

## The Principles of Availability, Reliability and Maintainability

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### Overview

The course addresses the general principles behind the concept of an Availability, Reliability and Maintainability (AR&M) Programme and focuses in particular upon the management aspects that need to be addressed, the engineering activities involved and the relationship and utility of commonly used parameters of interest and techniques.

The topic is developed using general principles, although references to appropriate statutory documentation are made to illustrate or reinforce a particular issue. In addition to the general principles, the application of the Reliability concept to both Mechanical and Software components of a System are addressed. This course provides an excellent 'grounding' for all personnel employed on AR&M programmes or activities within projects.

The course will enable the delegate to appreciate the inter-relationships between the various functional disciplines and the contribution of their specific area of expertise to the overall programme. The delegate's organisation will benefit from the delegates raised perception of their role within the overall process and the potential increases in efficiency that this engenders.

### Target Audience

The Target Audience consists of practicing engineers requiring a thorough appreciation of the objectives of an AR&M programme and knowledge about separate aspects of the topic.

### Objectives and Utility

One of the major objectives of this course is to rationalise the various disciplinary relationships and to provide a common baseline of understanding of the topic over the target audience.

This will enable the delegate to appreciate the inter-relationships between the various functional disciplines and the contribution of his specific area of expertise to the overall programme.

The course will also provide an insight into currently used techniques, some of the drawbacks associated with these and an introduction to future approaches and initiatives in relevant areas.

The delegate's organisation will benefit from the delegate's raised perception of his role within the overall process and the potential increases in efficiency that this engenders.

### The Training Process

The course begins by introducing the delegate to the concept of Systems Engineering and the need for integration and co-ordination of differing programmes and activities.

General approaches to AR&M management and programme planning are then addressed followed by an overview of the general engineering activities normally found within an AR&M programme.

The common AR&M parameters of interest are identified together with statistical distributions normally associated with AR&M parameters.

General AR&M topics are then addressed in more detail, these include the allocation and prediction of FoM, FRACAS / DRACAS and Data gathering and analysis. Approaches to address the reliability aspects of Software and Mechanical items are addressed and the topic of Statistical Demonstration discussed.

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## Course Programme

### Day 01 - AM

#### 002-S Systems and the Systems Engineering Concept

The concept of a "System" and its associated characteristics are discussed. The discussion will address system connectivity, emergent properties and the concept of environment from a system viewpoint. These will all be considered in the ILS context, the consequences of these properties, in ILS terms, for example their effect on support modelling requirements, and Life Cycle Cost analysis, will be addressed. The concept of Systems Engineering is introduced, and ILS is defined in the context of the Systems Engineering process. The aims of the Systems Engineering Process are defined. This leads in a logical manner to an expansion of the need for and the role of LSA (introduced in the "Defining ILS " module). The aims of LSA and its place in the Systems Engineering process are explored. The "Generic Systems Engineering" process is introduced and related to the concept of system Life Cycle Phases as a mechanism for controlling a major system development programme and for managing risk. The concept of Life Cycle phases is related to the acquisition process and the acquisition phases are defined in terms of their aims, processes and products.

#### 066-S AR&M Programme Planning

The module focuses on the management aspects of an AR&M programme and starts by addressing the general concepts that should be aspired to when attempting to manage such a programme. It then moves onto a more detailed discussion of some of the major management responsibilities and issues involved and their role within an AR&M programme.

The module addresses the topics from a first principle basis and is of equal value to both general Commercial industrial and Defence industry applications.

To assist with the mapping of the concepts to industrial sectors applications, it concludes with an overview of relevant AR&M standards.

### Day 01 - PM

#### 067-S An overview of AR&M Engineering

The module gives a brief overview of the engineering activities that are typically found in an AR&M programme. It addresses the general topics and some commonly used methods of implementation.

The module introduces the delegate to the concept of an R&M Case and discusses the wider issues that should be considered when addressing a project's AR&M requirements.

### Day 02 - AM

#### 036-P Support Mathematics

This module provides an introduction to the basic concepts of statistics. The topic is addressed in a "Popular Science" style that avoids the majority of the underlying mathematics.

The module examines some basic concepts relevant to statistical analysis and relates these to uses in both descriptive and inferential statistics. The major types of statistical distribution are addressed and particular attention is given to the Normal distribution and its implications in the field of statistical analysis.

The concepts of Confidence intervals are addressed together with concepts addressing the relationships between different samples and the larger population. The module concludes with an introduction to the basic Probability concepts applicable to the area of Support Mathematics.

### Day 02 - PM

#### 011-P Quantifying the System

This module provides an introduction to the basic measures of Logistics and their place within Support related analyses.

The aims are to raise the delegate's level of awareness of the measures whilst providing an introduction to their statistical basis and to ensure that they have a grasp of the concepts that are a pre-requisite to an understanding of Logistics.

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**134-S Reliability of Software**

The module addresses the topic by considering firstly the factors that contribute to the reliability of Software items and secondly, some of the current methods by which the reliability attributes of software can be assessed and evaluated.

The integration of the individual part characteristics into the system reliability characteristics is also addressed and various techniques discussed and illustrated.

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**Day 03 - AM**

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**051-P Human Factors (HF)**

A short module giving the delegate an insight into the Human Factor (HF) related issues that need to be considered during the design of a System or product in order to satisfactorily address the concept of Maintainability and thereby optimise the maintenance related aspects of the System Life Cycle costs.

The presentation will highlight some of the relevant issues and the associated MANPRINT initiative.

The module is intended to enhance the delegate's awareness of the topic, it's place within the Design Process and how it may be implemented in a cost-effective manner.

The module addresses the topic from a Systems Engineering viewpoint and it's overall style is pragmatic.

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**070-S Mechanical Reliability**

The module addresses the topic by considering firstly the factors that contribute to the reliability of mechanical items and secondly, the methods by which the mechanical reliability attributes of an item can be assessed and evaluated.

The integration of the individual part characteristics into the system reliability characteristics is also addressed and various techniques discussed and illustrated.

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**Day 03 - PM**

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**072-S FRACAS / DRACAS**

The module addresses the concepts of Failure Reporting Analysis and Corrective Action System (FRACAS) and Data Reporting Analysis and Corrective Action (DRACAS) within a Systems engineering environment and discusses why the management of information is necessary and its role within any engineering programme.

The topic of data classification is addressed and examples of generic categories of failure and classification discussed. Some of the problems and difficulties commonly associated with FRACAS / DRACAS are discussed and the module concludes with an overview of typical information content for a DRACAS.

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**071-S AR&M Data Gathering and Analysis**

The module addresses the requirement for the analysis of data in an AR&M programme. It focuses on two major methods of data analysis, the first being the use of the Weibull distribution and the second being the use of CUSUM (Cumulative Summation) techniques. The benefits and uses of both methods are discussed and illustrated using practical examples.

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**Day 04 - AM**

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**069-S AR&M Allocation and Prediction - An Overview**

The module introduces the concepts of allocation and prediction as part of the Systems Engineering Process. Each topic is then addressed in more detail for both Reliability and Maintainability parameters and typical techniques discussed.

The advantages and disadvantages of these techniques are also discussed and a detailed summary of a Maintainability Prediction technique for the early phases of the equipment life-cycle is provided.

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**Day 04 - PM**

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**101-S R&M Demonstration**

The module introduces the concepts of Statistical Demonstration as part of the Systems Engineering Process. Each topic is then addressed in more detail for both Reliability and Maintainability parameters and typical techniques discussed.

The advantages and disadvantages of these techniques are also discussed and a summary of R&M demonstration methods is provided.