NEW LOGISTICS IT SYSTEM FOR THE FLEET AIR ARM

BY

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ABSTRACT

The article aims to describe the Fleet Air Arm's initiative to introduce a logistic information management system for new and in-service aircraft and equipment, which embraces the latest Integrated Logistic Support standards.

Introduction

This article aims to describe the Fleet Air Arm's (FAA) initiative to introduce a logistic information management system for new and in-service aircraft and equipment, which embraces the latest Integrated Logistic Support (ILS) standards. Before discussing this system in detail, it is necessary to see how it fits into the overall Fleet Air Arm Information Technology (FAAIT) strategy.

Beginnings of the FAAIT Programme

Like many other organisations within the Services and MoD, the FAA is currently engaged in a major Information Technology (IT) investment programme. Following a resource management study by PA Consultants Ltd in 1984, the FAAIT Programme was formed to improve efficiency within an environment of reducing budgets and manpower ceilings.

FAAIT Programme organisation

The programme as it now stands comprises some sixty full-time FAA, civil service and contractor personnel. It is managed by a captain RN and consists of several projects and support elements, each managed by a commander/Grade 7 (except for the Naval Aircraft Repair Organisation (NARO) and systems integration group):

(*a*) *Programme support office.*

(*b*) *IT system manager.*

(*c*) *Systems integration group.*

(*d*) *Infrastructure.*
- General application Office Automation (OA) software.
- Local area networks.
- Wide area network.
- Main processors.
- PC-based terminals.
- Printers etc., both in ships and at air stations.

(*e*) *Work Recording and Asset Management (WRAM) application.*
The electronic collection of aircraft and component work recording and asset management data.

(*f*) *NARO application*

Materials requirements planning system to support the third-line deep repair of aircraft and components.

(*g*) *Mission support application.*

- Meteorology.
- Sortie planning.
- Aircrew availability.

(h) *Administration application*

- Activity recording.
- Training and cost planning.

(*i*) *Logistic Support (LS) application*

Logistic management of FAA aircraft and equipment.

This article concentrates on the LS application, starting with a discussion of the business functions it aims to support, and then examining the main features of the design.

Introduction to the LS application

The LS application has been designed to provide IT tools primarily for the Director General Aircraft (Navy) (DGA(N)) staff and:

- FAA engineering and support managers.
- ILS managers engaged in equipment procurement and logistics planning.
- Spares provisioning staff responsible for the day-to-day supply of aircraft parts.
- A Logistic Data Analysis Cell who perform in-depth analysis of support policies.

Following the MoD policy to adopt the principles of ILS, the LS application has been designed to comply with Mil-Std 1388–2B and AECMA 2000M. The LS database is built on standard commercial Logistic Support Analysis Record (LSAR) software, with numerous MoD specific extensions, and should migrate to comply with Def Stan 00–60 in the future.

Design features required of LS

To yield the benefits of IT support, the LS application had to provide ten key features:

1. *Assimilation of the whole picture.*

   Logistic managers have encountered great difficulty in assimilating the logistic support situation of their aircraft and equipment, because data is either not available at all or cannot be consolidated in a timely way. The new system has interfaces to gather together the data necessary to compile a 'whole picture' of a logistic repair loop, store this data in a central database and display it in a way that is easy to understand and evaluate.

2. *Manage by exception.*

   Some users already have on-line access (via stand-alone terminals) to existing logistics systems, but there is no practical means of monitoring for a change or deteriorating trend. LS will make vastly more data available on-line, and so an automatic monitoring and warning function is provided. This will help DGA(N) staff to 'manage by exception', so problems are identified and prioritized before they impact the aircraft fleet.

3. *Automatic data update.*

   The previous generation of engineering databases relied on manual upkeep and data maintenance and were therefore under-used and unreliable. To overcome this, the LS database is being constructed and maintained from the best sources of data available. The interfaces that update the database are either automatic or managed by full-time support staff.

4. *Intuitive and easy to use.*

   Given the frustrations of the last generation computer systems and the much greater size of the new, an intuitive and consistent (graphical/ Windows-based) Human Computer Interface (HCI) was considered essential.

5. *Cater for old and new.*

   Whilst the system caters for new data standards associated with the latest ILS aircraft and equipment, it had to be designed to also cater for some of the older aircraft which will remain in-service for many years.

