

Title: **MAAP VERIFICATION
AND VALIDATION
LOGBOOK**

Prepared for and on behalf
of BAE SYSTEMS by:

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Summary This document records the Verification and Validation state of the Monterey Activity-based Analytical Platform (MAAP). Its aim is to provide model users, customers and scrutineers with objective and auditable evidence on the credibility of MAAP as a Whole Life Cost/Cost of Ownership analysis tool.

This logbook does **NOT** cover the competency of the operators or users of MAAP, or the data used within the tool for cost forecast modelling.

DISTRIBUTION

(MAAP Verification and Validation Review Panel)

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CHANGE HISTORY

Version & date	Comment
Version 1 Oct 2002	Initial V&V Logbook
Version 1.1 Mar '03	MAAP Release 2.4.133L

LIST OF ABBREVIATIONS

CADMID	Concept, Assessment, Demonstration, Manufacture, In-service, Disposal
COO	Cost Of Ownership
COTS	Commercial Off The Shelf
DLO	Defence Logistics Organisation
ICM	Integrated Cost Modelling
IPDE	Integrated Product Data Environment
IPR	Intellectual property rights
LARO	Logistics Analysis and Research Organisation
LCC	Life cycle costing
LSA	Logistics support analysis
LSAR	Logistics support analysis report
MAAP	Monterey Activity-based Analytical Programme
PLCS	Product Life Cycle Support
RAB	Resource Accounting & Budgeting
TFD	Tools For Decision
TOC	Total ownership cost
V&V	Verification and Validation
WLC	Whole Life Cost

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MONTEREY ACTIVITY-BASED ANALYTICAL PLATFORM (MAAP)

VERIFICATION AND VALIDATION LOGBOOK

1. INTRODUCTION

1.1 Background

In the past procurement decisions have been made on the basis of acquisition costs with less attention on the cost of supporting equipment adequately throughout the life cycle. Today the focus of attention is on establishing a whole life, through life approach. This requires the identification of whole life costs at the earliest point possible in the acquisition cycle and the need to monitor and control these costs throughout the life cycle.

Whole Life Costing (WLC) is the continuous process of forecasting, recording, and managing costs throughout the life of an equipment with the specific aim of optimising its whole life costs and operational output. WLC employs a variety of techniques to produce cost estimates; one of these is Cost of Ownership (COO). The COO is the annualised presentation of resources consumed directly in the procurement, operation, training, support and maintenance of equipment at all stages of its life.

1.2 Verification and Validation

Verification is an essential prerequisite of validation. Verification is the process of checking that a model is consistent with its specification and is free from material errors. Validation aims to determine the extent to which a model represents the real world situation, thus providing information from which judgements can be made on whether the model can be used as a credible analytical tool for a specific purpose.

The primary aim of the V&V process is to ensure that objective and auditable evidence on the credibility of the modelling capability, and the underlying data, is available to model users, customers and scrutineers. With such information available in an auditable document, the possibility that a capability is inappropriately applied, thereby rendering a study invalid or unfit for purpose, will be reduced. The continuous availability of such evidence will also enable more effective scrutiny at an earlier stage in the work, such as when concepts are being formulated, rather than when results are emerging.

2. MODEL NAME AND OVERVIEW DESCRIPTION

The Monterey Activity-base Analytical Platform is a deterministic model founded on logistic support analysis principles and data. It incorporates activity-based costing and life cycle cost analysis, which account for all resource consuming activities under defined parameters or assumptions of system usage. Cost and resource profiles can be generated by system, by platform, by fleet or fleet of fleets and by year, by month or by day over any period of the entire life cycle. As a result, MAAP offers an ability to assess the impact on cost of proposed changes in operational and/or support activity or, the impact on operations and/or support activity of proposed changes in the budget. MAAP also provides visibility of the real-time effects of these changes.

3. MODEL MANAGEMENT AUTHORITY & INTELLECTUAL PROPERTY RIGHTS

MAAP is a Commercial-Off-The-Shelf (COTS) model produced by the Tools For Decision Group of companies. IPR for MAAP lies with Systems Exchange Inc¹, the founding company in the TFD Group. TFD Group registered addresses include:

Systems Exchange Inc. PO Box 3290, MontereyCA 93942. USA +1 831 649 3800

TFD Services Ltd. Suite 5, Keswick Hall, Keswick, Norwich, Norfolk. NR4 6TJ. UK. +44 (0) 1603 504 414

¹ Tools for Decision and MAAP are either registered trademarks or trademarks of Systems Exchange, Inc in the United States and other countries.

