

# Introduction to System Reliability Modelling

## Part 1

These methods are based on MIL-HDBK-338B.

**Sentient Systems Ltd in support of  
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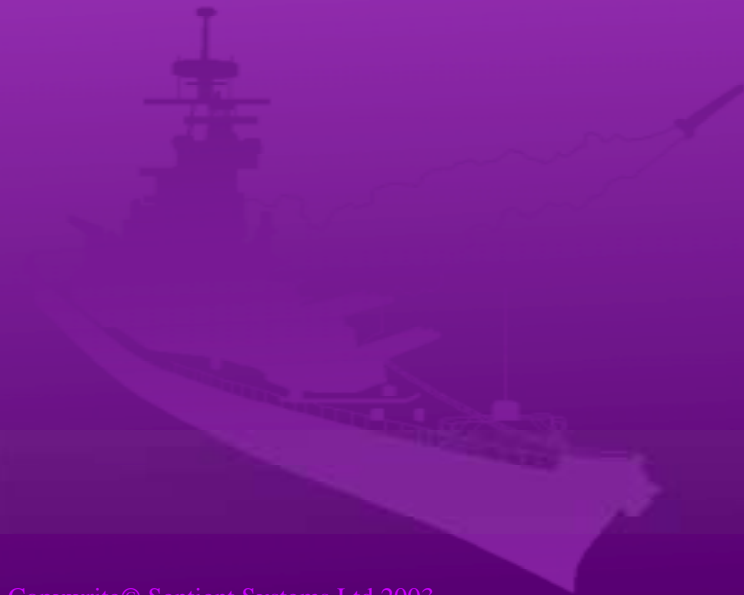


## Mission and Basic Reliability

- The methods can be applied to predictions for electronic, electrical, mechanical, electromechanical, and ordnance systems
- and can be applied to equipment ranging in complexity from the simplest subdivisions of equipment to complete platforms.
- They are **system design tools**.

# Purpose

- The techniques or methods are used to determine the probability that an equipment or system will satisfy specified reliability **requirements**.

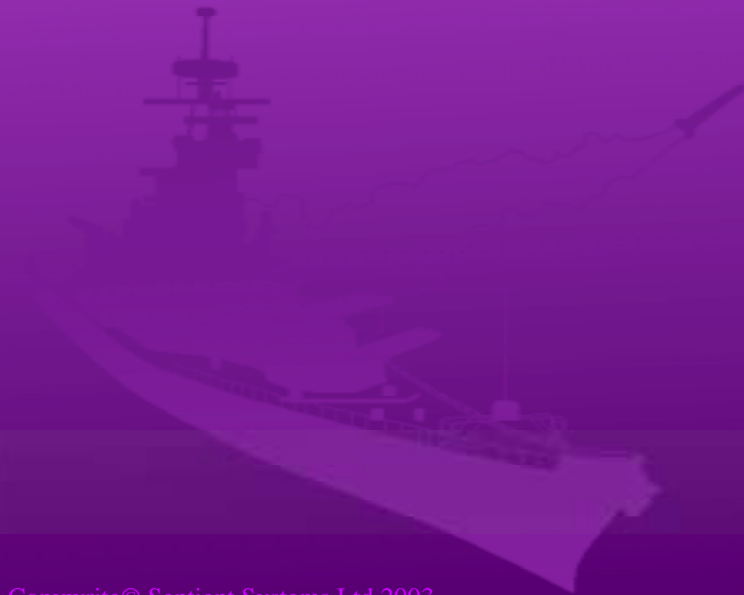


## Some Essential Concepts

- MIL-HDBK-338B - a **MIL**itary HanDBooK published by the U.S Department of Defense.
- **Ground rules** - these have to be stated and usually accompanied by **assumptions** i.e. **ground rules and assumptions**.

## Essential Concepts

- **Mission** - usual required in a Mission statement or **success definition** and stated in terms of system performance and limitations.
- **Reliability** - the probability that a system/equipment will perform to specification for a specified period.



# Essential Concepts

- **Mission duration is paramount.**
- **Basic Reliability** - a probability based on the summation of the **failure rates** of every individual item making up the system.
- **Mission Reliability** - the probability that the system will function as specified for the duration of **its Mission**.

## Here are a few key phrases that must be understood:

- **Failure rate.**
- **Indenture level** - open to all sorts of interpretations but the best start point is the equipment family tree or Build hierarchy.
- **Coding system** - usually the industry part/assembly number but might be the NATO code.