6. *Flexible database access.*

   Diverse and constantly changing user query and report requirements, meant that LS must provide an easy to use and flexible database access tool.

7. *Qualitative numerate decision support tools.*

   FAA staff have traditionally made support policy decisions based on experience and subjective evaluation. As the defence budget progressively reduces, so staff are under increasing pressure to identify the most cost effective solution to support requirements, and to substantiate decisions with numerate evidence. LS provides suitable analytical tools to assist in this process.

8. *Replace the Provisioning Data System (PDS).*

   The traditional process of deciding the types and quantities of aircraft spare parts to buy relies on laborious manual and subjective assessment. The results were recorded in the ageing PDS database. Given the vision of future provisioning activities and the imperative to improve efficiency, LS has necessitated significant business practice re-engineering. This has been necessary to introduce an integrated analytical spares optimization tool (e.g. OPUS9), adopt modern provisioning protocols (e.g. AECMA 2000M) and refine the crucial FAA to RAF provisioning interface.

9. *Quantitative simulation tool.*

   Previously the effect of in-service trends and the possible future effect of policy changes, could only be subjectively assessed. A quantitative simulation tool was required to provide objective evidence, especially where man hours and contracted repair capacity are being estimated, to substantiate policy proposals.

10. *ILS management.*

    The LS application as a whole would provide RN ILS managers with most of the tools and facilities required. In addition to this the following would be required:

    - Logistic Support Analysis (LSA) tailoring tool.
    - LSAR import/export function.
    - LSAR review facility.

The LS application is being constructed by the prime contractor by integrating a range of commercial 'off-the-shelf' software packages within a Windows environment. The next section examines how the business requirements above are being satisfied in the design.

OVERVIEW OF THE LS SOFTWARE APPLICATION

This section looks at the main sections (known as sub-applications) and interfaces of LS (FIG. 1). Where necessary, additional explanatory text has been included to describe how the needs of old and (ILS-compliant) new, have been reconciled within a central database.

