**SPM HW4 CWID:A20347964**

1. **Defect Removal effectiveness for Each Phase**

|  |  |  |
| --- | --- | --- |
| Phase | Defects Detected | Defect Removal Rate |
| Requirement | 113 | **1.686 defects/KLOC** |
| Analysis | 169 | **2.522 defects/KLOC** |
| Design | 284 | **4.238 defects/KLOC** |
| Coding | 674 | **10.059 defects/KLOC** |
| Unit Testing | 336 | **5.014 defects/KLOC** |
| Integration Testing | 189 | **2.82 defects/KLOC** |
| System Testing | 101 | **1.507 defects/KLOC** |
| Field | 46 | **0.686 defects/KLOC** |
|  | Total | **28.537 defects/KLOC** |

1. **Defect Injection Rate = Injected Defects / Product Size**

|  |  |  |
| --- | --- | --- |
| Phase | Defects in Each Phase | Defect Injection Rate |
| Requirement | 462 | **6.895 defects/KLOC** |
| Analysis | 271 | **4.044 defects/KLOC** |
| Design | 375 | **5.597 defects/KLOC** |
| Coding | 765 | **11.417 defects/KLOC** |
| Unit Testing | 9 | **0.134 defects/KLOC** |
| Integration Testing | 11 | **0.164 defects/KLOC** |
| System Testing | 14 | **0.208 defects/KLOC** |
| Field | 5 | **0.074 defects/KLOC** |
|  |  |  |

1. **Defect Escape rate = Escaped Defects / Product Size**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Phase | Defects in Each Phase | Defects Detected in Each Phase | Escape Defects | Defect Escape Rate |
| Requirement | 462 | 113 | 349 | **5.208 defects/KLOC** |
| Analysis | 271 | 169 | 451 | **6.731 defects/KLOC** |
| Design | 375 | 284 | 542 | **8.08 defects/KLOC** |
| Coding | 765 | 674 | 633 | **9.447 defects/KLOC** |
| Unit Testing | 9 | 336 | 306 | **4.567 defects/KLOC** |
| Integration Testing | 11 | 189 | 128 | **1.91 defects/KLOC** |
| System Testing | 14 | 101 | 41 | **0.611 defects/KLOC** |
| Field | 5 | 46 | 0 | **0 defects/KLOC** |

1. **Which phase is the most effective in removing defects?**

DRE = (Defects removed during a development phase / Defects latent in the product at that phase) x 100%

**DRE in Requirement** = (113/ (113+98+78+59+39+56+8+11)) \*100%= **24.45%**

**DRE in analysis** = ((98+71)/ (98+78+59+39+56+8+11+71+72+63+44+11+9+1))\*100%=**27.25%**

**DRE in design** = ((78+72+134)/( 78+59+39+56+8+11+72+63+44+11+9+1+134+121+55+44+13+8))\*100%

= (284/826) \*100%=**34.38%**

**DRE in coding** = ((59+63+121+431)/(59+39+56+8+11+63+44+11+9+1+121+55+44+13+8+431+189+67+57+21))\*100%

= (674/1307) \*100%=**51.56%**

**DRE in Unit Testing** =

((39+44+55+189+9)/ (39+44+55+189+9+56+11+44+67+8+9+13+57+11+1+8+21))\*100%

= (336/642)\*100%=**52.33%**

**DRE in IT** =

((56+11+44+67+11)/ (56+11+44+67+11+8+9+13+57+11+1+8+21))\*100%

= (189/317)\*100%=**59.62%**

**DRE in System Testing** =

((8+9+13+57+14)/ (8+9+13+57+14+11+1+8+21))\*100%

= (101/142)\*100%=**71.12%**

**DRE in Field**=

((11+1+8+21+5) / (462+271+375+765+9+11+14-113-169-284-674-336-189-101 + 5))\*100%

= (46/46)\*100%= **100%**

**Consolidated Table**

|  |  |
| --- | --- |
| Phases | % |
| Requirement | 24.45 |
| Analysis | 27.25 |
| Design | 34.38 |
| Coding | 51.56 |
| UT | 52.33 |
| IT | 59.62 |
| ST | 71.12 |

From the above table we can see that System Testing phase has 71.12% defect removal effectiveness, which is more compared to DRE in other phases. Therefore System Testing phase is more effective in removing defects.

