EFFECTIVE IMPLEMENTATION OF PROJECT ORIENTATED ENVIRONMENTAL MANAGEMENT FOR ROTARY-WING AIRCRAFT

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This is an edited version of the paper that was presented at the Equipment Safety Assurance Symposium 2005 (ESAS 05) *held at 26-27 October 2005 at Abbey Wood.*

ABSTRACT

The article describes the implementation of the Project Orientated Environmental Management System (POEMS) with two rotary-wing aircraft programmes:

1. Future-LYNX aircraft.
2. MERLIN Capability Sustainment Programme (CSP).

Increasingly, there is scrutiny of all government departments, including the MoD, to demonstrate consideration of environmental aspects in procurement. In 2003 the MoD launched the POEMS which requires all Integrated Project Teams to implement a set of management procedures that aim to identify, manage and mitigate environmental risk across the CADMID lifecycle.

The POEMS was developed to adopt a flexible and broad management approach in order to accommodate all potential project types, in terms of project size, type and complexity. This flexibility means that the POEMS can be applied in various ways.

The article describes how the POEMS has been effectively applied to two rotary-wing projects of different size and complexity. The article identifies the different approaches adopted and explores where cost savings and efficiency gains may be realized in the implementation of the POEMS.

Introduction

This article discusses the work conducted by Environmental Resources Management (ERM) and Echelon Consulting to implement the early procedures of the Project Orientated Environmental Management System (POEMS) with two rotary-wing aircraft programmes:

1. Future LYNX aircraft.
2. MERLIN Capability Sustainment Programme (CSP).

The POEMS provides a structured approach for Integrated Project Teams (IPTs) to identify, quantify and manage the potential environmental impacts of MoD equipment and services throughout the CADMID♣ cycle. Its implementation was mandated on 8 July 2005[1] and any IPT acquiring services or equipment must implement the POEMS, or meet its requirements in an equivalent manner. The POEMS is structured through eight *core procedures*, which broadly require IPTs to:

♣ Concept, Assessment, Demonstration, Manufacture, In-service and Disposal

- Gather an evidence base of environmental standards, conduct stakeholder consultation and conduct an initial assessment of the scope of potential environmental impacts.
- Conduct environmental impact assessment and report performance.
- Develop and implement an environmental management plan.
- Review and continuously improve the environmental management processes in place.

It is the IPTs responsibility to manage the completion of the POEMS and to ensure continuous review throughout the CADMID cycle. The DPA and DLO jointly hold responsibility for the overall management and maintenance of the POEMS.

POEMS adopts a *lifecycle thinking* approach which requires IPTs to manage potential environmental impacts across the complete CADMID cycle. It was also developed to contain a significant degree of flexibility in order to deal with the vast array of procurement projects that IPTs will be involved with, in terms of equipment platform, size and complexity. As such, the POEMS system is generic to accommodate all potential project types. The *lifecycle thinking* approach adopted by the POEMS is a sound and fundamental basis to conduct an environmental assessment of defence equipment and services. However, to implement the POEMS effectively and efficiently it is essential to specialize the POEMS approach to suit the equipment platform and specific project requirements.

This article describes how POEMS can be implemented effectively and efficiently for rotary-wing aircraft. The article aims to answer the following questions for two audiences:

- The IPT environmental manager:

  How to conduct an efficient environmental screening and scoping study? How to conduct preliminary environmental impact assessment?

- The DPA/DLO:

  How to reduce the costs of implementation of the POEMS system?

The article describes the *best practice* areas developed by the author and explores the early results achieved through the implementation of POEMS with the Future-LYNX Programme and the MERLIN Capability Sustainment Programme (CSP).

POEMS

Increasingly, there is scrutiny of all government departments, including the MoD, to demonstrate consideration of environmental aspects in procurement. The MoD is now expected to demonstrate that it has implemented appropriate controls and procedures to manage and mitigate the potential environmental impacts of its equipment and services.

Aims and Benefits of POEMS

In 2003, the Defence Procurement Agency (DPA) and Defence Logistics Organisation (DLO) launched POEMS which is designed to provide the necessary structure to manage the environmental performance and liabilities of a MoD acquisition project.

If implemented effectively, the POEMS will provide the following overall benefits[1]:

- Cost reductions by eliminating the need for equipment reworks and delays.
- Risk reduction for the MoD of potential land restoration costs.
- Risk reduction for the IPT of potential environmental issues, as well as identification of environmental benefits.
- Demonstration to internal and external stakeholders of the MoD's commitment to managing the environmental impacts of its equipment and services.
- Assisting with provision the of information to meet the requirements of Freedom of Information Act and the Environmental Information Regulation.

Structure of POEMS

The POEMS system is formalized through three sets of *procedures*, which are consistent with ISO 14001:

- The eight Core Procedures.
- The four Support Procedures.
- The four Assurance and Audit Procedures.

The *Core Procedures* (FIG.1) cover the main tasks and activities required by the IPT and are aligned with the CADMID cycle.

