CHAPTER 8

COMPUTER AIDED ENGINEERING TOOLS FOR R&M

CONTENTS

1. INTRODUCTION

1.1 Please note that this chapter is subject to continual editorial review.

1.2 Reliability and Maintainability engineering involves the processing of a substantial volume of interlinked textual, numerical, logical and graphical data. Much of the work involves producing models that express the situation and deriving quantitative results based on numerical input. Such tasks are particularly suited to computer aids.

1.3 The MOD Reliability Team therefore established a number of computer applications to aid the practitioner. These are listed in Section 2 and details provided of where and how to obtain more information.

1.4 Other parties (often R&M consultancies operating as software houses) also produce products to assist with R&M work. This Chapter does not attempt to provide a comprehensive listing of the available packages but does consider some of the criteria for selecting or using a package.

1.5 It is also possible to use standard computer packages such as spreadsheets, databases and drafting packages to good effect, particularly with simpler models. It should be noted that the basic needs of sound software engineering are required to ensure that any tool correctly processes input information.

2. SPONSORED R&M SOFTWARE

2.1 Overview

2.1.1 The Reliability Team sponsor 3 AR&M software packages. These tools have been developed over a number of years by this group and its predecessors specifically the DGSW(N) AR&M Cell. These tools are:

    a) SAM

    b) RAM4

    c) RDEMO

2.2 Pre 1996 Historical context.

2.2.1 Over the last 25 years or so a number of Tools to assist AR&M activities have been developed by various bodies involved with the AR&M of Naval equipment. Gradually the support of these tools has come to rest within what is now the MOD Reliability Team. The original sources of these tools are varied as are the reasons for the sponsorship ending up within this team. It is worth describing this history as it puts the current state of the tools into context; it also explains why some of the tools are similar in function, although the tools can reasonably be described as unique as there is no duplication.

2.2.2 SAM whose origins are firmly based at Foxhill was being known in turn as the Ship, Submarine, System Availability Model, as ownership transferred from DGShips, to DGSM, DGME, and back to DGSS.

2.2.3 Meanwhile at Portsdown, the old ASWE AR&M team developed or identified a number of tools, the sponsorship of which was passed to the DGSW(N) AR&M cell (on the disbandment of the ASWE team) in the mid 80s. These tools existed on various main frame computers at Portsdown and Portland. The DGSW(N) Cell over a period of time had these programmes *ported* to PCs running under DOS, merged a number to give improved functionality and developed a small number of new ones to cover new developments.

2.2.4 The DGSW(N) Cell, not only used the tools to assist in their work but also issued the software to projects and contractors to assist them in their AR&M work. The issuing of software to contractors was started for two reasons and both reasons continue to be valid to be valid:

a) by using tools that we have developed, we understand the tools and hence the answers generated; also when comparing two proposals we are "comparing apples with apples"; and

b) for a number of the tasks that the tools assist, there is no commercial alternative available.

2.2.5 Policy for issuing software was detailed in DCI GEN 98/93. These rules for the processing and issuing software are still followed in house.

2.3 Developments since Jan 1996.

2.3.1 SAM had previously been used in the main for modelling the availability of marine systems. Since 1996 the use of SAM has been expanded to model the Availability of all systems within a ship including the weapons systems. Additionally we have expanded the use of SAM from modelling Availability of systems under wartime situations to modelling the Availability under much longer peacetime scenarios. These new uses have been primarily used during support to the CV(F) project during ST(S) formulation to help set realistic and practicable AR&M targets. The techniques developed during this work are now being applied to the FSC and it is our intention that this methodology becomes the standard way ahead for platform projects[*].

2.3.2 PC SAM – When the original decision was taken to port SAM to a DEC Alpha, the plan had been to port to UNIX via VMS, UNIX giving the opportunity to port SAM easily to other platforms. (at that time it was considered that the most likely platforms would be high end workstations such as Sun Sparcs). As the SAM version 13 development lasted so long, on its completion the processing power within Desktop PCs had increased to such an extent that a good PC would be capable of running SAM. Therefore, the decision was taken in 1998 to port SAM to a PC (under UNIX); this programme has been completed successfully (see section 0 for details)

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[*] Details of the work on the CV(F) are given in the CODERM News Article by Trevor Reed published mid 99. It is intended to convert this to a standard process which can be tailored to any project.

