Statistical Quality Assurance

A quantitative way to look at software quality.

The Main Steps Involved

1. Categorise data on s/w defects
2. Define the underlying causes of s/w defects
3. Use the “Pareto” principle to condense the defect causes
4. Implement corrective measures on causes

The Causes of Software Defects

- Incomplete or erroneous spec. (IES)
- Misinterpretation of customer comm. (MCC)
- Intentional deviation from spec. (IDS)
- Violation of programming standards (VPS)
- Error in data representation (EDR)
- Inconsistent module interface (IMI)
- Error in design logic (EDL)
- Incomplete or erroneous testing (IET)
- Incomplete or inaccurate documentation (IID)
- Programming language translation of design error (PLT)
- Ambiguous or inconsistent HCI (HCI)
- Miscellaneous (MIS)

What lies at the root of defects

Consider the separate table given to you as a typical cross-section of statistical SQA observation over one year in a s/w development organisation.

- It can be argued that the main roots of serious s/w defects are: IES, EDR, PLT and EDL
- Therefore, short-term organisation reaction should concentrate on these

Corrective measure examples

- IES - Improve specification techniques, introduce new methods, upgrade personnel, etc.
- EDR - Adopt automated data design tools, impose stringent data modelling and reviews, etc.
- PLT - use more visibility, check design phase output, enforce strict translation techniques, etc.
- EDL - reinforce good requirements understanding, ensure personnel quality, adopt widespread design techniques, etc.

Error Index (EI) calculation *(1)*

- EI is an arbitrary value by which to quantify the quality (error-wise in this case) of s/w development. At every development phase in the SE process a phase index PI can be calculated as:

$$PI_i = w_s(S_i/E_i) + w_m(M_i/E_i) + w_t(T_i/E_i)$$

Where: S_i number of serious errors,
M_i number of moderate errors,
T_i number of trivial errors,
E_i total errors uncovered in i^{th} step of the SE process

It is recommended that: $w_s = 10$
$w_m = 3$
$w_t = 1$

Error Index (EI) calculation *(2)*

- The final error index is the sum of all the phase indices weighted according to their sequence in the SE process.

$$EI = (i \times PI_i)/PS_i = (PI_1 + 2PI_2 + \ldots + PI_i)/PS$$

Where: PS_i product size at i^{th} step *(depending on development phase could be pages of documentation, design units, LOC, specification units, etc.)*

EI calculation is intended to be done together with data from a table such as the one handed to you.

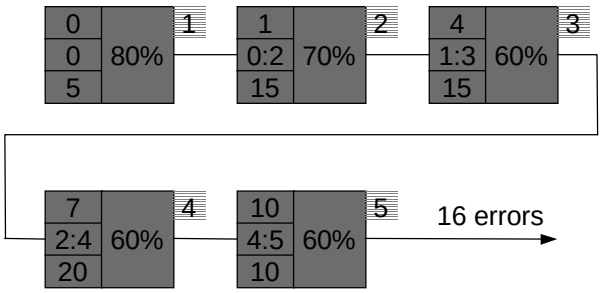
EI Calculation example *(1)*

For the sake of this example, let the following SE process be assumed.

1. Requirements Capture
2. Requirements Specification
3. Architectural Design
4. Component Design
5. Coding

EI Calculation example *(2)*

Assuming 10% serious, 50% moderate and 40% trivial errors after every phase. Also assuming the following error-flow chart.



EI Calculation example *(3)*

- Error breakdown after each phase:
  - 1: Requirements capture
    - 1 error: 0 serious / 1 moderate / 0 trivial
  - 2: Requirements specification
    - 5 errors: 0 serious / 3 moderate / 2 trivial
  - 3: Architectural design
    - 9 errors: 0 serious / 5 moderate / 4 trivial
  - 4: Component design
    - 14 errors: 1 serious / 7 moderate / 6 trivial
  - 5: Coding
    - 16 errors: 2 serious / 8 moderate / 6 trivial

EI Calculation example *(4)*

- Now apply the relationships to compute EI:

$PI_1 = 0 + 3(1/1) + 0 = 3.00$

$PI_2 = 0 + 3(3/5) + 10(2/5) = 5.80$

$PI_3 = 0 + 3(5/9) + 10(4/9) = 6.11$

$PI_4 = 1(1/14) + 3(7/14) + 10(6/14) = 5.86$

$PI_5 = 1(2/16) + 3(8/16) + 10(6/16) = 5.38$

Therefore (assuming PS = 400):

$EI = (3 + 2\times5.8 + 3\times6.11 + 4\times5.86 + 5\times5.38)/400$

$= 83.27/400$

$= \mathbf{\underline{0.21}}$

A Reliability Measure

- Hardware is subject to wear - software isn't
- Software is subject to design defects - hardware usually isn't
- In the case of s/w the "mean time between failure" is the measure used

$$MTBF = MTTF + MTTR$$

MTTF: Mean time to failure
MTTR: Mean time to repair

- Availability measure:

$$Avail = MTTF/(MTTF + MTTR) \times 100\%$$