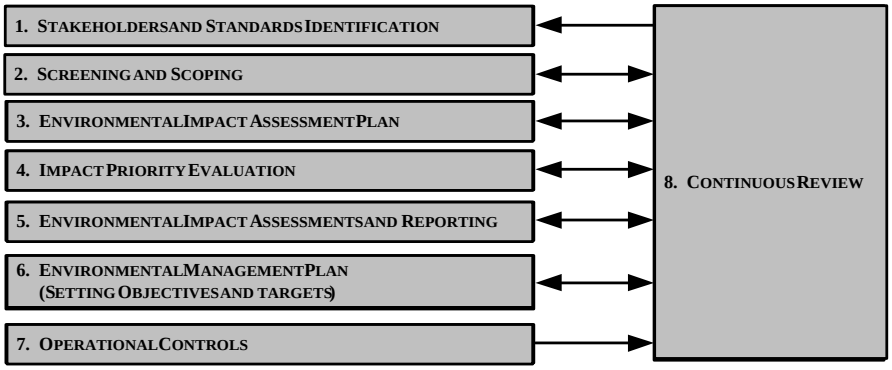


FIG.1 – POEMS SYSTEM PROCEDURES

The *Support Procedures* apply management controls for training, communications, document control and monitoring. The *Assurance and Audit Procedures* apply an assurance of the IPT's activities and outputs.

POEMS provides a structured and balanced approach to environmental management through the application of its *core procedures* which include general guidance, tools and forms to assist in generating the necessary environmental information.

Execution of POEMS

In general, the management responsibility of environmental issues falls upon the IPT safety manager, including the implementation of the POEMS. In practicality, the completion of tasks is more likely to be completed by an environmental advisor retained by the IPT or by the equipment or service supplier with support from an environmental advisor.

A primary objective of POEMS is to identify, at an early stage, the potential environmental impacts of an IPT's activities. This identification process is the objective of procedure two (screening and scoping) and its results will direct further study and form the basis for all further impact assessment and mitigation work. Consequently, it is essential to conduct the screening and scoping study both rigorously and in an efficient manner.

POEMS provides an outline step-by-step process to conduct the screening and scoping study, as follows:

- Identify activities across the lifecycle that interact with the environment.
- Identify environmental aspects (i.e. materials and energies) for each activity.
- Identify and record the environmental impacts (e.g. global warming, resource depletion, etc.) for each aspect.

The next section of the article provides details of the author's work of how to effectively and efficiently conduct the screening and scoping study for rotary-wing aircraft. Initially, a *best practice* methodology is presented that is compliant with POEMS and subsequently, the results of its application are discussed for the F-LYNX and MERLIN CSPs.

Effective Environmental Screening and Scoping of Rotary-Wing Aircraft

To effectively identify the potential environmental impacts of the aircraft all stages of the life cycle need to be considered, from raw material extraction through to product manufacture, demonstration testing, in-service use and decommissioning. By adopting a lifecycle approach it is possible to generate a complete picture of the aircraft performance and therefore identify where the most significant detrimental and beneficial environmental impacts are likely to arise in the life cycle. This identification process will direct further study and focus mitigation measures and the establishment of management targets.

It is necessary to adopt a structured approach when conducting the screening and scoping study. The following steps are proposed to characterize the aircraft life cycle:

- Identify and map the significant activities that arise in the aircraft life cycle across CADMID.
- Based on expert judgement, identify and record the significant environmental aspects. For example, the inputs include energy, fuels, materials and ancillary chemical consumption; and the outputs include emissions to air, water, land and noise nuisance.
- Based on expert judgement, record the potential environmental impacts.
- Identify how these activities are currently managed, if at all.

The first stage is to identify and map the main activities in the aircraft life cycle across CADMID, as presented graphically in (FIG.2). Initially, the life cycle activities are defined through cascading levels of detail. For example, during the In-Service phase, four high level activities can be identified: Delivery, Flight, Service and Upgrade. These four activities are then broken down into successive levels, thus, defining the main activities for the In-Service phase.

