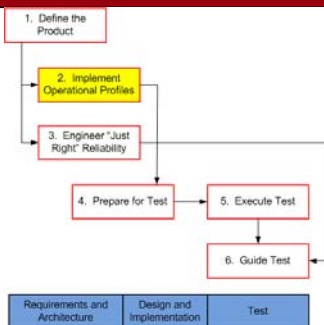


SRE: Implementing Operational Profiles



This lecture provides reference material for Chapter 2 of the book entitled "Software Reliability Engineering: More Reliable Software Faster and Cheaper" by John D. Musa © 2004

This lecture material is copyrighted by Laurie Williams (2007). However, you are encouraged to download, forward, copy, print, or distribute it, provided you do so in its entirety (including this notice) and do not sell or otherwise exploit it for commercial purposes.

For PowerPoint version of the slides, contact Laurie Williams at williams@csc.ncsu.edu.

Operational Profile

- **Operation:** a major system logical task performed for an initiator with control returned to the system when it is complete [so a new operation can start].
 - User stories (and use cases) are very operation-oriented.
- **Operational profile:** a complete set of operations with their probabilities of occurrence
 - Probability of occurrence refers to the probability among all invocations of all operations
 - Example: 17 out of every 100 invocations of operations is operations x, probability of occurrence = 0.17.

Table 2.1 System operational profile for Fone Follower

Operation	Operations /	Probability
Process voice call, no pager, answer	18,000	0.18
Process voice call, no pager, no	17,000	0.17
Process voice call, pager, answer	17,000	0.17
Process fax call	15,000	0.15
•		
•		
Total	100,000	1

Developing an Operational Profile

- Often done by systems engineers/marketing and product personnel, but system testers should be involved too.
- Five principle steps in developing an operational profile:
 1. Identify initiators of operations
 2. Create operations list
 3. Review operations list
 4. Determine occurrence rates
 5. Determine occurrence probabilities
- All started in the requirements phase and refined iteratively in future phases.
- Generally takes 1-2 weeks for small products, longer with larger products, but decreases after first release.

1. Identify the Initiators of Operations

- **Customer type:** set of customers (organizations or individuals who acquire but may not directly employ your product) who have similar businesses and hence tend to have the same user types.
- **User types:** set of users (individuals who directly employ the product) who tend to employ the product in the same way.
 - User is anyone who can initiate an operation on the system.
 - Including maintainers and administrators
- **External systems** that initiate operations on the system
- **System under study** if it initiates operations itself

2. Create the Operations List

- Generate an operations list for each initiator-type
- Consult system requirements, work process flow diagrams, user manuals, prototypes, and information on previous releases
- Meet with systems engineers, human factors engineers, marketing personnel and expected users
- Be sure to include “housekeeping operations” that (re)initialize or clean up data
- Rough guideline: each operation should have more than 100 deliverable source lines different from another operation.
 - High probability each test case would reveal unique faults.
- We should execute each operation at least once in test
 - unless it has a very low occurrence probability **and** is non-critical

3. Review the Operations List

- At least one expert for each initiator-type for the operations list to be as complete as possible
- Check to make sure:
 - Operations are of short duration in execution time (want to run lots of tests rather than a few long tests)
 - Each operation has substantially different processing from the others.
 - Operations are well-formed (sending messages and displaying data are PART of the operation, not the operation itself)
 - The list is complete with high probability
 - The total number of operations is reasonable (taking into account the budget)
 - 20 to several hundred operations, typically, depending on size
 - Cost to develop operational profile: roughly half a staff hour per operation
- The list will evolve over time and as the system is developed (need to adjust profile)

4. Obtaining Occurrence Rates

- **Occurrence rate:** number of occurrences of the operation divided by the time the total set of operations running
- Where to find data
 - Look for existing field data from previous release/similar system
 - Look at system logs
 - Search for existing business data; product business case
 - Ask a marketer (engineers should network with marketers!)
 - Record field operations from current product (data for old operations)
 - No recourse . . . Make estimates
 - Group low probability operations (or all of them) and assign equal probability to each
 - Apply the Delphi method.
- Instrument your code so that it identifies the operations that were executed . . . for future occurrence data.

5. Determine Occurrence Probabilities

- Divide occurrence rate of each operation by the total operation occurrence rate.
- Sort in order of descending probabilities.

Table 2-5. System occurrence probabilities for Fone Follower

Operation	Occurrence Probability
Process voice call, no pager, answer	0.21
Process voice call, pager, answer	0.19
Process fax call	0.17
Process voice call, pager, answer on page	0.13
Process voice call, no pager, no answer	0.10
Process voice call, pager, no answer on	0.10
Enter forwardees	0.09
Audit section of phone number database	0.009
Add subscriber	0.0005
Delete subscriber	0.0005
Recover from hardware failure	0.000001
Total	1.0

Applying Operational Profiles

- Proportionally distribute the number of new test cases and the overall test time according to the operational profile
- But, this information can be used in other ways as well:
 - Aids in determining a competitive release strategy
 - Implement the most critical and/or most used in early releases
 - Build an operation-based architecture, not a component-based architecture
 - Pareto principle (a small number of things occur most of the time): in a typical software system, 5% of the software operations may provide 80% of the functionality the customer wants
 - Allocate development resources to best serve the needs of the customer as quickly as possible

Summary

- The operational profile is developed to systematically determine how to proportion effort.
 - The user types are enumerated
 - The operations they users want to perform are enumerated
 - The proportion of time each type wants to perform each operation are estimated