4. RELATIONSHIP TO OTHER MODELS

MAAP is an activity-based decision support tool that analyses the capability and support requirements of complex systems subject to dynamic operating profiles in any number of locations. It was designed to capture costs and meet all the cost modelling requirements detailed in a recognised Logistics Support Analysis (LSA) process (e.g. MIL-STD-1388-2B and DEF STAN 00-60). MAAP is able to exchange data with other tools developed to support LSA activities and to import/export data to many other applications including Microsoft Excel and Microsoft Access.

5. HISTORY OF DEVELOPMENT AND INTENDED DOMAIN OF USE

In 1996 Systems Exchange Inc., providers of logistics analytical software, began development of a new Total Ownership Cost (TOC) model commissioned by the Avondale Alliance, a joint-venture group competing for a major U.S. Navy contract. The goal of the new model was to provide unprecedented levels of accuracy and credibility in predicting the total costs that would result from constructing, operating and supporting the LPD 17 class of amphibious assault ships over an assumed life cycle of 40 years.

The LPD 17 TOC model was conceived as a process model. Cost estimates were generated by aggregating the resources predicted to be consumed by the many activities involved in introducing the ships into service, operating them and maintaining their many components over the life cycle. At first the new model was seen as a descendant of another Systems Exchange process model, EDCAS (the Equipment Designer's Cost Analysis System). Reflecting this view, Systems Exchange named the LPD 17 model EDCAS 17.

With MAAP, Systems Exchange has broadened the EDCAS 17 modelling concept to encompass major systems of all kinds. MAAP can be readily customised to model the TOC associated with fleets of aircraft, ships or land-based vehicles, industrial plant, information systems, organisational elements, or any of these things in combination.

6. HISTORY OF USE

6.1 Major applications

In 1996 the Avondale Alliance made the first use of MAAP, then called EDCAS 17, during the proposal process for development of the LPD 17 ship. Though not the favourite in the competition, Avondale won that contract and the U.S. Navy stated (and, upon a protest, the GAO² concurred) that the discriminating factor in the award was their proposal to use the model to manage through-life costs.

More recently, the USAF, as part of a Total System Support Responsibility (TSSR) contract awarded to the Northrop Grumman Corporation, has funded a strategic planning device called JCAPS (Joint Cost and Performance System). The purpose of the system is to tie the budgeting process, not to historical projections, but to detailed modelling of the link between its near-term plans for the Joint STARS aircraft fleet and the resources required to carry out the plan. The heart of JCAPS is MAAP.

Parker Aerospace have been using MAAP since 1998 as a flexible support costing model for the F22, JSF and Apache programmes. Lockheed Martin selected MAAP for use in support analysis of JSF and are also extending the use of the model to other programmes in the company. In BAE SYSTEMS, MAAP was selected in 2000 to enhance the LSA modelling capability of the Eurofighter Typhoon programme specifically for supportability analysis but more recently as a WLC tool to support system selection for the ground attack version of the aircraft.

6.2 Other Applications

MAAP has also been used in support of the US Navy SPAWARS programme, the Canadian DND LUVW Programme, the US Coast Guard Deepwater project and an Australian DSTO study into Seahawk midlife upgrade options.

² The General Accounting Office, the analytical assessment arm of the U. S. Congress, used by government agencies as an expert honest broker. Subsequently, during the ship design process, MAAP was used for tender evaluation and source selection for all 35 major systems used on the ship.

7. OPERATOR REQUIREMENTS AND TRAINING

MAAP is a complex costing model designed for use by a skilled analyst. Operators should be familiar with the concepts of support and operation of the equipment being modelled. Also, knowledge of probability and statistics is necessary in order to understand properly outputs from the model, and an ability to manipulate data in spreadsheets and databases will prove a distinct advantage to speed data entry. Operators will need to have attended at least the basic course (T002) in order to be able to begin using MAAP effectively. Users will need to have completed the advanced course (T003) to gain maximum benefit from the tool when modelling complex scenarios. The TFD Group offers six MAAP training courses.

