DIFFERENCE BETWEEN RELIABILITY TESTING AND DURABILITY TESTING

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INTRODUCTION

One definition of reliability is "the measure of *unanticipated interruptions* during customer use." The unanticipated interruptions typically arise from unexpected failures. During a reliability test, one important goal is to maximize the opportunities for observing unexpected failures, so that they can be fixed. The fewer the opportunities we have to observe unpredictable failures, the greater the chance that we are not testing to measure reliability. A test may appear to be a reliability test and actually be a durability type test when opportunities for discovering unscheduled interruptions are minimized unintentionally.

How can we minimize the probability of discovering unexpected interruptions?

RELIABILITY AND DURABILITY

Let us first discuss the difference between reliability and durability. One measure of durability is represented by the duration of product ownership. Reliability, on the other hand, represents interruptions in usage during that ownership. The ownership of any product or system cannot be enjoyed if it is continually interrupted and the desired functions lost for even a brief time. This means reliability takes precedence over durability even though both are desired in most applications.

To assess reliability or durability we rely on internal qualification tests, because it is not possible to calculate either reliability or durability from basic principles alone. Even if we can generate mathematical models to estimate reliability or durability, the models still need to be verified by testing.

This brings us to a discussion about the differences between reliability testing and durability testing. A durability test is a subset of a reliability test. We may be able to estimate durability from a reliability test but we cannot estimate reliability from a durability test. Additionally, both these tests appear very similar from the testing mechanics' viewpoint, it is often difficult to discern any differences. So how can we make a clear distinction between a reliability test and a durability test?

RELIABILITY TESTING AND ACTUAL INDUSTRY PRACTICE

Earlier we defined reliability as a measure of unexpected interruptions. Therefore, a reliability test must maximize the opportunity to observe unexpected interruptions typical of customer experience. In Table 1, we examine the differences between what reliability testing practices should be versus actual industry testing practices. Furthermore, we identify the best practices.

Considering all the differences that potentially exist between actual industry testing practices and what should be as described in Table 1, a formal definition of reliability testing can be stated as follows.

RELIABILITY TESTING - DEFINED

The testing of a product in the end-user environment and in the end-user hands -- on a randomly selected production sample constitutes a major part of a well-designed reliability test. It is a test in which the chances for catching unexpected interruptions are maximized. Any departure from the reliability test definition most likely estimates durability and not reliability. Figure 1 describes the subtle differences between durability testing paths and reliability testing paths.

Table 1 – Reliability Testing Practices

Reliability test should be	Actual industry practice	Best practice
Reliability test should reflect a true customer. Actual likely users in an actual environment should be testing products.	In most instances, industry uses expert or well-trained employees to simulate customers' feedback. Well-trained employees are not a true reflection of potential customers. Employees have vested interest and therefore, one cannot consider the data as 100% valid.	Use actual users and actual environments for tests whenever possible.
If testing must be done in a laboratory, a reliability test should reflect a true user environment.	Many tests are conducted in a laboratory under a simulated, single environment. The outcome of such tests most likely represents durability rather than reliability.	If only laboratory tests are possible, measure customer environments and design tests accordingly, so that all environments and the operating profile are included simultaneously.
The reliability test should reflect a sample coming from a true production environment.	In many instances, prototype parts are used for the test. Prototype parts may exhibit the validity of physical principles but may not necessarily reflect reliability.	Define reliability at two levels: 1) hardware level D (design level) and 2) hardware level P (production level). Design engineering is considered complete only when both the D level and P level are proven.
Reliability tests should use random samples.	Industry practice is to use pre-qualified test samples. That means, the test samples are inspected and assured to be within specifications before they are subjected to the tests. This, in turn, reduces the chances of observing premature failures. Pre-qualified samples most likely measure durability not reliability.	Use random samples. Or, if pre-qualified samples have to be used, make the pre-qualification scheme a part of the production control plan.
The reliability test should be a validation test, not just a verification test.	Most tests are designed to verify design requirements. These requirements are supposedly a translation of customer requirements. Such tests can be labeled as verification tests. The outcome of such tests most likely measures durability rather than reliability. Additionally, the tests do not reflect the fact that some customer environments may be inadequately translated or some customer environments may be omitted altogether.	Perform verification tests on a smaller sample. Perform validation tests on a larger sample.