## and more:

- **Co-ordination of effort** - to avoid duplication.
- **Item definition** - what the item is? Beware different names for the same thing.
- **Service Use profile** - how do the Services use this thing? Usually illustrated in a sequence of activities.

## more buzz words:

- **Logistic cycle** - best understood with a model - from procurement of the system, packing, transportation, cyclic storage, unpacking, periodic testing, re-packing, more transport, issue,.....disposal.
- **Operational cycle** - what happens from when it is switched on to when it is switched off?

## more buzz words:

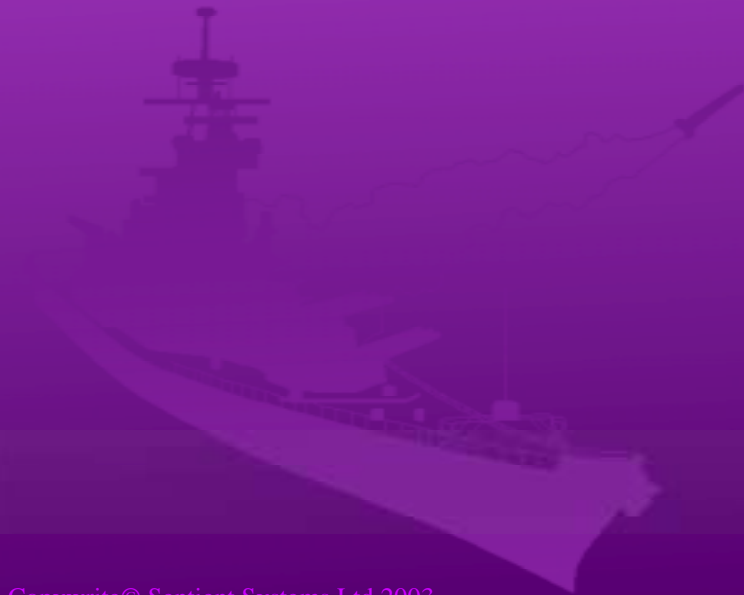
- **Mission (use) profile** - events and conditions associated with specific operational usage of the system. Could be one segment of the **Operational cycle**.
- **Environmental profile** - specific natural and induced environments (usually worst case). Each **Mission profile** will likely have an associated environmental profile.

## more buzz words:

- **Reliability Critical Items Lists** - items which by their nature are critical to the performance of the system because they cannot be repaired/replaced easily and would jeopardise the mission by failure.
- **Operational mode** - there can be several modes of operation. **Standby** could be one operational mode.

## more buzz words:

- **Operational cycle** - how it switches between operational modes.
- **Repairable/non repairable?**



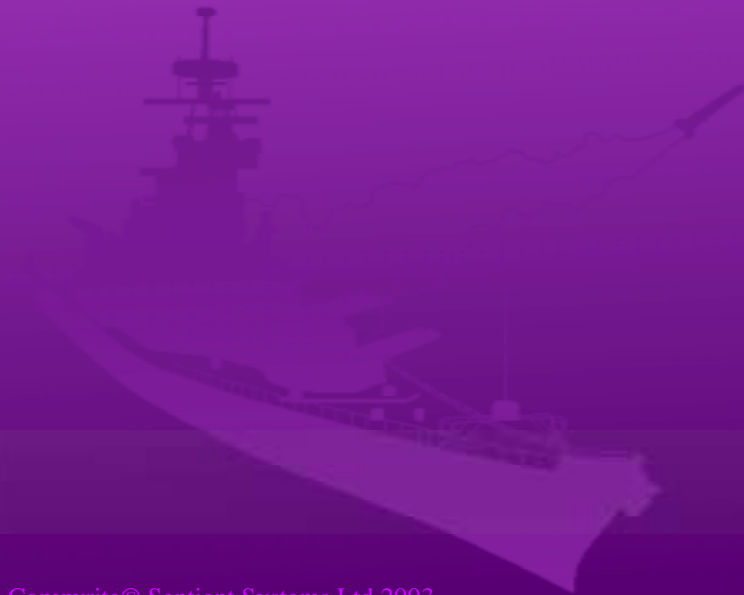
# Understanding System Reliability Modelling.

- “What is the **reliability** of a system?”
- “What is the **probability** that the system will fail?”
- “What is the **probability** that a system will survive?”



