

**AECMA PRODUCT SUPPORT SERVICES
WORKING GROUP**

LYFE CYCLE COST (LCC)

**An Investigative Survey of LCC Models
used by Companies in the
European Aerospace Industry**

PSSWG/92/23335

Issue : January 92

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Product Support Services Working Group

LIFE CYCLE COST (LCC)

An Investigative Survey of LCC Models used by Companies in the European Aerospace Industry.

This document includes :

- An Introduction.
- Seven Identification sheets for LCC Models which are available on the market :
 - CESAR 3
 - CORE
 - EDCAS
 - OPUS 9
 - PRICE HL
 - SYCAP
 - WLCC
- Eighteen Identification sheets for LCC Models or Models partly associated with LCC, non-available on the market :
 - AVCEST
 - CALCLCC
 - COCA
 - COMPACT
 - DOWTY (Method)
 - ENGSIM
 - FASLEM
 - LCCNOMAD
 - LCECM
 - LOTUS 123 (Fokker aircraft method)
 - MALCOM (1)
 - MALCOM (2)
 - MEDOC
 - OBS-CORE
 - PACE
 - SENLSC
 - TYPFA
 - WICKERS (Method)
- A check list of LCC models, for which it is very difficult to produce Identification Sheets (these programmes are owned by organisations or companies which have developed them for their own specific needs).

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LCC

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LIFE CYCLE COST (LCC)

An Investigative Survey of LCC Models used by Companies in the European Aerospace Industry.

This investigation survey of LCC Models is an additional information at the document AECMA - PSC/87/18535 :

"LIFE CYCLE COSTS PERSPECTIVES MILITARY AIRCRAFT APPLICATIONS"

which discusses :

- the concept of LCC as it relates to the specification, design, procurement, operation and support of aircraft, systems, equipment and services and its relevance to the current market place,
- the various cost elements and factors which have a bearing on LCC, how it is applied, the type of analyses applicable to the status of a programme, the need for data collection, computer modelling, sensitivity tests and verification.

1 - INTRODUCTION

To identify and understand the main features of the different estimation systems for LCC's used by the European Aerospace Industries, AECMA sent out questionnaires through the PSSWG to a selection of aerospace companies.

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2 - INVESTIGATION RESULTS

The following companies answered the questionnaire :

- AEROSPATIALE
- ALENIA
- BERTIN
- BRITISH AEROSPACE LTD
- DASSAULT-AVIATION
- DOWTY ROTOL LTD
- FERRANTI DEFENCE SYSTEM LTD
- FOKKER AIRCRAFT B.V.
- GEC AVIONICS
- HUNTING ENGINEERING LTD
- MESSERSCHMITT-BÖLKOW-BLOHM GMBH
- NORMALAIR-GARRETT LTD
- PLESSEY
- SAAB-SCANIA (Aircraft Division)
- SEXTANT AVIONIQUE
- SNECMA
- VICKERS SYSTEMS LTD (Aero div)
- VOLVO FLYGMOTOR

as a result information has been obtained concerning thirty-two different estimating models - some available and some not available.

Seven of the thirty-two models identified are commercially available and, in general, support all aspects of LCC requirements, they are :

- CESAR 3
- CORE
- EDCAS
- OPUS 9
- PRICE HL
- SYCAP
- WLCC

A list of contact addresses relating to these models is included at the end of this introduction.

The remaining twenty-five non-available LCC models are cost models partly associated with LCC and are proprietary and confidential systems owned and operated by particular companies.

A few of these LCC models, for which it has not been possible to produce Identification Sheets, have been listed.

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- 3 - The characteristics of each of the following estimating models are summarized on the following pages. These summaries are based upon information either supplied by actual users and/or extracted from the designer's notes.

AVAILABLE MODELS

- CESAR 3
- CORE
- EDCAS
- OPUS 9
- PRICE HL
- SYCAP
- WLCC

NON-AVAILABLE MODELS

- AVCEST
- CALCLCC
- COCA
- COMPACT
- DOWTY (Method)
- ENGSIM
- FASLEM
- LCCNOMAD
- LCECM
- LOTUS 123 (FOKKER Aircraft Method)
- MALCOM (1)
- MALCOM (2)
- MEDOC
- OBS-CORE
- PACE
- SENLSC
- TYPFA
- WICKERS (Method)

Check list of non-available models for which it has not been possible to produce identification sheets

- AFLCP/ALSCP
- BOEING LCC
- CASA
- COCOMO
- ROMUS
- SECOMO
- USALSC

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LIST OF CONTACT ADDRESSES
(AVAILABLE MODELS)

- CESAR 3

GECI
Tour Winterthur
Cedex 18
92085 PARIS-LA DEFENSE (France)

Tel : (1) 49.03.92.00
Fax : (1) 49.03.92.55

- CORE

Department of the Air Force
Headquarters US Air Force
WASHINGTON DC 20330-5000 (U.S.A.)