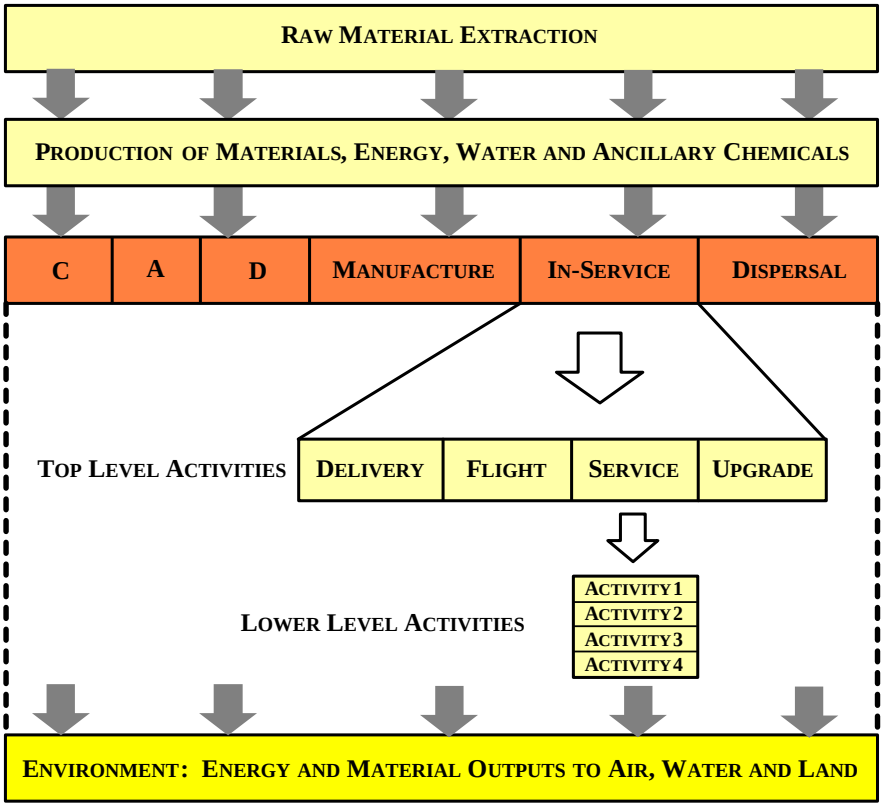


FIG.2 – ENVIRONMENTAL ASSESSMENT AS APPLIED TO CADMID

The second stage is to establish the input and output environmental aspects for each activity in the life cycle. The two bars at the top of FIG.2 graphically represent the input environmental aspects (i.e. the raw materials and energy inputs extracted from the environment) and the bar at the bottom of the diagram graphically represents the output environmental aspects (i.e. the emissions to air, water, land and wastes). Compiling a list of all inputs and outputs for each activity subsequently will form a preliminary inventory analysis, which describes the aircraft life cycle.

(FIG.3) shows an illustration of the activities and input aspects associated with aircraft flying during In Service.

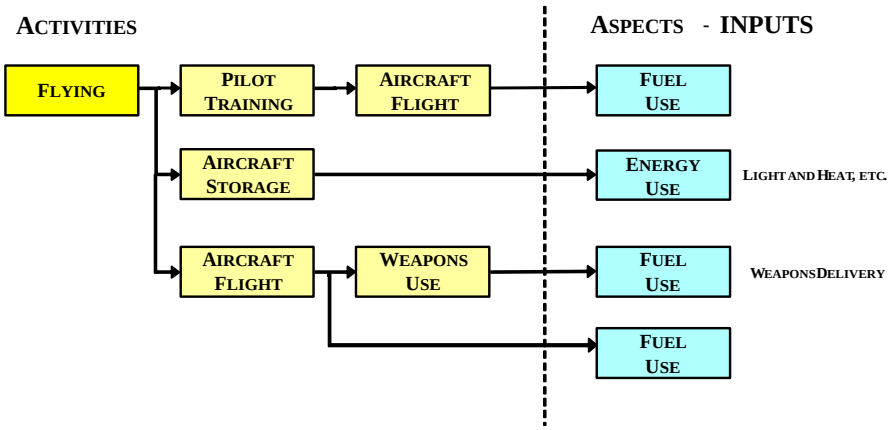


FIG.3 – FLYING ACTIVITIES AND ASPECTS DIAGRAM – INPUTS[3]

This approach of mapping the activities through successive levels of detail provides a clearly structured and transparent assessment process. However, it can involve a significant amount of time and resource in order to understand each activity to a sufficient level of detail. For example, during aircraft flight it is necessary to establish the engine fuel type, aircraft operating life, number of flight hours and fuel economy, etc.

The information to identify and describe each activity should be obtained from the following sources:

- Interviews with key stakeholders identified in Procedure One.
- Review of published documents and other research (e.g. journals, internet, etc.).
- Review of studies of similar projects/services.

The objective of the screening and scoping study should be to identify all significant activities and aspects across the life cycle that interact with the environment. The level of effort committed to identifying and assessing environmental impacts should be commensurate with the potential impacts. Unless suitably qualified, it is likely that the IPT will be reliant on external expertise to estimate the potential impacts of the project.

Environmental Screening and Scoping of the F-LYNX Programme

The Future LYNX programme is a development of the existing LYNX aircraft and will encompass an improved airframe, new engines and an updated avionics suite, which aims to replace the:

- LYNX Mk7&9 (Army) with the Battle Field Reconnaissance Helicopter (BRH); and
- LYNX Mk3&8 (Navy) with the Surface Combatant Maritime Rotorcraft (SCMR).

As specified by POEMS, the primary aim of the screening and scoping study is to identify a project's potential environmental impacts and to direct the gathering of further relevant environmental information for more detailed assessment later in the completion of the POEMS.