**5.** **Overall Defect Removal Effectiveness** = (Pre-release Defect) / (Total Defects) x 100%

= (1866/1912) \*100=**97.59%**

**6. Question 6**

If you see number of defects detected in each phase indicates a steep rise and fall of number of defects during end of our product testing, this is similar to bell curve and also it is similar to a pattern in typical commercial product development.

The defect rate in each phases are requirement(462),Analysis(271),Design(375),Coding(765),Unit Testing(9),Integration Testing(11), System Testing(14), Field(5). This data follows a bell cure pattern and strongly indicates the reviews and inspections are effective, additionally Overall defect removal effectiveness is 97.59% which strengthen our conclusion.

**7. Question 7**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Requirement | Analysis | Design | Coding | UT | IT | ST | Field | Total in each phase |
| Requirement | 113\*1.4=158.2 |  |  |  |  |  |  |  | 158.2 |
| Analysis | 98 | 71 |  |  |  |  |  |  | 169 |
| Design | 78 | 72 | 134 |  |  |  |  |  | 284 |
| Coding | 59 | 63 | 121 | 431 |  |  |  |  | 674 |
| UT | 39 | 44 | 55 | 189 | 9 |  |  |  | 336 |
| IT | 56 | 11 | 44 | 67 | 0 | 11 |  |  | 189 |
| ST | 8 | 9 | 13 | 57 | 0 | 0 | 14 |  | 101 |
| Field | 11 | 1 | 8 | 21 | 0 | 0 | 0 | 5 | 46 |
|  | 462\*1.4=647 | 271 | 375 | 765 | 9 | 11 | 14 | 5 |  |
|  |  |  |  |  |  |  |  |  |  |

The number of defects originated in Requirements is 462 and it is increased by 40%, which leads to 647 defects approximately. The number of defects detected in Requirements phase is 113 and when increased by 40 % it leads to 158 defects approximately. The number of defects originated in requirement phase is increased to 185 and the defects detected in Requirements phase has increased by 45.

Let us assume that 45 defects out of 158 defects which is originated in Requirements have been identified in the same phase. Hence there are 113 more Requirement defects which will be passed on to other phases. If any of those defects is detected after the coding phase or in the coding phase, it is going to change the analysis and design. When there is a change in the design, subsequently the code violates the change in design also ends up increase in number of defects originated in the coding phase. Hence it leads to increase in defects originated in coding phase which causes a negative impact. And also to note when there is a change in requirement which do not effect code, then there would be no effect in the coding phase.

**8. Question 8**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Requirement | Analysis | Design | Coding | UT | IT | ST | Field | Total in each phase |
| Requirement | 113 |  |  |  |  |  |  |  | 158.2 |
| Analysis | 98 | 71 |  |  |  |  |  |  | 169 |
| Design | 78 | 72 | 134 |  |  |  |  |  | 284 |
| Coding | 59 | 63 | 121 | 431 |  |  |  |  | 674\*1.9=1281 |
| UT | 39 | 44 | 55 | 189 | 9 |  |  |  | 336 |
| IT | 56 | 11 | 44 | 67 | 0 | 11 |  |  | 189 |
| ST | 8 | 9 | 13 | 57 | 0 | 0 | 14 |  | 101 |
| Field | 11 | 1 | 8 | 21 | 0 | 0 | 0 | 5 | 46 |
|  | 462 | 271 | 375\*1.1=412(412.5) | 765 | 9 | 11 | 14 | 5 |  |
|  |  |  |  |  |  |  |  |  |  |

The number of defect originated in the design phase is 375; increasing it by 10% leads to 412 approximately. The increase of defects in design and catching defects in coding will not actually have any impact on the defect removal rate of the testing phase. This conclusion is based on the formula to calculate “defect at exit of a development phase”=Defects escaped from previous step +Defects injected in current phase –Defects removed in current phase. If you see the defects detected at testing phase are defects escaped from coding phase / defects injected in current phase, however the question states about increasing defects in design phase and increasing in number of defects found in coding phase through code inspections. So the increase of defects in design and catching more defects in coding will not have any impact on the defect removal rate of the testing phase, this conclusion also strengthen by Dunn’s formula, this formula states Defect removal effectiveness depends on current phase and the phases after the current phase, consequently there will be no impact on DRE in testing phase.