**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 |
|  | Requirement | 90 |  |  |  |  |  |  |  | 90 |
| Where | Analysis | 75 | 47 |  |  |  |  |  |  | 122 |
| Found |
|  | 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 |
|  | Requirement | 112.5 |  |  |  |  |  |  |  | 112.5 |
| Where | Analysis | 93.75 | 47 |  |  |  |  |  |  | 140.75 |
| Found |
|  | 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** |  |  |  |  |  |  |
|  |  | Requirement | Analysis | Design | Coding | Unit Testing | Integration Testing | System Testing | Field | Total |
|  | Requirement | 90 |  |  |  |  |  |  |  | 90 |
| Where | Analysis | 75 | 47 |  |  |  |  |  |  | 122 |
| Found |
|  | 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.