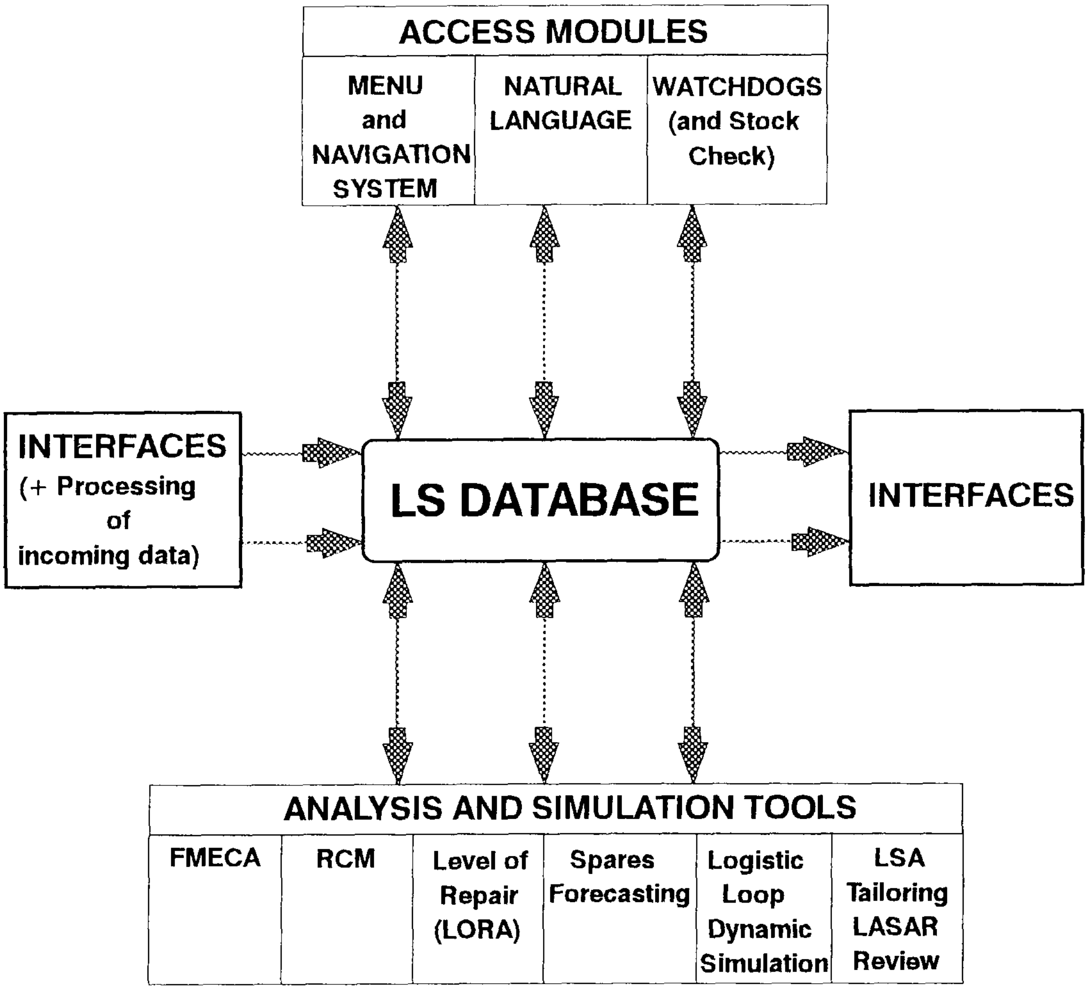

FIG. 1—LS APPLICATION OVERVIEW

THE LS DATABASE

Architecture

The Mil-Std 1388 concept of ILS, and the process of LSA, has been accepted by the MoD as a design methodology that should be adopted on all new major procurement. The FAA policy is to contract manufacturers to perform a tailored LSA programme and deliver the results in an LSAR database. Notwithstanding this approach, there is benefit in having the capability to perform further selective in-house analysis on an ILS equipment after the LSAR is delivered and the equipment has entered service. Exceptionally the selective use of LSA tools could be beneficially applied to non ILS in-service equipments.

It follows that the LS application must be compatible with Mil-Std 1388–2B to cater for the new MERLIN helicopter and all subsequent ILS procurement projects, and this approach may also yield benefit for some in-service equipments. Conversely, of the eight aircraft type/marks that will remain in FAA service through the next decade (and are therefore to be supported by the LS application) only MERLIN is ILS; the other seven are non ILS in-service aircraft types. In addition, LS needs to interface with a range of non-standard existing logistic computer systems.

Thus the LS database structure must cater for both old and new, non-standard and –2B compliant. This is being done by building the database around a commercial –2B LSAR software product, but with a range of extensions and enhancements to satisfy the wider needs of the FAA. LS is the first computer system to base an in-service engineering database on a –2B LSAR core, thus straddling old and new. The architecture, proposed data take-on and maintenance plan for constructing and supporting the LS database will be discussed in more detail below.

The –2B LSAR Core

Hoskyns/OMI are building the LS database based upon their standard –2B LSAR database product; 'SQL*ILSA'. The basic package will be extensively developed to meet FAA requirements:

(*a*) Introduction of the 'LYSIS' graphical structure editor software package as part of the database front-end. This will satisfy the FAA requirements for a graphical database navigation tool (FIG. 2).

