Dunn's formula: 114.05/(114.05+38.15+13.1) =0.6899	72.04% Dunn's formula: 68.99%
System Testing	38.15	372.3+233.85+355.89+684.05+5+7-(90+122+212.15+819.09+256.55+114.05) = 44.25	5	38.15/(44.25+5) = 0.7746 Dunn's formula: 38.15/(38.15+13.1) = 0.7443	77.46% Dunn's formula: 74.43%

On comparing the initial calculation and the updated one,

Testing Phase	Previous DRE	New DRE	Previous Dunn's value	New Dunn's value
Unit Testing	62.93%	62.90%	60.81%	60.81%
Integration Testing	71.79%	72.04%	68.71%	68.99%
System Testing	77.55%	77.46%	74.5%	74.43%

From the above calculations:

If the number of defects originated in design phase is increased by 5% and defects detected in code inspections increased by 95%, we can conclude that there would be **no major impact** on the testing phases as the values have increased in very minute scale which could help a very little positive impact on the defect removal effectiveness in testing phase.