7.1 T001 - MAAP Overview

The overview course shows how MAAP, as a comprehensive analytical decision support system, sheds light on the capability, resource and cost implications of complex systems in dynamic operating scenarios.

7.2 T002 – Using MAAP

The basic course covers the use of MAAP as an analytical data repository and describes data interchange between MAAP and other analytical tools. It covers the basic principles of analysis, the benefits and limitations of analytical processes and assesses when and how to use MAAP. Finally, the course explains how to interpret MAAP outputs.

7.3 T003 – Modelling and Analysis using MAAP

This course builds on the basic course and provides users with advanced knowledge of the application of MAAP to support complex decisions. It gives a brief explanation of the processes, equations and algorithms within MAAP and identifies the sensitivities of input parameters to output values.

7.4 T004 - Algorithms

A detailed understanding of the internal processes, equations and algorithms is provided in this course, building on the information provided in the Modelling and Analysis Course.

7.5 T005 – System Administration

The System Administrators course is designed for MAAP installations where several users will be accessing the data and modelling capability provided by a multi-seat license. It covers the TFD Database as implemented in MAAP. It explains the installation and configuration of MAAP including user-group permissions and logon security, database permissions, backup and restoring of databases and how to maintain database performance.

7.6 M25T006 – Instructor Training

The instructor course trains and qualified instructors to deliver courses T001, T002 and T003.

8. HARDWARE/SOFTWARE REQUIREMENTS

Basic Hardware and software requirements are for an Intel or AMD processor with a Windows operating system; NT, 2000 or XP are preferred. As a project progresses through the life cycle the cost model developed in MAAP may become more complex and volumes of data being handled by MAAP can become very large. Accordingly, run times for the model may increase as the cost model gets bigger. Increasing the amount of memory or upgrading to a faster processor will help to reduce model run time. The minimum recommended hardware specification is:

Processor: 1.0 GHz
Hard Drive: 20GB
Memory: 512MB DDR RAM
Video: Integrated Intel Extreme Graphics or similar

9. VERIFICATION STATUS

9.1 General Approach

Details of the algorithms and equations used within MAAP were obtained from the TFD Group publication Reference 1. A detailed functional specification for MAAP was obtained from Systems Exchange and compared to the specification for a WLC/TOC/LCC tool needed to support the LSA process as described by MIL-STD-1388 2B, Def Stan 00-60 and the Roadmap for Support Engineering produced under the Product Life Cycle Support (PLCS) initiative³. Simple tests for each aspect of the functional specification were designed to ensure that the model had been built correctly and that the specified functionality had been achieved. In a second phase of V&V, complex tests were designed to ensure that the analysis of multi-system multi-echelon equipments and fleets of equipments, operating in dynamic environments could also be carried out with output expectations in line with input parameters and data. The plan and results for the first phase of the testing can be found at references 2 and 3 respectively. The plan and results for the second phase can be found at reference 4 and 5 respectively.

9.2 Assessment Review

A review panel of costing and logistics experts was assembled to ensure that a rigorous and robust testing process was followed, and to approve the process and agree the results obtained. As well as members of the Integrated Cost Modelling Capability Development Team in BAE SYSTEMS, the panel comprised representatives from: the TFD Group, various Air Programmes in BAE SYSTEMS, and members of the Logistics Analysis & Research Organisation from the from the UK MOD DLO.

9.3 Test Results

Testing identified 3 areas where MAAP failed to meet its design specification. These are ability to:

- Use Distance as an Operating Event Measurement base where MAAP treats input distance as operating hours.
- Use the Causes End Item Downtime Function, which limits the operational availability of the end item but fails to record the number of Maintenance Events correctly.
- Apply capacity restrictions to some resource types – Data, Facilities and Tools.

Other than these minor faults, Reference 3 shows that when using MAAP it is possible to capture acquisition costs as well as the costs for operations, maintenance, training and disposal. In doing this it is possible to:

- vary the life cycle duration
- vary the operating tempos for a single system
- calculate the necessary scheduled and the expected unscheduled maintenance events for varying task durations (defining tasks by a variety of methods including calendar time, and operating hours)
- calculate the cost of maintenance, training and operating activities
- break the maintenance events down to tasks
- handle multiple resource types (i.e. skills, parts, tools, facilities, energy and data).

