

Reliability: From Definition to Analytical Products

Reliability¹
is ...

The **likelihood**
(used to make
1 of the 2 axes
of a risk matrix)

An item will
perform its
**intended
function²**

For a stated
mission time
(duration as
time or cycles)
or stress (load)

Under stated
conditions
(environment).

**Qualitative
Reliability⁵**

**Quantitative
Reliability**

When an item
has multiple
elements, map
the
configuration
of these
system
elements to
the level of the
available test
and
operational
data³ (or
handbook data
if used)

1 – Reliability (**R**) does not address or model Maintainability (**M**). **M** is the item’s design in regards to the need for, ease to perform, and amount of downtime for maintenance, repairs, and replacements. Availability (**A**) addresses and models both **R** and **M**. **A** is a math function of **R** and **M**.

2 – A description of intended function includes the boundaries of the item and the definitions of success and failure.

3 – Types of input data used in **RMA** analyses:

- Time to failure⁴ with no maintenance or repair by failure mode. This data type models Reliability.
- Time to failure⁴ with time to return service. This data type being a pattern of uptimes with corresponding downtimes models Availability.
- Stress-Strength (Load-Capacity) Interference. This data type models failures caused by variation.

4 – Time to failure (or uptime) data is typically stated in hours or as number of successes (demands or cycles) out of a number of attempts (trials). The latter is known as success-failure or pass-fail data.

5 – Other reliability analysis techniques used to design reliability systematically include **Worst Case, Sneak, Durability, Thermal, and Electromagnetic Analyses**. Use testing to verify the results of the analysis.

Perform a
bottom-up
analysis to
show the
effect(s) of
the item’s
failure

Perform a
top-down
analysis to
show how
item(s)
contribute to
a specific
failure event

Make and
use a custom
failure-rate
function
using item’s
test and
operational
data³

Use
handbooks
to obtain
constant
failure rates
(adjusted for
various
conditions)

**Failure Mode
and Effects
Analysis
(FMEA)**

**Fault Tree
Analysis
(FTA)**

Probability of
success called
**Demonstrated
Reliability**

Probability of
success called
**Predicted
Reliability**

**Reliability
Block Diagram
Analysis
(RBDA)**