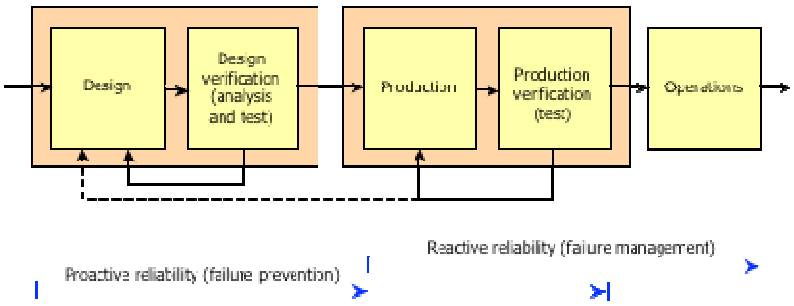
# Reliability and FMEA

## Reliability

Reliability is the absence of failures in products and systems. Reliability Engineering is defined as the management function that prevents the creation of failures by people (such as systems engineers, design engineers, production personnel, users and maintenance personnel).

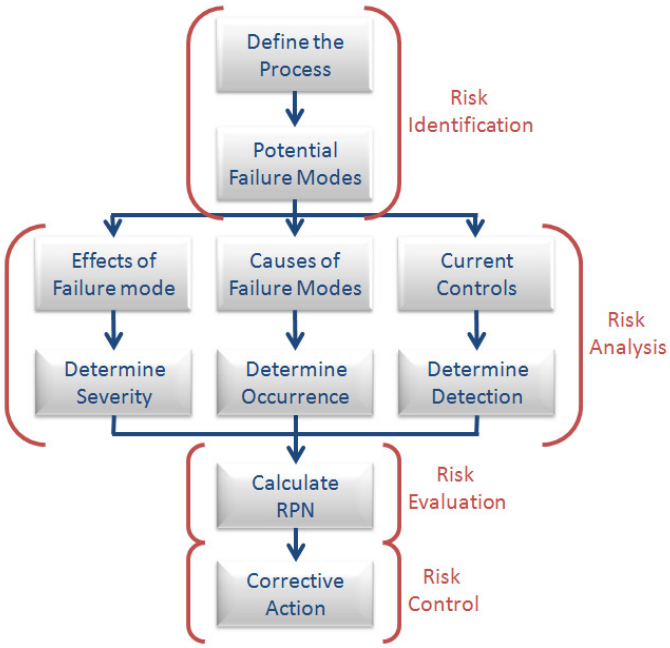
The ideal state of 'absence of failures' is achieved in practice by preventing failures from occurring. This is only possible if there is a thorough understanding of all of the potential failure modes and then taking appropriate steps to prevent them from occurring. Understanding potential failure modes is achieved by analysing and testing during both the design and the production phases of a project.




## Failure Analysis

Failure analysis, performed with the objective of understanding how the product or system will react to potential failure modes, is extremely useful to influence a design. Typical analyses include FMEA (Failure Mode and Effects Analysis), FTA (Fault Tree Analysis) and reliability block diagram analysis, design (and process)

## FMEA




Failure modes and effects analysis (FMEA) is a step-by-step approach for identifying all possible failures in a design, a manufacturing or assembly process, or a product or service. Where 'failure modes' means the ways, or modes, in which something might fail. FMEA is a bottom-up analysis where potential failure modes of a product or system are identified, and the effects of these failure modes on a higher level are determined. For each potential failure mode, the probability of occurrence and the ability to detect it are also determined. FTA uses top-down logic to determine what failures (and in what combinations) can cause an undesirable event to occur. Both are well-known and very old reliability analysis tools.