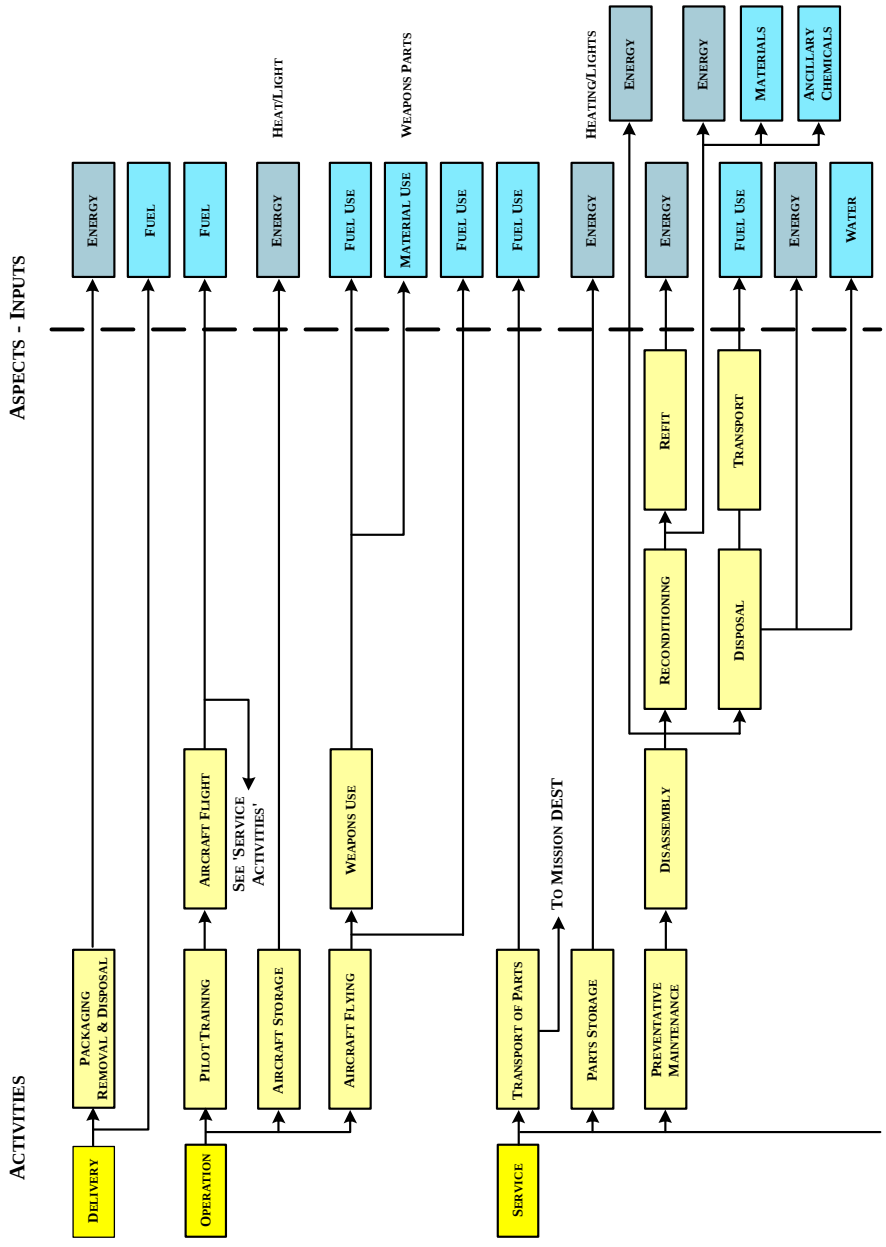
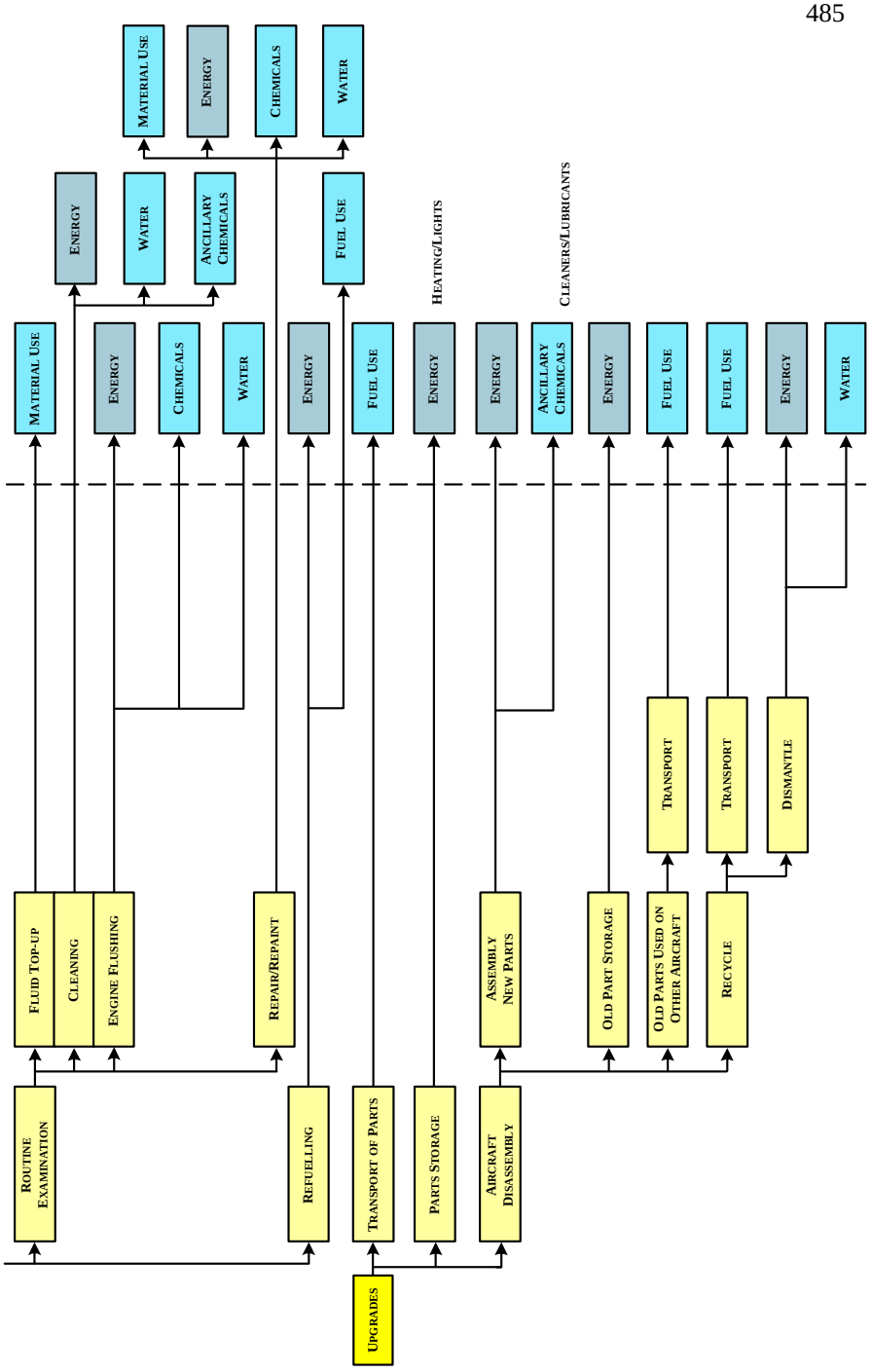