In addition, the more complex testing results detailed in Reference 5 show that MAAP:

- has the ability to vary cost procurement lead-time, and disposal for each part
- can generate packaging and shipping costs for individual parts
- can handle warranty considerations for each part
- can handle multiple levels of maintenance
- can handle multiple operating units and locations

³ See www.plcsinc.org

- can handle resource sharing
- permits sharing of common parts, tools, etc in a multiple system situation
- can calculate the software support and maintenance costs

9.4 Conclusion

MAAP calculates costs in a recognised manner and meets the specification defined by a recognised LSA process.

10. VALIDATION STATUS

MAAP Version 2.4.133d has undergone full assessment by review and testing results are recorded in References 3 and 5. There were no costing activities within the LSA process where MAAP was considered inappropriate for use. Testing was conducted using data sets prepared for the purpose, which provided a realistic representation of the costs of providing a defined military capability. A complete data set from test or trial results or of historical cost out-turns could not be found and therefore was not used in the V&V exercise. However, the tests provide confidence in the ability of MAAP to accurately forecast and estimate cost when such a data set can be identified.

MAAP is considered valid for use as a life cycle cost tool in a logistics support analysis process.

Under the DG(S&A)Guidelines for Cost Forecasting Validation MAAP has achieved Level 1 Validation.

11. PROPOSALS FOR FUTURE VERIFICATION AND VALIDATION OF MAAP

11.1 Verification

The extensive testing completed by the ICM Team in BAE SYSTEMS verified that MAAP version 2.4.133d met its design specification – it had been built right. As the model evolves and additional functionality added, additional testing will be required. It is recommended that the owners of the model IPR, Systems Exchange Inc., provide this service for future releases as part of their routine quality procedure.

11.2 Validation

The extensive testing completed by the ICM Team in BAE SYSTEMS validated MAAP version 2.4.133d for use in a recognised LSA process – the right model had been built. In the future, it is recommended that each MAAP user should validate the model for use in analysis outside the LSA process and maintain individual validation logbooks for this purpose. It is recommended that results of these individual validations are made available to the wider user community through a consolidated validation logbook maintained by Systems Exchange Inc. for all MAAP users. This logbook would not need to include any company proprietary information, but could alert other users to how the model was used.

12. REFERENCES

1. "MAAP, Monterey Activity-based Analytical Platform, version 2.4 equations", Systems Exchange, 2001, UNCLASSIFIED
2. Dixon, A., "MAAP Verification & Validation Exercise Phase 1 Test Plan, version 1.1", BAES-FSDA-GEN-SP-00348, BAE SYSTEMS, August 02, UNCLASSIFIED
3. Dixon, A., "MAAP Verification & Validation Exercise Phase 1 Results, version 1.2", BAES-FSDA-GEN-AS-00349, BAE SYSTEMS, September 02, UNCLASSIFIED
4. Dixon, A., "MAAP Verification & Validation Exercise Phase 2 Test Plan, version 1.1", BAES-FSDA-GEN-SP-00351, BAE SYSTEMS, August 02, UNCLASSIFIED
5. Dixon, A., "MAAP Verification & Validation Exercise Phase 2 Results, version 1.2", BAES-FSDA-GEN-AS-00353, BAE SYSTEMS, September 02, UNCLASSIFIED



Appendix 1.

History of Updates.

MAAP Release 2.4.133L – 18th March, 2003.

12.1 MAAP Release 2.4.133L – Including Service Packs 133D to 133L

This build includes Service Pack 133L that introduces, corrects and or enhances:

- Import TFD Common Format data: Apostrophes in Object parameter text fields; Facilities Price Reference Year
- TFD Common Format Template version 2.4.133K
- Activity Analysis: Maintenance Event Precedence Series
- TFD Common Format Template version 2.4.133J: data validation for field Maintenance Event Name in specific worksheets
- Activity Analysis: calculation of Warranty occurrences: calculation of costs associated with Warranties with a cost measurement base of 'per Annum'
- Application Database Update 4.00.043
- TFD Common Format Template version 2.4.133H: End Item Structure data elements, Maintenance Event data elements
- TFD Common Format Template version 2.4.133H: definitions for Skill Classification Code, Skill Community, Skill Level, Skill Effective Hours per Year, Effective Hours per Week
- File – Purge Database function
- Import Logistic Support Analysis Records: functional LCN structures
- Import TFD Common Format data: Maintenance Tasks assigned to Maintenance Events; apostrophes in Resource names, reference numbers; count of imported Resources
- Activity Analysis: Precision of Operating Event duration-related measurement bases limited to two decimal places
- Activity Analysis: Maintenance Event Precedence Series



