TUTORIAL DISCUSSION (7)

A Model for SQA Defect Removal Effectiveness and Cost

- It is assumed that any QA activity filters (screens) a certain percentage of existing defects.
- This is because in most cases, the percentage of removed defects is somewhat lower than the percentage of detected defects as some corrections (about 10%) are ineffective or inadequate.
- The remaining defects, those undetected and uncorrected, are passed to successive development phases. The next QA activity applied confronts a combination of defects: those remaining after previous QA activities together with "new" defects, created in the current development phase.
- The model is based on three types of data:
  - Defect origin distribution
  - Defect removal effectiveness
  - Cost of defect removal

Example:

Table 1 – A Characteristic Distribution of Software Defect Origins

Software Development Phase	Average % of defects originating in phase
Requirement Specification	15%
Design	35%
Coding (Coding 30%, Integration 10%)	40%
Documentation	10%

Table 2 – Average Filtering (Defect Removal) Effectiveness by Quality Assurance Activities

QA Activities	Average defect filtering effectiveness rate
Requirement Specification Review	50%
Design Inspection	60%
Design Review	50%
Code Inspection	65%
Unit Test	50%
Unit Test after code inspection	30%
Integration Test	50%
System Test / Acceptance Tests	50%
Documentation Review	50%

Table 3 – Representative Average Relative Defect-Removal Costs

Defect Removal Phase	Average relative defect removal cost [cost units in Working Day] Defect Origination Phase				
	Req	Des	Uni	Int	Doc
Requirements Specification (Req)	1	-	-	-	-
Design (Des)	2.5	1 *	-	-	-
Unit Coding (Uni)	6.5	2.6	1	-	-
Integration (Int)	16	6.4	2.5	1	-
System Documentation (Doc)	-	-	-	-	1
System Testing / Acceptance Testing (Sys)	40	16 *	6.2	2.5	2.5
Operation by Customer (after release)	110	44	17	6.9	6.9

Table 4 – Standard Quality Assurance Plan

No	Defect Removal Phase	Defect Removal Effectiveness	Average relative defect removal cost [cost units in Working Day] Defect Origination Phase				
			Req	Des	Uni	Int	Doc
1	Requirements Specification (Req): Requirement Review	50%	1	-	-	-	-
2	Design (Des): Design Review	50%	2.5	1	-	-	-
3	Unit Coding (Uni): Unit Test	50%	6.5	2.6	1	-	-
4	Integration (Int): Integration Tests	50%	16	6.4	2.5	1	-
	System Documentation (Doc): Documentation Reviews	50%	16	6.4	2.5	1	-
5	System Testing / Acceptance Testing (Sys): System Test	50%	40	16	6.2	2.5	2.5
6	Operation by Customer (after release)	50%	110	44	17	6.9	6.9

Notation:
POD = Phase Originated Defects (from Table-1)
%Fe = % of Filtering Effectiveness (also termed % screening effectiveness, from Table-2)
PD = Passed Defects (from former phase or former quality assurance activity) = x – (50%)x
RD = Removed Defects
RDRC = Relative Defect Removal Cost (from Table-3)
TRC = Total Removal Cost = RD x CDR
cu = cost units

The model is based on the following assumptions:

- The development process is linear and sequential, following the waterfall model
- A number of "new" defects are introduced in each development phase. For their distribution, see Table-1. It is assumed that no "new" defects are introduced in the phases of system tests and acceptance test
- Review and test software quality assurance activities serve as filters, removing a percentage of the entering defects and letting the rest pass to the next development phase. For example, if the number of incoming defects is 30, and the filtering efficiency is 60%, then 18 defects will be removed, while 12 defects will remain and pass to be detected by the next quality assurance activity. Typical filtering effectiveness rates for the various quality assurance activities are show in Table-2.
- The filtering efficiency is the same for every defect, no matter what its origination phase.
- At each phase, the incoming defects are the sum of defects not removed by former quality assurance activity together with the "new" defects introduced (created) in the current development phase.
- The average cost of defect removal at the phase it was originated is the same for all phases – one cost unit
- The cost of defect removal is calculated for each quality assurance activity by multiplying the number of defects removed by the relative cost of removing a defect (according to its originating and removal phases – see last table)
- The remaining defects, unfortunately passed to the customer will be detected by him or her. In these circumstances, full removal entails the heaviest of defect-removal costs.