Fig.4 – IN-SERVICE PHASE ACTIVITIES AND ASPECTS – INPUTS[3]


MATERIAL USE
ENERGY
CHEMICALS
WATER
ENERGY
WATER
ANCILLARY CHEMICALS
FUEL USE
HEATING/LIGHTS
CLEANERS/LUBRICANTS
MATERIAL USE
ENERGY
CHEMICALS
WATER
ENERGY
FUEL USE
ENERGY
ENERGY
ANCILLARY CHEMICALS
ENERGY
FUEL USE
FUEL USE
ENERGY
WATER
FLUID TOP-UP
CLEANING
ENGINE FLUSHING
REPAIR/REPAINT
ASSEMBLY NEW PARTS
OLD PART STORAGE
OLD PARTS USED ON OTHER AIRCRAFT
RECYCLE
TRANSPORT
TRANSPORT
DISMANTLE
ROUTINE EXAMINATION
REFUELLING
TRANSPORT OF PARTS
PARTS STORAGE
AIRCRAFT DISASSEMBLY
UPGRADES

The F-LYNX programme is a complex project with environmental impacts that are likely to be significant. The first stage of the screening and scoping study was to develop a reliable understanding of the main life cycle activities and to establish the boundaries of the study. Through discussions with the environmental working group members (set up during Procedure One) it was determined which parts of the life cycle should be included and excluded from the study. The exclusions identified were munitions, as these are the responsibility of another IPT, and ground-based support equipment, as this is already in operation. All other activities were to be included.

Due to the complexity of the F-LYNX programme it was impractical to identify all activities where interactions with the environment may occur. Instead, only the significant activities and aspects should be identified. Expert judgement was used to identify the likely activities to cause significant environmental impacts. At this early stage, POEMS requires the collection of some quantitative or qualitative data. The author proposes that it is essential to collect as much quantitative data at a high level as is practicable. The use of quantitative data will provide the basis to substantiate the most significant environmental impacts. If insufficient data is available then this will identify the need for further study.

An illustration in (FIG.4) presents the life-cycle-map of the In-service phase activities and the input aspects for the F-LYNX aircraft. The screening and scoping study mapped all phases of the CADMID cycle in a similar manner. Quantitative data was gathered to describe each activity in the life cycle where possible.

Through interviews with key stakeholders and further research, it was possible to identify and map all significant F-LYNX activities and aspects. The study indicated that the final four phases of the CADMID acquisition cycle have the most significant environmental impact. The study also revealed that further study would be necessary to gather and interpret sufficient quantitative data to identify the programmes key environmental impacts.

A streamlined Life Cycle Assessment (LCA) study was recommended as the most appropriate method to identify efficiently and robustly the significant environmental impacts of the aircraft.

A streamlined LCA will provide detailed baseline knowledge of the environmental impacts of the aircraft, without the need for completing a comprehensive LCA study. The study will provide the IPT with a robust assessment that will focus on the most significant activities causing environmental impacts across the acquisition cycle, and within each acquisition phase. Hence, high impact activities can be prioritized and mitigated with the most efficient and effective use of resources. A streamlined LCA is a cost effective method to identify the environmental impacts of the F-LYNX aircraft. Where possible, previous studies should be used an as initial reference point to further reduce resource requirements.

A streamlined LCA of this kind would provide the Lynx IPT (and also the MoD) with a considerable knowledge base of the specific environmental impacts of aircraft flight based on quantitative data and robust environmental assessment techniques. This allows for the possibility of considerable knowledge sharing across other IPTs, thus, potentially reducing the resource requirements and costs of implementing POEMS in future projects. Additionally, it will provide a ‘benchmark study’ that could the basis for a consistent and focused approach to be adopted by different IPTs.

Environmental Screening and Scoping of the MERLIN Capability Sustainment Programme (MCSP)

The MERLIN IPT is responsible for the MCSP, which is an upgrade of the aircraft avionic systems. The author provided expert environmental advice to LOCKHEED MARTIN ASIC to support their implementation of Procedures One to Three of the POEMS system.

Based on an initial expert judgement, the environmental impacts of the programme were estimated to be moderately low. In line with POEMS, the aim of the screening and scoping study was to identify the project's potential environmental impacts and to direct further study. Additionally, however, the study also aimed to gather data to quantify the relative scale of the impacts to substantiate the initial judgement of a moderately low impacts.

In a similar manner to the F-LYNX programme, the environmentally significant activities of the MCSP were mapped across the CADMID cycle and quantitative data was gathered where possible.

In order to demonstrate the level of environmental significance of a programme it is necessary to compare the scale of the impacts by placing them in a specific context. For example, the environmental impacts of a car tyre may be placed in the context of car use, or for example, the impacts of car use may be placed in the context of entire UK transport.

For the avionic systems upgrade for the MCSP the chosen context was the MERLIN aircraft if it had remained in-service. Consequently, the scale of environmental impact of the programme can be determined in comparison to the complete MERLIN aircraft life cycle.