2.3.3 RAM4 was issued as version 3.0 in January 1996. Version 3.0 was a direct conversion of the existing software and a number of proposed improvements had never been fully defined. A number of these improvements were investigated during 1996/7 and resulted in version 3.1 being produced Jan 1998, the main changes being:

a) conversion of the calculation engine to 32 bit to speed up simulation times; and

b) enhancements to the RBD builder graphical front end.

2.3.4 Although RAM4 has always been the most popular of the tools, use within the AR&M cell has normally been limited to checking other peoples' work and simple usage. During the period Autumn 97 to Summer 98 the AR&M cell was deeply involved with supporting the Radar 996 project; this resulted in intensive usage of RAM4 and highlighted a number of improvements that would greatly ease such activities (these activities should happen for all projects). These improvements have been investigated and were implemented as version 3.2. Part of the development involved an early release of the new software including limited new functionality. This software has been used to continue supporting RADAR 996 and during the first task, it reduced a 3 day task to under half a day.

2.3.5 A number of other developments have been started and completed since Jan 96 as follows.

a) RDEMO version 2 – this was the porting of RDEMO to MS Windows from DOS and the introduction of the ability to do *what ifs* (assessing what can be said about an items reliability given a number of running hours and faults encountered).

b) PC Alpha improvements – PC Alpha had been inherited from the DGUW(N) AR&M cell who had developed the software to enable data gathering at sea using PC rather than Psion's. This software had never been used as the trial for which it had been intended was cancelled and when first used a number of deficiencies were identified with the user interface, i.e. the original specification was wrong. These problems were subsequently rectified.

c) RTD Population – The RTD had been produced but never populated, this exercise was completed and a number of minor modifications were completed.

d) MCAS Software for T23 – in order to support the T23 Marine systems data gathering exercise a program was developed which allows data to be captured direct from the MCAS system and stored on a laptop. Six standard Toshiba laptops were deployed at sea, 24 hours per day, collecting usage data directly from the MCAS systems of 6 T23.

2.3.6 Additionally Reliability Capability Group has developed (with the Delegated Design Authority) training courses for all of the software other than SAM. It has been agreed that the Delegated Design Authority will provide these courses for MOD consumption on demand. It is considered that the maximum practicable number of course delegates is 6, as the cost is based on the agreed hourly rates for the presenter plus expenses; the current cost of a course can be obtained from Reliability Capability Group. A course for SAM was produced and the first run through of the course was programmed in July 1999.

2.3.7 Since 2005 a combination of:

a) Improvements to commercial software packages;

b) Reduction in the number of "equipment" projects being directly contracted for by the MOD.

Resulted in a decrease in demand for a number of tools, this in turn lead to a decision to withdraw support for a number of tools, these are listed at Annex A for record purposes.

2.4   Package Details

2.4.1 Systems Availability Model (SAM)

A suite of programs which have the capability to model in an analytical or simulation mode. In the simulation mode it can model complex integrated systems against a number of mission profiles. Both active and passive redundancy can be modelled as can logistic delay, number of repair teams, local and forward support spares holdings and forward support delay time. Has been used primarily to model ship systems but is suitable for multi-reconfigurable weapon, sonar or communication systems. User Guide is SSP48.

Originated	Current Status	Delegated Design Authority	Platform and Operating System
1972	Version 14	Atkins	Runs under UNIX on a PC

2.4.2 RAM 4

A Monte Carlo digital simulation program for the analysis of complex repairable or non-repairable systems. RAM4 models active and standby redundancy, logistic delays, common mode failures and repair teams with specific skills. It performs sensitivity analysis and apportionment. Currently available to run under WINDOWS 3.1x, NT or 9x on any suitable PC, it offers comprehensive graphics input and output facilities including a colour coded RBD highlighting reliability risk areas. User Guide published as SSP41 Part 8.

Originated	Current Status	Delegated Design Authority	Platform and Operating System
1973	Version – 4	Atkins	WINDOWS 3.1x, NT or 9x on any suitable PC

2.4.11 RDEMO

A program for planning and analysing reliability trials. The User Guide is SSP41 Part 15.