- EDCAS

O.B.S. Organisationsberatung und
Softwareentwicklung GmbH
Geschwister - Scholl - Ring 1
D-8034 Germering

Tel : (089) 849306-0
Fax : (089) 8401843

- OPUS 9-SYCAP

SYSTECON AB
Kungsgatan 8
S-111 43 STOCKHOLM (Sweden)

Tel : 46.8.676.50.50
Fax : 46.8.676.50.60

- PRICE HL

PRICE Systems
PRICE House
Meridian Office Park
Osborn Way
Hook, Hampshire, England RG27 9HX

Tel : 44.256.760.012
Fax : 44.256.762.122

- WLCC

Société BERTIN et Cie
BP N°3 - Zone Industrielle des Gâtines
78373 PLAISIR CEDEX (France)

Tel : (1) 34.81.85.00
Fax : (1) 30.54.04.14

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LIST OF CONTACT ADDRESSES

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Documents

Document Sharing Hub

CESAR 3

- Developed by
 - . Centre d'Analyse de Défense.
 - . French Ministry (DGA/ETCA/CAD) since 1985.

- Purpose
 - . Assistance to maintenance concept evaluation.
 - . Life Cycle Cost determination.
 - . Availability calculation.
 - . Determination of means :
 - Staff involved (number of people).
 - Support equipments.
 - Spares.
 - . Sensibility analysis

- Methodology
 - . Analytic model.

- Application
 - . Any civil or military application, for any collection of materials composed of assemblies and sub-assemblies (5 levels), i.e. aircrafts, helicopters, cars, radars, tanks, machine-tools,...

- Output Data
 - . Initial costs :
 - Development.
 - Documentation.
 - Training.
 - Support equipment acquisition.
 - Spares.
 - . Recurring costs (preventive and corrective maintenance actions) :
 - Direct support man hours cost.
 - Documentation updating.
 - Training.
 - Support equipment maintenance.
 - Transportation.

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CESAR 3
Page 1

CESAR 3

(continued)

- . Operational and inherent availability.
- . Availability is given for the whole system, for each module and for each operational site.
- . The maintenance down time is distributed according to the different events : MTTR (repair), MTT (transport), MSDT (stock), MPDT (staff), ADM (administrative delay time),...
- . Spares required for each site.
- . Staff and support equipment required.

▪ Availability

- . CESAR is dedicated to run on PC-AT compatible using MS-DOS. CESAR does not require any mathematical coprocessor or additional memory.
- . CESAR is distributed all over the world by GECI.

▪ Users Comments

- . Detailed and complete results.
- . Prompt processing.
- . Easy data capture thanks to default values.
- . Material critical points are clearly shown up

▪ DesirableImprovements

- . Interface MIL-STD-1388.
- . Level of Repair Analysis (in process).
- . English version (in process).

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CESAR 3
Page 2

CORE

- Developed by . US Air Force

- Purpose . To develop and estimate operating and support costs or resource requirements for air force weapon systems.

- Methodology . Parametric.

- Application . Cost Oriented Resource Estimating model is designed to provide a cost-estimating model that may be used to develop aircraft squadron annual operating and support cost estimates.

- Output Data .
 - . Unit mission personnel cost.
 - . Unit level consumption cost.
 - . Depot maintenance cost.
 - . Sustaining investment cost.
 - . Installation support cost.
 - . Indirect personnel support cost.
 - . Acquisition and training cost.
 - . Total operating and support annual cost.

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CORE
Page 1

CORE

(Continued)

- Availability . Government and civilian agencies should submit their requirements to HQ USAF/ALCC.

- Users Comments . Used by companies and administration since 1987.

- . The factors presented are for general estimating when combined with more specific programming, operational or activity data.

- . They are not intended to be an air force standard, as different units may experience different costs.

- . They are not costs associated with any particular budget year, but are average costs to be expected over the life cycle of the weapon system. The CORE model was used to generate these typical squadron operating and support costs.

- . The input factors are given for reference purposes only.

- Desirable Improvements . The 1986, 1987, 1988 and 1989 issues have been released and used without any problems.

- Now US Air Force only release this model if there is a contract.

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CORE
Page 2

EDCAS

(Equipment Designer's Cost Analysis System)

- Developed by
 - . OBS GmbH and Systems Exchange (in Germany).
 - . The basis of this model is the general structure of the algorithm of MIL-STD 1390B and the US Air Force's LCM.
- Purpose
 - . Predominantly to evaluate technical concepts/solutions on the basis of LCC (Design-to-LCC) with the emphasis on maintenance cost, in order to influence design early and therefore efficiently, what means typically Front End application of such a software program.
 - . To estimate and collect much of the engineering, logistics and cost data required to establish a technical and logistics data base.
- Methodology
 - . Parametric or Accounting (analytical model).
 - . Deterministic / probabilistic / optimizing procedures combined.
- Application
 - . General purpose Logistic Support Costs (LSC).
 - . Commercial and Technical studies for aircraft, mechanical and electronic equipments.
 - . Early comparative cost analysis.
 - . LCC Analysis, Level of Repair Analysis (LORA), Trade-off Studies, Sensitivity Analysis, Front End Analysis, RAM (Reliability, Availability, Maintainability) Analysis, determination of optimal quantities and cost of Manpower, Spares and Support Equipment per echelon.
- Output Data
 - . LIFE CYCLE COST
 - Initial costs :
 - Production.
 - Training.
 - Spares.
 - Support equipment.
 - Documentation.
 - Recurring costs :
 - Labour.
 - Training.
 - Spares.
 - Repair.
 - Support equipment.
 - Documentation.
 - Others.