The data gathering process for the screening and scoping study therefore focused on collecting data for two systems, as shown by the dashed boxes in (FIGS.5 & 6). The study collected or estimated quantitative data at a high level for all activities.

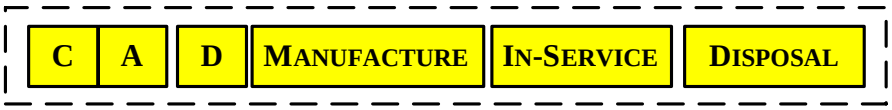


FIG.5 – SCOPE OF ACTIVITIES FOR THE MCSP

The scope of activities identified for the MCSP included all those which have a significant interaction with the environment that result from implementation of the programme, including manufacture, use and disposal of new avionics equipment and the disposal of old avionics equipment.

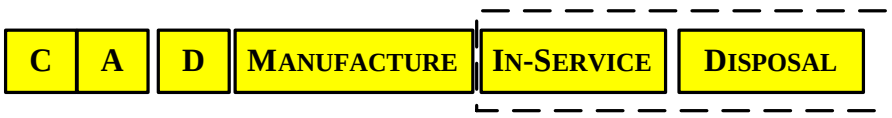


FIG.6 – SCOPE OF ACTIVITIES FOR THE MCSP

For the complete MERLIN aircraft lifecycle, the In-Service and Disposal phases on the CADMID cycle were assessed. The other four phases are not relevant to the study because the aircraft is a legacy system that has already been designed, demonstrated and manufactured. Consequently, any activities associated with future use of the aircraft will only occur in the In-Service and Disposal phases.

The study indicated that environmental benefits are likely to arise due to reduced fuel consumption during in-service flight, as a result of aircraft weight reduction.

The study also indicated that the largest environmental impacts are likely to arise during the manufacture of new avionic systems and the disposal of old avionic systems. Previous studies conducted by the MERLIN IPT also indicated potential impacts on marine fauna.

The following section describes the author's work with MCSP to determine the environmental significance of the programme.

Preliminary Environmental Impact Assessment (EIA) of Rotary-Wing Aircraft

The objective of Procedure Three of the POEMS is to initially identify whether a full EIA is necessary and, if so, to determine the best strategy for applying the EIA process to the project. The POEMS requires reconsideration of the environmental impacts identified in the screening and scoping study (Procedure Two). The POEMS system states that a full EIA is required if:

- A material risk to the environment, stakeholders or legislative or policy requirements is identified.

or

- Insufficient information is available to determine if a material risk exists.

Guidance is not provided on how to determine whether a material risk is present. Although POEMS does state that this step has an element of subjectivity and may be open to interpretation. POEMS therefore recommends that an IPT seeks specialist advice where there is uncertainty. It is a key decision to determine whether to proceed with a full EIA study as this is likely to commit the IPT to significant ongoing research and study costs.

Presented here is a quantified and streamlined method to assist in making the decision as to whether a material risk exists. The author presents a preliminary EIA method to indicate the scale of environmental significance, as applied to the MCSP. The use of quantified data helps to remove subjectivity and increase the credibility of the decision. The method presented is a low data intensive approach and was applied to the MCSP based on the initial judgement that the impacts of the project were moderately low. The effort is commensurate with the likely level of impacts.

The preliminary EIA method was conducted as follows:

- Select the 'context' to determine environmental significance.
- Identify key indicators for significant environmental impacts based on screening and scoping study.
- Gather quantitative data to characterize the life cycle activities.
- Interpret results.

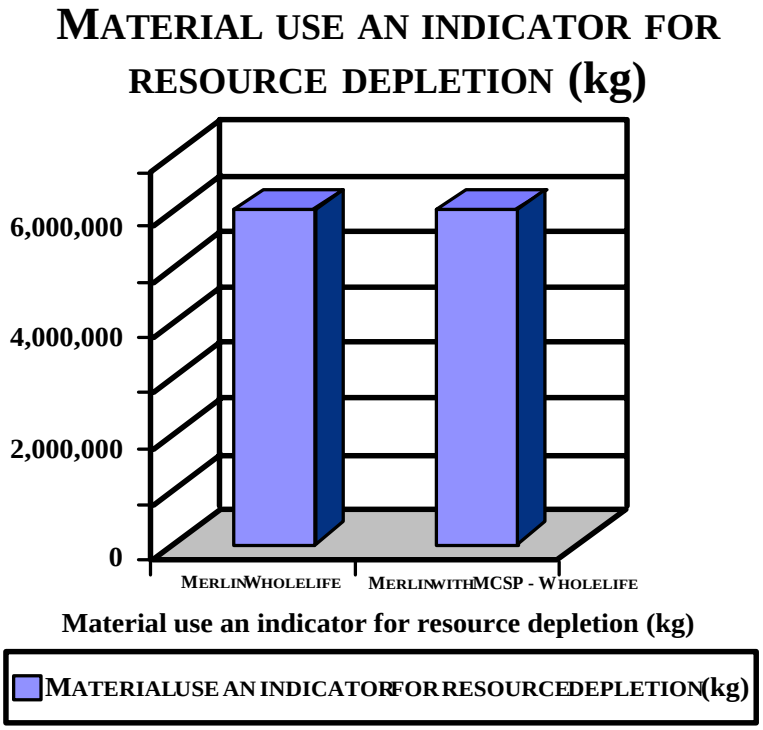
The level of environmental significance can be determined by placing the equipment or service being studied in a specific context. As mentioned in the previous section, the chosen context for the MCSP was the MERLIN aircraft if it had remained in-service.