Originated	Current Status	Delegated Design Authority	Platform and Operating System
1993	Version – 2	Atkins	PC Windows

2.5   Availability of Software

2.5.1   Commercial.

All of the software listed in this document is available commercially from the Delegated Design Authority. For further information contact:

Atkins

Iain Davison, The Barbican, East Street, Farnham, Surrey. GU9 7TB
Tel. 01252 738500, Internet www.advantage-business.co.uk

2.5.2   MoD Users

a)   All PC Windows and DOS software.

b)   For that software which is not readily downloadable from the DII Service Catalogue users should request their respective Authorised Demander for assistance in accordance with current DII instructions.

2.5.3   Free Loan to Industry

2.5.3.1 All of the software listed in this document is available as Government Furnished Information (GFI) to MOD contractors (both Prime and Sub) if required to support R&M activities on specific MOD contracts.

2.5.3.2 The software is issued for the use of nominated persons on specified machines against a single contract. Should the contractor be working on more than one contract he will require a licence for each software model used on each contract.

2.5.3.3 On requesting the software, the appropriate Project Team will be required to supply an end date for the software loan. With the exception of RAM 4, which needs renewing every 12 months, all of the software will cease to work on the specified date and should then be returned to the R&M Cell. (If the R&M work ends before the expiry date of the software then the software should be returned when no longer required.) **It is the Project Teams responsibility to ensure that the software is returned**.

2.5.3.4 Issue is achieved by submitting the necessary details on the form shown in Leaflet A8/1.

2.5.4   Other MOD Users

For those MOD users who do not have access to DII the software can be supplied on disc for installation on a stand alone machine. The requesting officer will be required to complete the form shown in Leaflet A8/1 with the relevant details.

NOTE: It is the requestor's responsibility to ensure that the software is returned at the appropriate time.

2.6   Health Warnings

2.6.1   There are other tools available (commercially) which may be more suitable for a specific task than those supported by the Reliability Team.

2.6.2   As with all modelling all assumptions and data used should be fully recorded.

2.6.3   The sensitivity of any results from modelling should be tested.

2.6.4   When assessing modelling work, the major questions to be asked are:

    a)   is the expected usage reflected in the modelling (including assumptions)?

    b)   does claimed redundancy exist physically (i.e. is a lightly used terminal suitable to act as a backup to a more important terminal)?

    c)   are data sources suitable for comparison purposes?

    d)   how sensitive is the model to uncertainty?

    e)   have the findings of modelling work been used to improve the design or is it merely a reflection of what has been designed?

    f)   is the accuracy of presented results justified by the confidence in the assumptions and data used?

    g)   have the results of modelling been examined or has the model been run and the results presented?

2.6.5   More in depth guidance is available from your local R&M specialist and PtACh9 of this manual.

ANNEX A

OBSOLETE SOFTWARE PACKAGES (ON LONGER SUPPORTED)

CONTENT

1. INTRODUCTION

The following software packages are no longer supported by the MoD mainly due to more suitable commercial software packages being readily available in the market place. The details have been retained to provide an historic record should the use of these application be questioned in the future.

1.1 ANSAR

A program which evaluates the steady state reliability parameters of systems consisting of elements that are repaired on failure. Like RAM4 the system is represented by a Reliability Block Diagram (RBD) whose elements have known reliability and repair time characteristics. It evaluates system availability, MTBF and MART. It may also be used to undertake sensitivity analysis, apportionment analysis and to evaluate confidence intervals for given uncertainties in the element MTBFs. PC-ANSAR runs under WINDOWS 3.1x, NT 3.x and has similar graphics facilities to RAM4. User Guide published as SSP41 Part 11.

Originated	Current Status	Delegated Design Authority	Platform and Operating System
1975	Version – 1.1.5	Advantage Technical Consulting	WINDOWS 3.1x, NT 3.x

1.2 REPSTOCK

A PC based model, currently running under DOS, which predicts the number of spares of an item type to be held centrally for issue to units (ships/squadrons etc.) to replace spares used during normal support. To make its prediction the model uses the cost and failure rates for each item, repair turn-round time and percentage of items beyond economic repair. Spares for Backup and Replenishment Stock are calculated. User Guide is SSP41 Part 6.