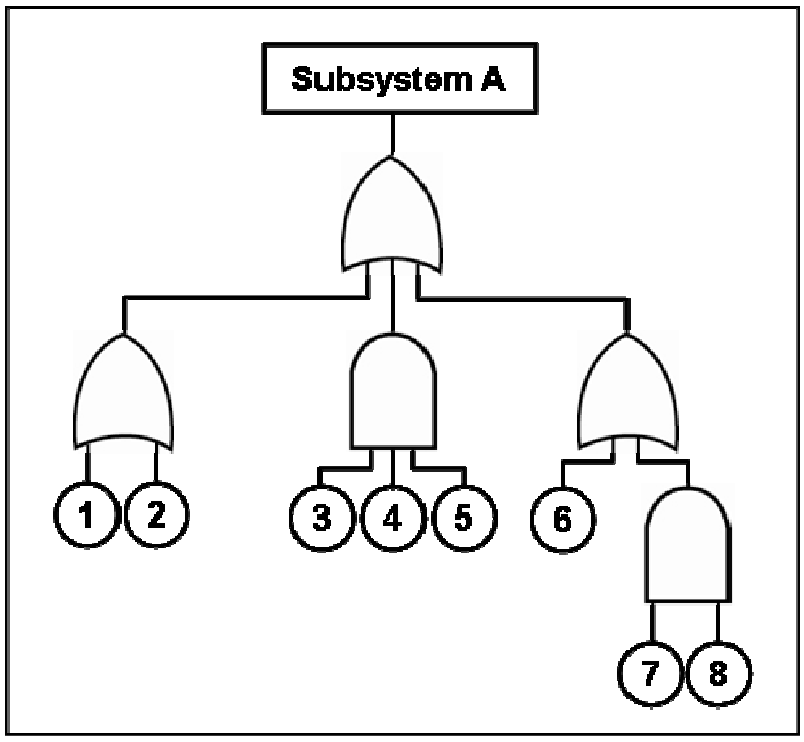
FMEA is one of the most powerful reliability tools available and can be applied as a Design FMEA (to design reliability into the system) and a Logistics FMEA (to ensure the optimum mix of spare parts are available for maintenance and repair).

Logistics FMEA forms part of Logistic Support Analysis (LSA). Typically, in performing a LSA, the product or system Bill of Materials is used to develop a hardware breakdown structure, which forms the basis for listing failure modes. These failure modes are then used to identify logistic support in terms of spare parts, special test equipment and tools, maintenance personnel and documentation. The focus is on how to support the product or system either when a failure has occurred or by replacing parts at appropriate maintenance intervals.

The focus of a design FMEA, is on how to prevent failure from occurring in the first place! It requires substantial technical input from design engineers.

## FTA

FTA is a top down failure analysis, applying deductive reasoning to analyse an undesired state of a system using Boolean logic[1] to combine a series of lower-level events.



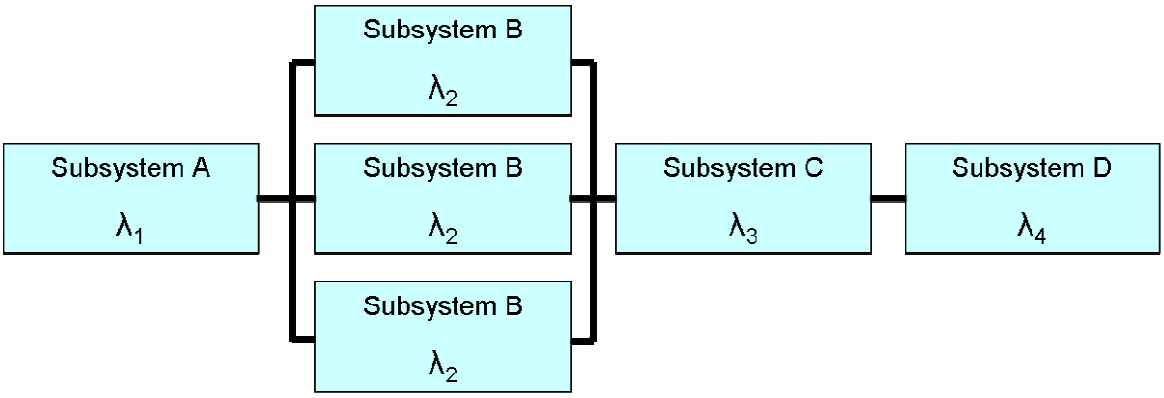

FTA analysis involves five steps:

1. Define the undesired event to study
2. Obtain an understanding of the system
3. Construct the fault tree
4. Evaluate the fault tree
5. Control the hazards identified

## Reliability block diagram

A reliability block diagram (RBD) is a diagrammatic method for showing how component reliability contributes to the success or failure of a complex system. RBD is also known as a dependence diagram (DD). It is drawn as a series of blocks connected in parallel or series configuration. Each block represents a component of the system with a failure rate. Reliability block diagrams often correspond to the physical arrangement of components in the system being modelled. However, in certain cases, this may not apply.

[1] Boolean logic - the values of the variables are either true or false,




The probability of system failure can be calculated as can the potential for a complex system to keep operating with some of its systems in failure mode.

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