Safety Corner

What is Reliability Engineering?

In general, **reliability** (systemic def.) is the ability of a person or system to perform and maintain its functions in routine circumstances, as well as hostile or unexpected circumstances.

Reliability engineering is an engineering field, that deals with the study of reliability: the ability of a system or component to perform its required functions under stated conditions for a specified period of time.[1] It is often reported in terms of a probability.

Reliability theory is the foundation of reliability engineering. For engineering purposes, reliability is defined as:

> **the probability that a device will perform its intended function during a specified period of time under stated conditions.**

Mathematically, this may be expressed as,

$$R(t) = Pr\{T > t\} = \int_t^\infty f(x)\,dx$$

,

where $f(x)$ is the failure probability density function and *t* is the length of the period of time (which is assumed to start from time zero).

Reliability engineering is concerned with four key elements of this definition:

- First, reliability is a probability. This means that failure is regarded as a random phenomenon: it is a recurring event, and we do not express any information on individual failures, the causes of failures, or relationships between failures, except that the likelihood for failures to occur varies over time according to the given probability function. Reliability engineering is concerned with meeting the specified probability of success, at a specified statistical confidence level.
- Second, reliability is predicated on "intended function:" Generally, this is taken to mean operation without failure. However, even if no individual part of the system fails, but the system as a whole does not do what was intended, then it is still charged against the system reliability. The system requirements specification is the criterion against which reliability is measured.
- Third, reliability applies to a specified period of time. In practical terms, this means that a system has a specified chance that it will operate without failure before time t. Reliability engineering ensures that components and materials will meet the requirements during the specified time. Units other than time may sometimes be used. The automotive industry might specify reliability in terms of miles, the military might specify reliability of a gun for a certain number of rounds fired. A piece of mechanical equipment may have a reliability rating value in terms of cycles of use.
- Fourth, reliability is restricted to operation under stated conditions. This constraint is necessary because it is impossible to design a system for unlimited conditions. A Mars Rover will have different specified conditions than the family car. The operating environment must be addressed during design and testing.

Reliability engineering is performed throughout the entire life cycle of a system, including development, test, production and operation. The function of reliability engineering is to develop the reliability requirements for the product, establish an adequate reliability program, and perform appropriate analyses and tasks to ensure the product will meet its requirements. These tasks are managed by a reliability engineer, who usually holds an accredited engineering degree and has additional reliability-specific education and training. Reliability engineering is closely associated with maintainability engineering and logistics engineering. Many problems from other fields, such as security engineering, can also be approached using reliability engineering techniques. This article provides an overview of some of the most common reliability engineering tasks. Please see the references for a more comprehensive treatment.

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The Safety Corner is contributed by Ir Dr. Vincent Ho, who can be contacted at vsho.hkarms@gmail.com