- Activity Analysis: Shipping Container costs in Replenishment Support Period
- Activity Analysis: m BOSS Resource Optimization (limited release)

This build includes Service Pack 133K that corrects and/or enhances:

- Maintenance Event Precedence Series: resizing of grid columns
- Activity Analysis: calculation of unscheduled Maintenance Event Occurrences for countbased and hours-based maintenance events
- Activity Analysis: calculation of Energy Logistics Management costs

This build includes Service Pack 133J that corrects and/or enhances:

- File – Purge Database function resulting from deletion of Operating Units in Environment

This Service Pack includes Service Pack 133H that corrects and/or enhances:

- MAAP Data Dictionary

This build includes Service Pack 133G that corrects and/or enhances:

- creation of MAAP objects

This build includes Service Pack 133F that corrects and/or enhances:

- Application Database Update 4.00.042
- TFD Common Format Template: format of text fields



- Import EDCAS data
- Import VMetric data

- Activity Analysis: 'Other' option 'Split Activity Analysis database' splits the Activity Analysis database at the beginning of an Activity Analysis (if not set, the Activity Analysis will still split the Activity Analysis database if required)

This build includes Service Pack 133E that corrects and/or enhances:

- Application Database Update 4.00.041
- File – Purge function
- File – Most Recently Used file list: where the file no longer exists or the network path is not available
- Software Discrepancy Log: database file path / name in reports
- Options window: incorrect behaviour when other windows open; recording of Maintenance Event Support Level names
- Maintenance Event Appearances: Price Reference Year value when Maintenance Event created or activated
- Resources Attribute 'Shelf Life': identified as '(non-deteriorative)' unless set by user
- TFD Common Format Import: import of numeric data with leading or trailing spaces; option switch logic
- TFD Common Format Template: data validation
- Activity Analysis: Environment Cost Set calculations
- Operating States for Systems performing Operating Events in Environment: operating states for Systems that have no End Items; changed operating state for End Item during Operating Phase

This build includes Service Pack 133D that corrects and/or enhances:



- Application Database Update 4.00.040
- scheduled maintenance event occurrences with hours-type measurement bases
- calculation of Data costs, Facilities costs and Tools costs
- import of incomplete and non-compliant LSAR Data Exchange File data, and export of data to an LSAR data exchange file
- Maintenance Events notes
- Environment Unit Stocks for operating units and support units

Project Find Object function

- import of TFD Common Format data
- display of charts and reports for users with MS Access 97 installed

Service Pack 133D also:

- introduces version 2.4.133E of the TFD Common Format Template, which allows users to identify up to 100 maintenance event support levels
- imports EDCAS databases version 3.1.21.

This build includes Service Pack 133C that corrects and/or enhances:

- Supply Part prices when the SPEF option is selected during Activity Analysis
- scheduled maintenance event occurrences with count-type measurement bases where the operating event occurs with a frequency greater than once per day
- training event occurrences other costs where the training unit is identified as 'Unit Performs Training'

This build includes Service Pack 133B that corrects and/or enhances:

- Application Database Update 4.00.039



This build includes Service Pack 133A that corrects and/or enhances:

- training event occurrences where the duration of training is greater than one year
- single-click functions for Currency Units and Units Of Issue in Options

Certificate of Test:

I have completed the testing of MAAP 2.4.133 build 3044 (release 133L) in accordance with the V&V test suite used for the verification of MAAP 2.4.120 (Release 133D) by BAE Systems. This testing showed that the results obtained using MAAP 2.4.133 build 3044 are unchanged from those obtained using MAAP 2.4.120.

Senior Tester – TFD Group.

Name: Chris Hampson Signature: _____ (Signed) _____ Date: February 17, 2003

Certificate of Compliance:

MAAP Release 2.4.133L programming, build and test maintains the Level 1 Validation status in accordance with the DG(S&A) Guidelines for Cost Forecasting Models.

Release Authority – TFD Group.

Name: James H. Russell Signature: _____ (Signed) _____ Date: March 18, 2003