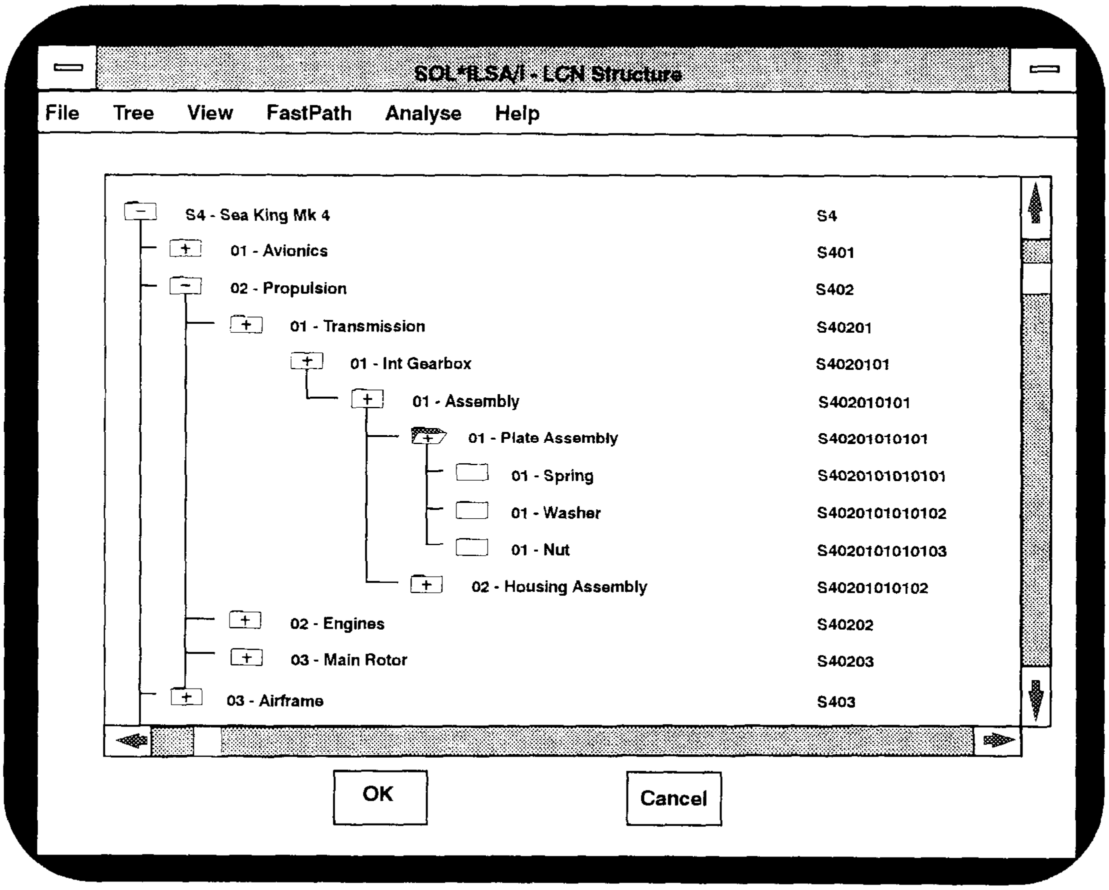

FIG. 2—LCN LIST WINDOW

(*b*) SQL*ILSA database tables and menu modules will be extended to include AECMA 2000M data elements.

(*c*) An extensive suite of FAA specific database tables will be written to make provision for all the legacy (i.e. subsumed from existing systems) and interface data that does not fit into the –2B core. These extensions will be integrated within the SQL*ILSA menu modules and will thus be easily accessed by the user.

The central spine of a LSAR database is the hierarchical LSA Control Number (LCN) structure, relating parts to their next higher assembly and finally to the end-item. Thus, if the LS database is to use a –2B core, the eight LS-applicable aircraft and all their equipment must be represented by an LCN structure. In the case of Merlin this will be relatively straight forward, but for the remaining seven aircraft it is being done by Hoskyns/OMI using aircraft and equipment paper and electronic Illustrated Parts Catalogues (IPC).

Creation of the LCN structures for the eight aircraft will constitute the first major step in the data take-on strategy. At the completion of this stage the LS Database will contain an authoritative manufacturer's parts hierarchy, supported by additional manufacturer's data.

The part/item of supply concept

Due to the business needs of the FAA, the LS database will effectively straddle the design/introduction to service and in-service support phases of an equipment life-cycle. One of the problems encountered with this approach is that part details, as specified by the manufacturer on the IPC or LSAR, may be different to those actually used in-service as a result of codification and procurement. The ramifications of this problem within the FAA environment are not satisfactorily catered for by the core –2B software package, and so a new approach has been found.

The LS database will hold data related to the authoritative aircraft configuration and manufacturer's part details (identified by part number/LCN structure) on the –2B core. Data related to the procured Item of Supply (IOS) (identified by section/reference or NATO Stock Number (NSN)) will be held on separate bespoke INGRES tables outside the core. Part and IOS will be related by a multi-key look-up table populated and maintained using the ISIS interface with the Defence Codification Authority at Glasgow.

Data take-on strategy

Once the full LCN structure for all eight LS applicable aircraft has been established, existing NASDAS (legacy engineering) data will be taken-on, and the Part-IOS look-up tables populated from ISIS, IOS tables will be created and populated from the existing spares provisioning databases (e.g. PDS). Finally, data take-on will be completed by an initial run of the RAFSITS, WRAM, NARO, MACD, ORAC and OASIS interfaces.