EPILOGUE

Some industries are still riddled with substantial warranty expenses. Typically elements of unrecognized user environments and processing problems that escape the quality system make up a major portion of the causes of these warranty expenses. Companies sometimes still do not understand why warranty costs are high in spite of successful product releases. Engineering or management may feel satisfied when tests pass the prescribed criteria yet the test plan does not reflect the full customer environment or the full range of manufacturing variability. In such cases, we can say that quality-planning efforts are "focused on verification, not on validation."

I believe that understanding the difference between reliability testing and durability testing is a key to reducing design/development expenses as well as warranty expenses by an order of magnitude. Specifically, these benefits are based on the following facts:

1) Reliability tests are shorter than durability tests by a considerable amount of time. The best practices described in Table 1 will discover failures sooner.
2) Validation planning efforts are usually much more meaningful than verification planning efforts resulting in a net benefit.
3) Reliability tests often discover problems before they are discovered in the field.

Are you conducting durability tests or reliability tests at your company?

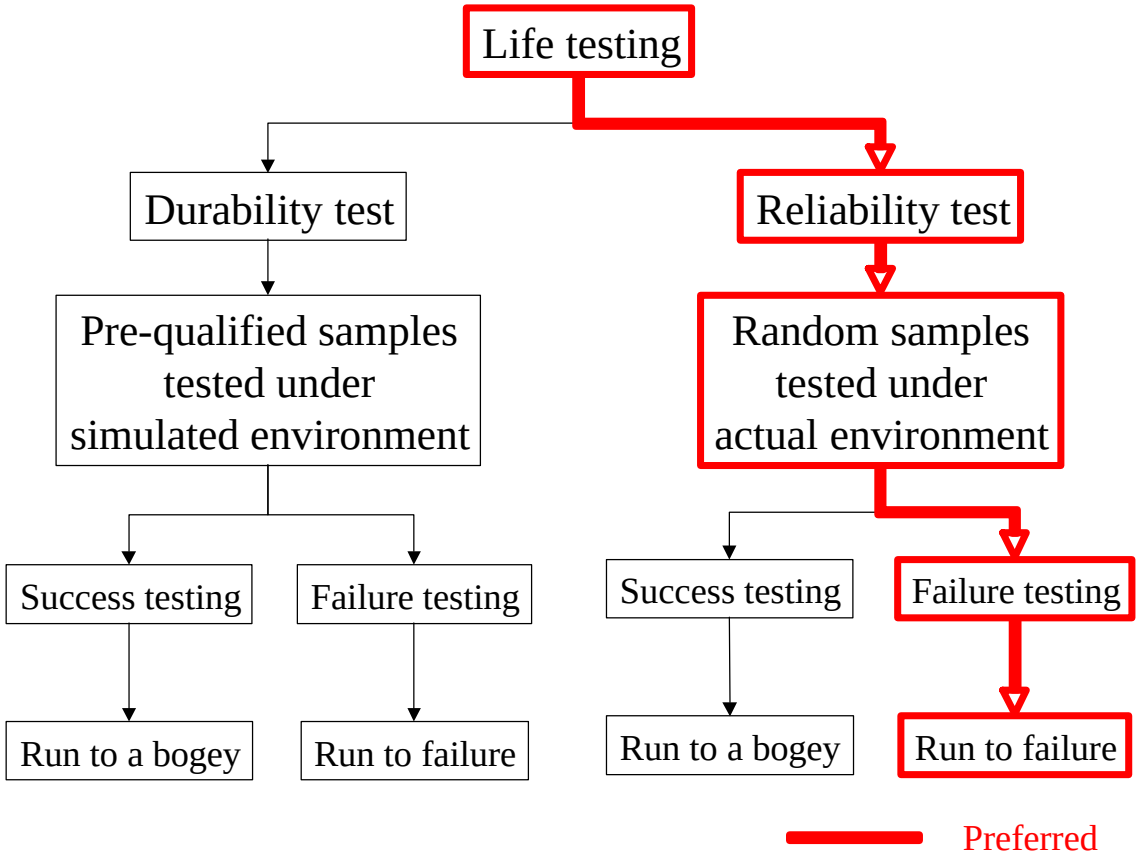

Figure 1 – Difference between Reliability Testing and Durability Testing