Reliability

Reliability

- *Reliability*: The ability of a product، part، or system to perform its intended function under a prescribed set of conditions.
- Reliability is a probability. A reliability of 0.985 implies 15 failures per 1،000 parts of trials.

Reliability

Probability (reliability) is used in the following two ways:

1. The probability that the product or the system will function when activated. This is often used، when a system is used for a relatively few number of times.
2. The probability that the product or the system will function for a given length of time. This is often used in product warranty.

System Reliability

Rule 1. If two or more events are independent and "success" is defined as the probability that all of the events occur، the probability of success is

$$R = \prod_{i=1}^{n} p_i$$

System Reliability

Rule 2. If two or more events are independent and "success" is defined as the probability that ANY of the events occur، the probability of success is

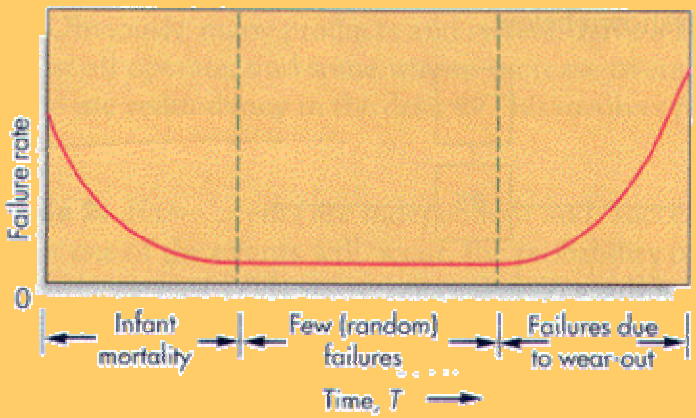
$$P_1 + (1 - P_1)P_2 \quad \text{or} \quad P_2 + (1 - P_2)P_1$$

System Reliability

Rule 3. For three independent events، if two of the three events are backup events and "success" is defined as the probability that *at least one* of them occurs، the probability of success is

$$R = p_1 + p_2(1 - p_1) + p_3(1 - p_2)(1 - p_1)$$

Bathtub Curve



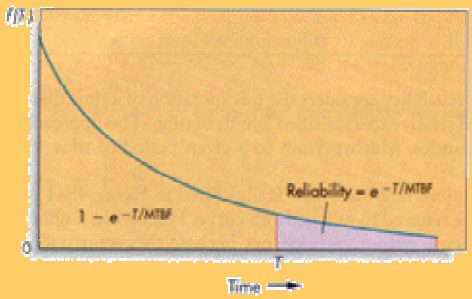
Mean Time Between Failure (MTBF)

The mean time between failures (MTBF) in the infant mortality phase can be modeled by a negative exponential distribution (cumulative distribution function).

$$P\{\text{no failure before } T\} = P\{t \geq T\} = \int_T^{\infty} f(t)dt = e^{-\frac{T}{\text{MTBF}}}$$

Mean Time Between Failure (MTBF)

The probability is equal to the area under the curve for t>=T. Observe that, as the specified length of service increases, the area under the curve to the right decreases.



Mean Time Between Failure (MTBF)

The probability that failure will occur before T is

$$P\{\text{failure before } T\} = P\{t < T\} = 1 - P\{t \geq T\} = 1 - e^{-\frac{T}{\text{MTBF}}}$$

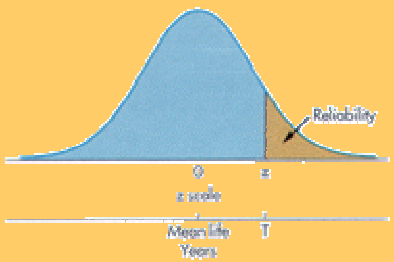
Reliability Under Normal Distribution

Product failure due to wear-out can be modeled by a normal distribution with a parameter z, where z is a standardize value computed using the formula

$$z = \frac{T - \text{mean wear - out time}}{\text{standard deviation of wear - out time}}$$

Reliability Under Normal Distribution

1. To obtain a probability that service life will not exceed T, compute z and refer to the normal distribution table. Next, to find the reliability for time T, subtract this probability from 100 percent.
2. To obtain the value of T that will provide a given probability, locate the nearest probability under the curve to the left in the table. Then, use the corresponding z in the proceeding formula and solve for T.



Availability

- Availability measures the fraction of time a piece of equipment is expected to be operational.
- Availability can range from 0 to 1.
- Availability is a function of the mean time between failures (MTBF) and the mean time to repair (MTR).

$$\text{Availability} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTR}}$$

Availability

- Availability increases as the MTBF increases؛ availability increases as the MTR decreases.
- Some design options enhance reparability ، e.g.، laser printers are designed with printer cartridges than can easily be replaced.
- Companies that can offer equipment with a high availability factor have a competitive advantage.

Reliability Summary

- Reliability is understood by its use by perspective buyers in comparing alternatives and by seller as one determinant of price.
- Reliability can have an impact on repeat sales، reflect on the product's image and create legal implication.
- Failure is used to describe a situation in which an item does not perform as intended.
- Reliability is always specified with respect to certain conditions، called *normal operating conditions*. Failure of users to heed these conditions often results premature failure of parts or complete systems.

Directions of Improving Reliability

- Improve component design.
- Improve production and/or assemble techniques.
- Improve testing.
- Use backup components.
- Improve preventive maintenance procedures.
- Improve user education.
- Improve system design.

پرسش و پاسخ

موضوعات جهت تحقیق

- شکست کار(خرد کردن کار) تکوین محصول در زنجیره تامین
- کنترل و تضمین کیفیت تکوین محصول در زنجیره تامین
- تکوین محصول واثر آن بر رده بندی تامین کنندگان
- طراحی روباست در خدمات
- طراحی روباست محصول