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EDCAS
Page 1

EDCAS

(Continued)

- Availability . Commercially available. The manual explains calculations and formula in great detail.
- Users Comments . EDCAS is an official tool to be used for LORA in the four nations (UK, I, SP, GE) Eurofighter Program.
- . EDCAS is an integrated tool for:
 - Front end analysis.
 - Design trade-off studies.
 - Sensitivity analysis.
 - Reliability and Maintainability.
 - Life cycle cost analysis.
 - Configuration studies.
 - Level of Repair analysis.
- . Nothing specified about reliability and userfriendliness of the programme (i.e. no manual user necessary to operate the software, although a manual is provided, of course).
- . There is - as far as we can see it - no real competitive Software such as EDCAS on the market.
- . The results are in accordance with those expected. Maximum variation in confidence to apply to its results : 30%.
- . Time to obtain the results : 15 - 20 mins.
- . Total LCC : Yes, but the annual cost and cost-per-flying hour are not available.
- . Particular application of learning curves, inflation and discount rates.
- . Required staff : Non specialists in computers logistics.
- Desirable Improvements . In general, satisfactory system.
- . Further improvement in spares calculation method expected.

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EDCAS
Page 2

OPUS 9

- Developed by . Systecon AB, Since 1970.

- Purpose . OPUS is a powerful model for Logistic Support Analysis, Spares Optimization and Spares Provisioning.
- OPUS has a powerful modeling capability making it a most valuable tool in studies and decisions involving trade-offs between :
 - System design factors.
 - Alternative logisitcs support structures.
 - Repair policies.
 - Stocking polocies and constraints.
- OPUS is not a complete LCC-model, but it contains a number of elements included in a typical LCC-model.

- Methodology . Optimization using Dynamic programming. In LCC classification terms : accounting method.

- Application . All types of systems including Aircraft and Engine.

- Output Data . Measures of Effectiveness (System Availability, Waiting Time, Backorders, etc) LCC and its elements.
- Spares assortments and allocations.
- Cost Effectiveness Curves.
- Detailed cost summaries including effectiveness related marginal costs.
- Reorder policies including reorder size, point, first stock size, etc.
- Detailed info per station.
- Repair and transportation volumes.

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OPUS 9
Page 1

(continued)

[illegible]

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OPUS 9
Page 2

PRICE HL

- Developed by . GE Price System. Division RCA International Ltd, since 1962.

- Purpose . The hardware life cycle model estimates the support costs of material.
 . To predict future expenditure as input to budgets.
 . Compares alternative solutions to same requirement.
 . Will be a change in ownership costs when requirements or concept are modified.

- Methodology . Parametric.

- Application . General purpose LCC Military projects.
 . Commercial studies (all aspects).

- Output Data . Cost of Development.
 . Acquisition and Support.
 . Cost of effectiveness comparison between different concepts.
 . Total cost breakdown per annual costs.
 . Escalates life cycle costs or discount present value.
 . Operational availability and readiness.
 . Customised maintenance concepts can be generated.

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PRICE HL
Page 1

PRICE HL

(Continued)

- Availability
 - . Yes, but the computer program source code is owned by GE Price systems and is not available to users.
 - . Explanations of the models calculations are given in the user manual and during technical support.

- Users Comments
 - . Used by firms and administrations since 1975.
 - . Satisfactory system : Yes, in general.
 - . The Price HL is most powerful when used in conjunction with Price H (another system developed by GE Price systems) to rapidly evaluate whole life costs during the concept stage of a product or a project.
 - . Using Price HL and H models simultaneously can give considerable time economies during the estimating process.
 - . Staff required = Specialised training necessary.

- Desirable Improvements
 - . The model is regularly updated by GE Price Systems to reflect changing life cycle philosophies

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PRICE HL
Page 2

SYCAP

- Developed by . Systecon AB, Since 1985.

- Purpose . SYCAP is flexible tool for Life Cycle Cost calculations.
- . It is an interactive menu driven program for computation of LCC and its cost elements given a set of user defined equation operating on one or several input data sets. It is also equipped with standard dedicated cost models.
- . SYCAP includes functions for :
 - Data input.
 - Computation of results.
 - Sensitivity analysis and ranking.

- Methodology . Accounting methodology.

- Application . All types of systems including aircraft and engine.

- Output Data . LCC and cost elements.
- . Annual costs
- . Result from sensitivity analysis.
- . Combinations of cost elements.

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SYCAP
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