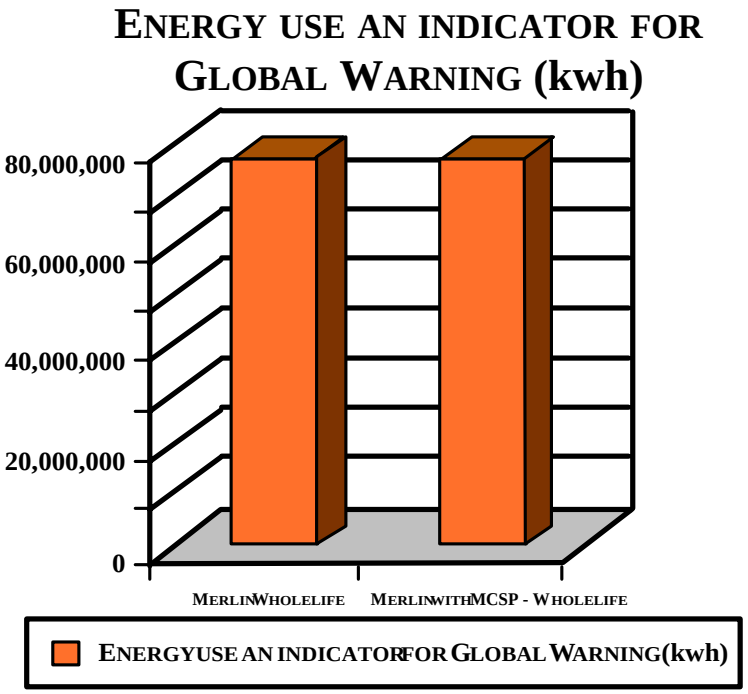
Based on the largest environmental impacts that were identified in the screening and scoping study for the MCSP, four headline indicators were identified:

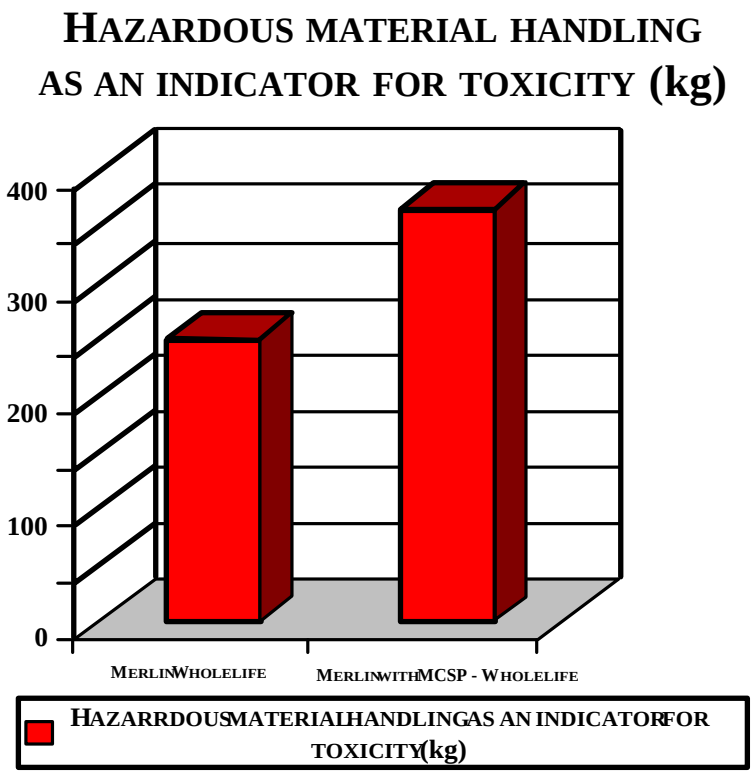
- Material use as an indicator for resource depletion (kg).
- Energy use as an indicator for global warming (kwh).
- Hazardous material handling as an indicator for toxicity (kg).
- Aircraft flight as an indicator for noise/downdraft impact (hrs).

Data was gathered to determine the direct environmental impacts of each activity for the two systems being compared. This was gathered for both detrimental and beneficial impacts.

Although the study was still underway when writing this article, the preliminary results are presented below in (FIG.7). The results indicate that with the exception of the toxicity indicator, the other impacts can be considered insignificant. The toxicity impact arises predominantly due to the disposal old avionics equipment and the manufacture of new avionics. This implies that safe handling and disposal of waste electronic equipment is required to mitigate the environmental risk associated with this waste stream. Additionally, an environmental benefit is achieved due to fuel savings in-service, as a result of aircraft weight reduction, indicating a direct benefit over the old avionic systems.