Note: The LS interfaces mentioned here will be discussed in more detail below.

Maintenance Planning Data (MPD)

The FAA currently use inception reporting procedures during the introduction to service of non ILS equipment. Whilst this practice will decline in the future (with the increasing use of ILS principles), the data and functions of the existing NASDAS database will be replaced by the MPD facilities within the LS database.

Database maintenance

The main areas of activity required to sustain the database are:

- Amendment of the LCN structure to reflect modifications.
- Management of the interfaces.
- Control of access permissions.

INTERFACES AND DATA PROCESSING

Interfaces

The LS application is in essence a logistics data handling, processing and analysis system. LS is thus a data user and relies heavily on interfaces with other systems to gather the required data. The major electronic interfaces (minor magnetic media and all paper based interfaces omitted) are:

(*a*) *FAAIT WRAM application.*

Internal automatic interface by monthly file transfer within the FAAIT infrastructure. WRAM pass first, second and third-line maintenance work order data to LS, and LS provides parts catalogue updates to WRAM.

(*b*) *FAAIT NARO application.*

Monthly collection of Component Repair Programme (CRP) reports on 3½″ diskettes posted from NARO. Ad-hoc exchange of required spares lists by diskette between LS and NARO.

(*c*) *RAF Maintenance Analysis and Computing Division (MACD).*

Data collected from MACD on RAF third-line maintenance depots will serve a similar purpose to that collected from NARO at Para *b* above.

(*d*) *On board Accounting System In Ships (OASIS).*

Monthly collection of air stores stock and usage reports on 3½″ diskettes posted from RN warships. This interface and ORAC below, represent a major advance by giving HQ staff some visibility of ship stock data.

(*e*) *On board Royal Fleet Auxiliary Accounting Computer (ORAC).*

As para c above, but collected from RFA stores and ammunition ships.

(*f*) *RAF Supply Central Computing System (RAFSCCS).*

This automatic interface copies provisioning data from the RAFSCCS to LS on a monthly basis.

(*g*) *Item of Supply Information System (ISIS).*

The Defence Codification Authority computer ISIS will be used during data take-on and then quarterly thereafter to establish and maintain the part to IOS look-up tables in the LS Database.

(*h*) *LSAR import/export.*

In order to support the exchange and review of LSARs during an equipments development, and then to read delivered LSARs and updates, the application will have a –2B LSAR import/export facility.

(*i*) *RAF Initial Provisioning Support System (IPSS).*

Initial Provisioning (IP) data will be read from, and sparing data passed to, the RAF procurement authority using the AECMA 2000M format magnetic tape interface with IPSS. In due course IPSS will be subsumed by the RAF Logistic Support System (LSS), and the FAA's first interface with the RAF's huge new Logistic IT System (LITS) will be established in TRANCHE '0'.

Of the above interfaces:

- *a-c* are primarily to collect in-service maintenance work order data.
- *d-f* are to collect in-service spares supply data.
- *g* and *h* are to help maintain the LS database structure.
- *i* is to support Initial Provisioning (IP).

In-service data processing

Once all the in-service actual data is collected and stored in the LS database each month, it must be collated and processed to support the monitoring, display and analysis functions within the LS application. In-service data processing is the software sub-application that will perform this sorting automatically.

ACCESS MODULES

Menu and navigation system

As a standard means of database access, users will use a versatile and flexible Windows-based menu structure. Standard screens and options will give access to:

- Data filters.
- Fast paths.
- Monitoring, analysis and query tools.
- Graphical parts hierarchy.
- A colour Logistic Support Status display.

The item data within the database can be accessed by entering a key identifier (or combination) into either the IOS or Part Filter menus. To illustrate this, it is assumed the user has selected IOS on the main menu and is then presented with the IOS filter (FIG. 3).

