CE-370 Reliability of Engineering Systems

Instructor: Eric M. Hernandez, PhD

WHAT IS RELIABILITY?

From the Merriam-Webster dictionary we find the following definitions:

Reliability: (noun) The quality or state of being *reliable*.

Reliable: (adj.) Able to be trusted to do or provide what is needed. Able to be relied on.

The following definitions are found on various specialized textbooks on the subject:

Reliability has an exact meaning. Not only can it exactly defined, but it can also be calculated, objectively evaluated, measured, tested, and even designed into a piece of equipment. Stated simply, reliability is the capacity of an equipment not to break down in operation. - Reliability Theory and Practice, I. Bazovsky, 1961.

Reliability of a component is the probability that it will function properly throughout the period of interest. - Probability, Statistics, and Decision for Civil Engineers, J.R. Benjamin and C.A. Cornell, 1970.

The reliability of a system is the probability that, when operating under stated environmental conditions, the system will perform its intended function adequately for a specified interval of time - Reliability in Engineering Design, K.C. Kapur and L.R. Lamberson, 1977.

Reliability can be considered as the science of estimating, controlling, and managing the probability of failure. - Reliability: Management, Methods and Mathematics, D.K. Lloyd and M. Lipow, 1984.

The reliability at time t is defined as the probability that the component, subsystem or system is still functioning at time t. - Probability and Random Processes for Electrical Engineers, A. Leon-Garcia, 1994.

Reliability is the probability of a devise performing its purpose adequately for the period of time intended under operating conditions encountered. - Engineering Reliability, R. Barlow, 1998.

The term 'reliability' is commonly defined as the complement of the probability of failure but more properly it is the probability of safety (or proper performance) of the structure over a given period of time. - Structural Reliability Analysis and Prediction, R.E. Melchers, 1999.

Reliability is a probability of survival for a given period (of time). - Mathematical Foundations for Design, R.M. Stark and R.L. Nichols, 2000.

Reliability pertains to the quantification of the occurrence of adverse events in the context of engineering and physical systems...the ultimate goal of doing a reliability analysis is to appreciate the nature of the underlying risk and to propose strategies for managing it...one's uncertainty about reliability, is personal. - Reliability and Risk, N.D. Singpurwalla, 2006.

Reliability of a structure is its ability to fulfill its design purpose for some specified design lifetime. - Reliability of Structures, A.S. Nowak and K.R. Collins, 2013.

My definition is:

The reliability of a system at time t, evaluated at time t_o (with $t > t_o$) is the conditional probability that the system will not fail in the interval $t_o > \tau > t$. The probability is conditional on all available information to the analyst at time t_o.

This means that conceivably various independent analysts could compute different values of reliability based on their available information, but all analysts must make consistent and logical use of prior information based on the rules of probability calculus. Therefore, reliability is not personal. If two analysts have the same prior information, their results should be the same.