ENERGY USE AN INDICATOR FOR GLOBAL WARNING (kwh)
80,000,000
60,000,000
40,000,000
20,000,000
0
MERLIN WHOLELIFE
MERLIN WITH MCSP - WHOLELIFE
ENERGY USE AN INDICATOR FOR GLOBAL WARNING (kwh)


HAZARDOUS MATERIAL HANDLING AS AN INDICATOR FOR TOXICITY (kg)
400
300
200
100
0
MERLIN WHOLELIFE
MERLIN WITH MCSP - WHOLELIFE
HAZARRDOUS MATERIAL HANDLING AS AN INDICATOR FOR TOXICITY (kg)

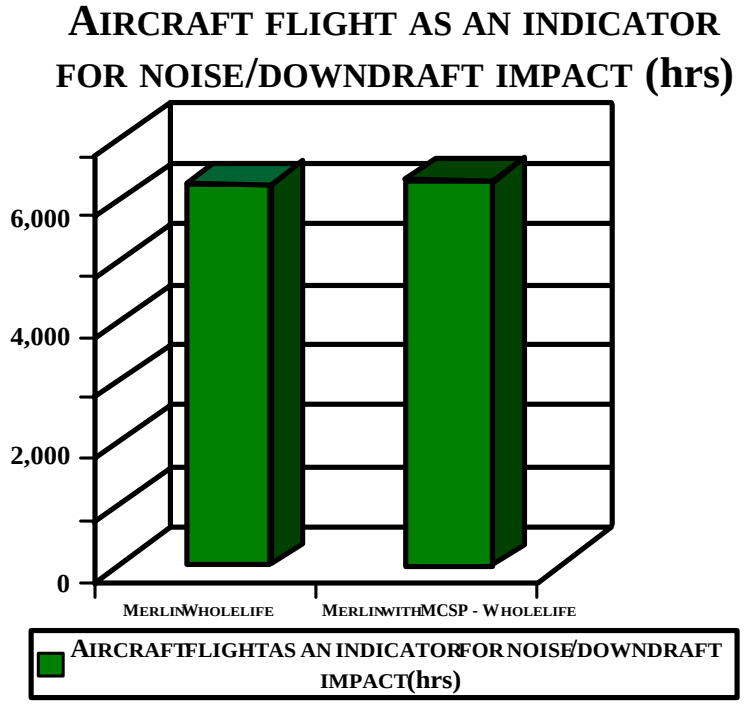


FIG.7 – ENVIRONMENTAL PROFILE OF MCSP[2]

The streamlined preliminary EIA method presented here is equally applicable to other aircraft programmes. However, the chosen context and specific indicators will need to be tailored to match the project under study.

Conclusions and Recommendations

The article presents new research on the implementation of the POEMS for rotary-wing aircraft. In particular, the author presents a cost effective and robust method for conducting the mandatory environmental screening and scoping study, completed in Procedure Two. The results of its application are discussed for the F-LYNX and MCSPs.

The article also presents a quantified and streamlined method to conduct a preliminary EIA as part of completing Procedure Three, to determine if a full EIA is required. The method presented aims to remove potential subjectivity through the use of quantified indicators that are project specific. Therefore increasing the credibility of the decision to commit to further environmental assessment. The results of this method are discussed for the MCSP.

Additionally, the author proposes several recommendations to reduce the overall costs of implementation of the POEMS. There is substantial opportunity to achieve significant cost saving by reducing the effort necessary to complete common activities that are required in the early procedures of the POEMS. The areas where significant cost savings could be achieved include:

- Review of environmental standards and legislation (in Procedure One).
- Completion of the environmental screening and scoping study (in Procedure Two).

- Decision as to proceed to a full environmental impact assessment is necessary (in Procedure Three).

As outlined in this article, it is essential to specialise the POEMS approach to suit the equipment platform and specific project requirements to effectively and efficiently meet the requirements of POEMS. The author advocates that substantial cost savings could be achieved by developing generic assessment methods and guidance according to the equipment platform type (e.g. rotary-wing aircraft or fixed-wing aircraft, etc.) to support the individual IPT. This information would be most appropriately stored on a POEMS 'knowledge base' and would include:

- A register of environmental standards.

  This would include a log and summary of relevant environmental standards (including the updated JSP 418), both for the UK and other countries. The register would be mapped across the CADMID cycle and be electronically stored for rapid access. Cost reduction will be achieved by eliminating the need for each IPT to engage in intensive research to obtain the relevant standards. Rather it will only be necessary to identify and interpret each standard's applicability to the particular project. A well maintained database should also assure the IPT that the register is up to date and reliable. Initial data gathering may be conducted by IPTs that are currently involved in the implementation of POEMS. However, future IPTs would benefit from the knowledge sharing potential.

- Generic platform assessment models.

  The author proposes that a generic assessment model and guidance should be developed for each platform type to assist the IPT to complete the core procedures of the POEMS. Essentially, this would take the form of a predefined life cycle model of the equipment platform and would include all the main activities and environmental aspects and impacts for that equipment type for each CADMID phase (e.g. as presented in FIG.4). The IPT would use this 'model' as the 'starting point' for a screening and scoping study. The model would be further streamlined to the project specific activities. Additionally, guidance for the specific platform type could be provided to assist in making the decision to proceed to a full EIA. Similarly, this guidance would be generic to the platform type. A platform-based approach of this kind will significantly reduce costs by providing a tailored and consistent approach that is focused on the specific nature and requirements of that particular platform type. The IPT will benefit from knowledge sharing and the efficiency gains of adopting this streamlined and focused approach. It will also provide additional validity and reliability of results.

A generic platform approach would provide the following benefits:

- Substantially reduce any duplication of work across IPTs.
- Reduce time for the IPT to access relevant information.
- Reduce time to complete environmental assessments due to use of streamlined and tailored approaches that are specific to the platform type.
- Improve consistency and credibility of assessments.

The research outlined in this article provides a foundation to develop a generic platform model and tailored guidance for rotary-wing aircraft. The research presents practical guidance for the IPT and also identifies significant opportunities to reduce the overall financial cost to implement the POEMS.

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