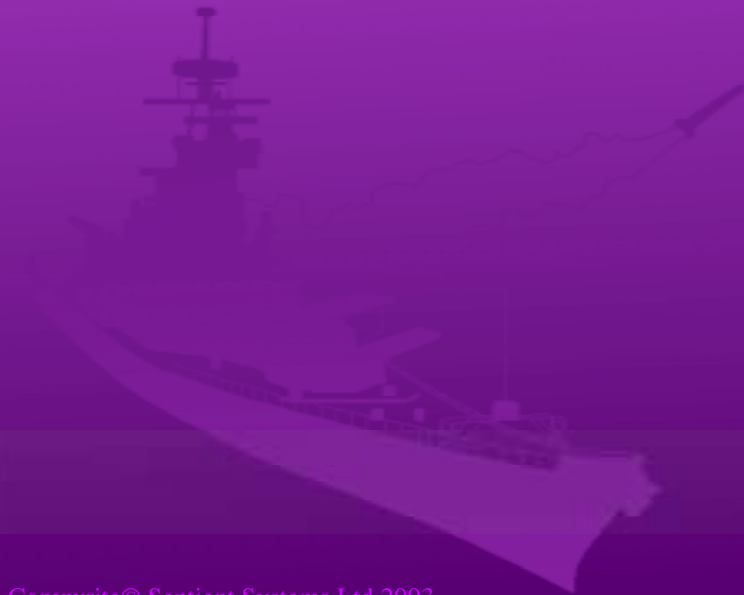
## Not as simple as it seems:

- “What is its reliability to do **what?**”
- “What is the probability that it will fail to do **what?**”
- “What is the probability that a system will survive **what?**”



## The question re-phrased:

- “What is the **probability** that the system will function (i.e. meet all its functional requirements) for a given period of time?”

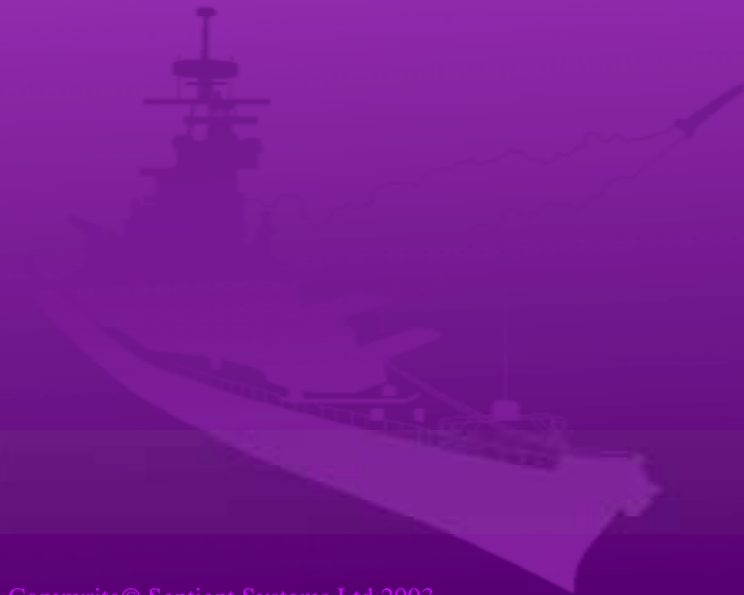


## but to answer the question -

- a lot of other system information is required.
  - ▼ What is the **operational environment**?
  - ▼ What is the **period** in question?
  - ▼ Are there **operational constraints** on the system?
- These questions and quite a few others need answers.

## but why?

- because the definitions of failure and the failure rates depend on these factors.



## The problem doubles in size:

- Partly because of the difficulty of answering the system reliability question (and the time necessary to arrive at the answer) the question usually takes two forms:
    - ▼ Do you want to know what the “Basic” reliability of the system is?
- OR
- ▼ Do you want to know what the “Mission” reliability of the system is?

## Basic and Mission system reliability:

- Both these are very relevant but to two quite different interest groups.
- The **Logistics function** will need to know what is simply understood to be the total system failure rate, usually referred to as the **Basic failure rate**. It is the sum of all component part failure rates of the system.
- This is because they want to know things like “How many spares do I need to supply?”.

## Basic and Mission system reliability:

- The system **user** will probably only be interested in those failures that jeopardise the equipment operation and impinge on the success of **his** mission.
- But note; his mission is not necessarily the systems mission.

# End of Part 1

If you have any questions relating to the information presented herein. Feel free to send an e-mail to [info@sentient-systems.co.uk](mailto:info@sentient-systems.co.uk). We might be able to help.