Originated	Current Status	Delegated Design Authority	Platform and Operating System
Mid 1970s	Version – 1.5.1	BMT Reliability Consultants Ltd	PC – DOS

1.3 RASCAL

A PC based model, currently running under DOS, which predicts the spares range and scale required to achieve a specified level of availability. To make its prediction the model uses the mission length, block repair time and associated item failure rates, costs and volumes and the availability block diagram of the equipment or system being modelled. The number of spares to be held in both ready use and remote stores for various equipment availabilities and stock-out risks are calculated. The information presented allows trade-offs to be made between

availability, spares cost, the volume required to store the spares and quantity. User Guide is SSP41 Part14.

Originated	Current Status	Delegated Design Authority	Platform and Operating System
1986	Version – 2.4.1	BMT Reliability Consultants Ltd	PC – DOS

1.4   MART

A PC based model, currently running under DOS, which forecasts the maintainability of naval weapon systems during feasibility and early design stages. To make its prediction the model uses block failure rates and scored maintenance attributes. The arithmetic and geometric mean time to repair and the standard deviation of the logarithm of repair times are calculated. Its User Guide is SSP41 Part 3.

Originated	Current Status	Delegated Design Authority	Platform and Operating System
1980	Version - 2.1.1	BMT Reliability Consultants Ltd	PC - DOS

1.5   MDEM

A PC based model, currently running under DOS, which calculates the number and range of maintainability tests required to perform a maintainability demonstration. To make its calculation the model uses the required minimum and maximum distribution of repair times and acceptable producer and consumer risks. The data then collected from the maintainability demonstration are used by MDEM to determine if the equipment in question will achieve a required maintainability. The model is used in conjunction with Naval Engineering Standard 1017, which describes how to carry out Maintainability Demonstration Testing.

Originated	Current Status	Delegated Design Authority	Platform and Operating System
1985	Version – 3	BMT Reliability Consultants Ltd	PC Windows

1.6   MTBF4

A PC based statistical analysis tool for in-service reliability trials data. The data is collected manually or automatically, using the procedures set out in Naval Engineering Standard 1016, and entered into the program for analysis. From the data the model calculates intrinsic and operational availability, MTBF and MTTR using an agreed system or equipment breakdown and availability block diagram. An interface to PC-ANSAR allows graphical representation

and re-modelling of the ABD. The model runs under WINDOWS only and its User Guide is SSP41 Part 16.

Originated	Current Status	Delegated Design Authority	Platform and Operating System
1985	Version - 2.0.1	BMT Reliability Consultants Ltd	PC - DOS

1.7   ASP System

A series of programs which are not issued but are used by SS831 to provide trial specific programs for use in portable data gathering units such as Psion Organisers or laptop PCs. The data gathered is analysed by MTBF4 and/or PC-ANSAR to provide the final results.

Originated	Current Status	Delegated Design Authority	Platform and Operating System
1987	Version – 1.5	BMT Reliability Consultants Ltd	

1.8   The Reliability Trials Database

A suite of programs used to collect, store and analyse R&M and usage data from MOD(PE) trials of systems and equipments in use, or being accepted by, the RN. Currently the data is in respect of weapon systems only but it is intended to save the results of recent marine trials (CV(F) & T23) in due course. The User Guide is SSP41 Part 18.

Originated	Current Status	Delegated Design Authority	Platform and Operating System
1995	Version – 1.2.1	BMT Reliability Consultants Ltd	PC Windows

LEAFLET A8/1

FORM FOR REQUESTING LOAN OF AR&M SOFTWARE

Request For Loan Of AR&M Software		
Project Details		
Project Title		
	MOD IPT Leader	MoD Requestor
Name		
Tally		
Address		
Email		
Contract Details		
	Company	Address
Prime Contractor		
Using Contractor		
Contract No		
User Details		
	Name	Phone No	Email
Nominated User			
Deputy User			
Computer Details		
Make	Serial No	Operating System
Loan Details		
	Required Until	Version	Media Type
RDEMO			
RAM4		4.5	CD
SAM			

On completion the form should be forwarded as detailed overleaf.

Mail the completed form to:

DES JSC SCM EngTLS Rel1d
Ministry of Defence
Abbey Wood South
Bristol
BS34 8JH

Enquiries:

Telephone   030 679 35355
Email: desjscscm-engtls-rel1d@mod.uk

Or contact the R&M Helpdesk:

Help Desk: 030 679 37755
Email: desjscscm-engtls-rela@mod.uk