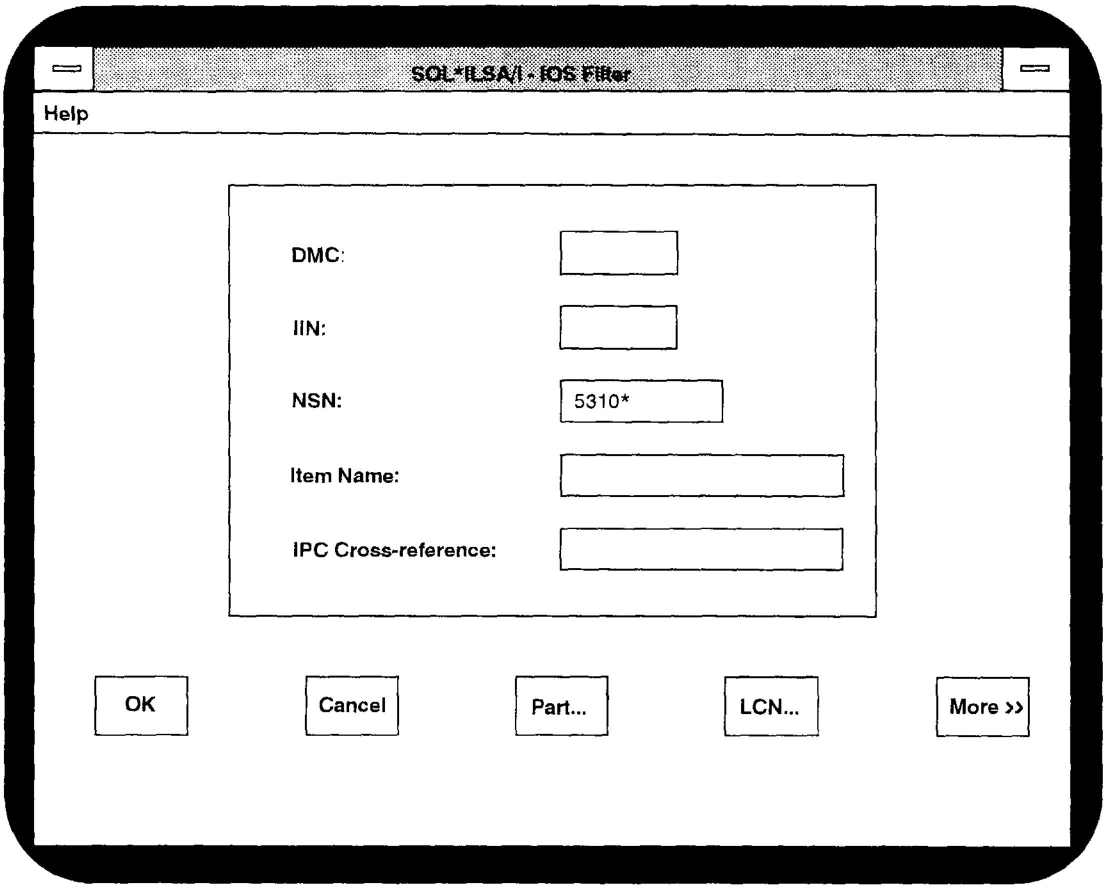

FIG. 3—IOS FILTER WINDOW

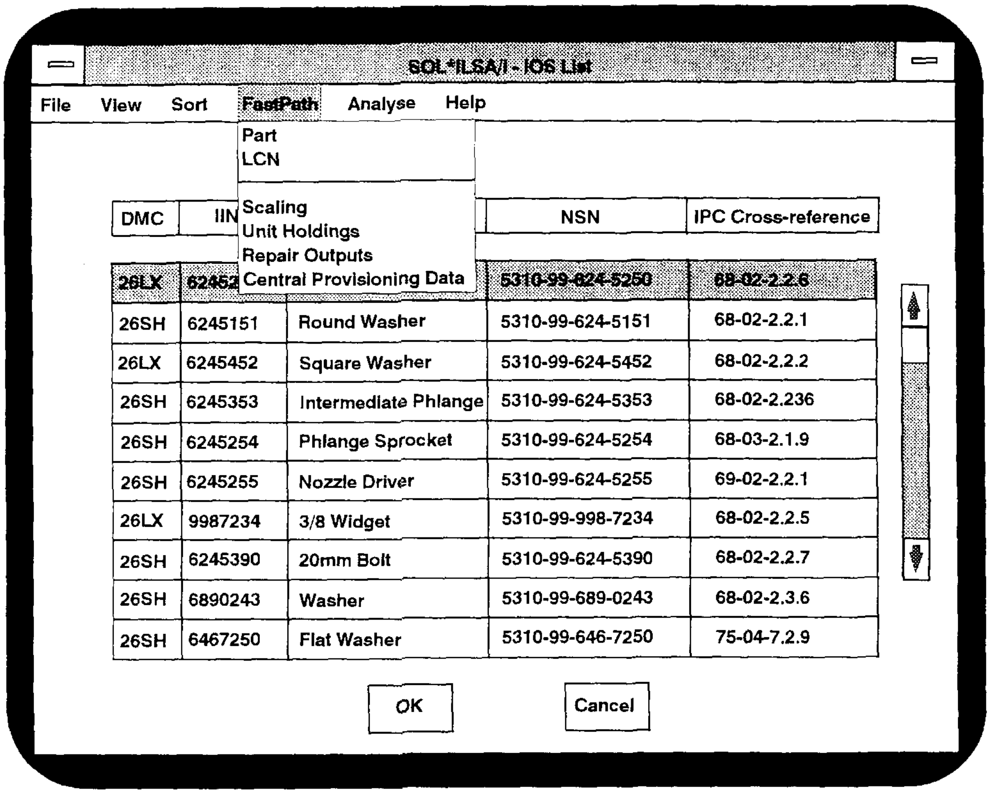

FIG. 4—IOS LIST WINDOW FASTPATH MENU

By entering some identification details, perhaps only the NATO Stock Code (NSC) (the first four characters of the NSN), the user will see a screen showing all the matches in the database (FIG. 4). This screen can then be used as a menu to gain access to fast path displays or IOS details (FIG. 5).

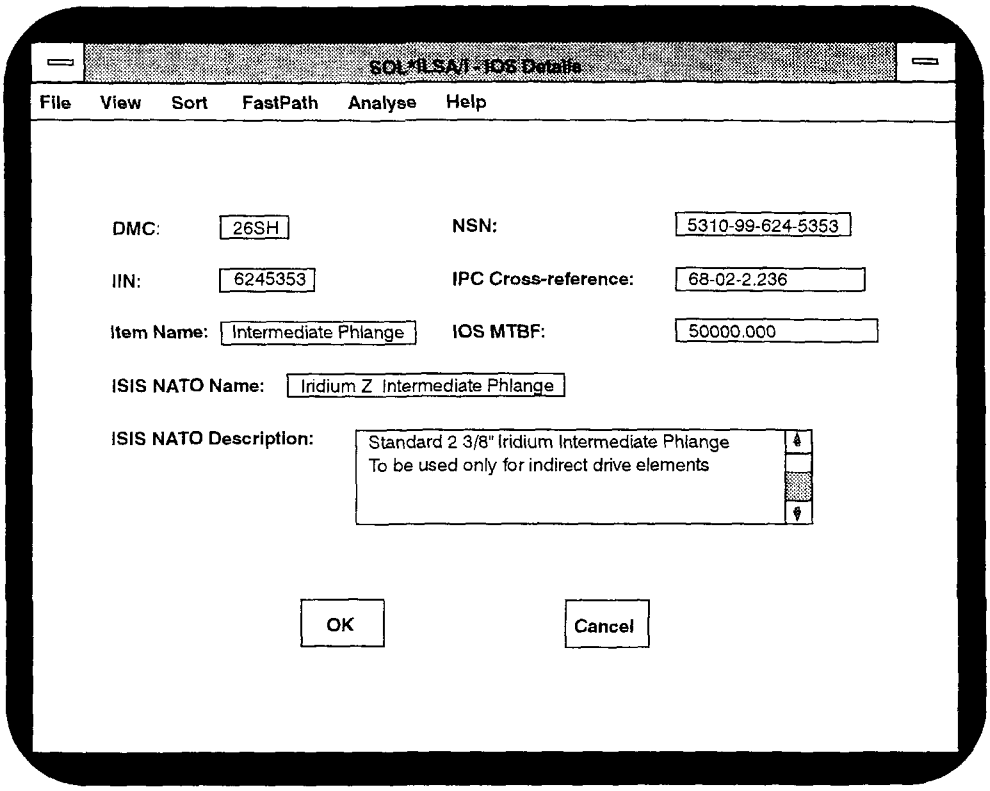

FIG. 5—IOS DETAIL WINDOW

A similar procedure can be used to gain access to the graphical LCN hierarchy, which itself can be used as a menu to access related data (FIG. 2).

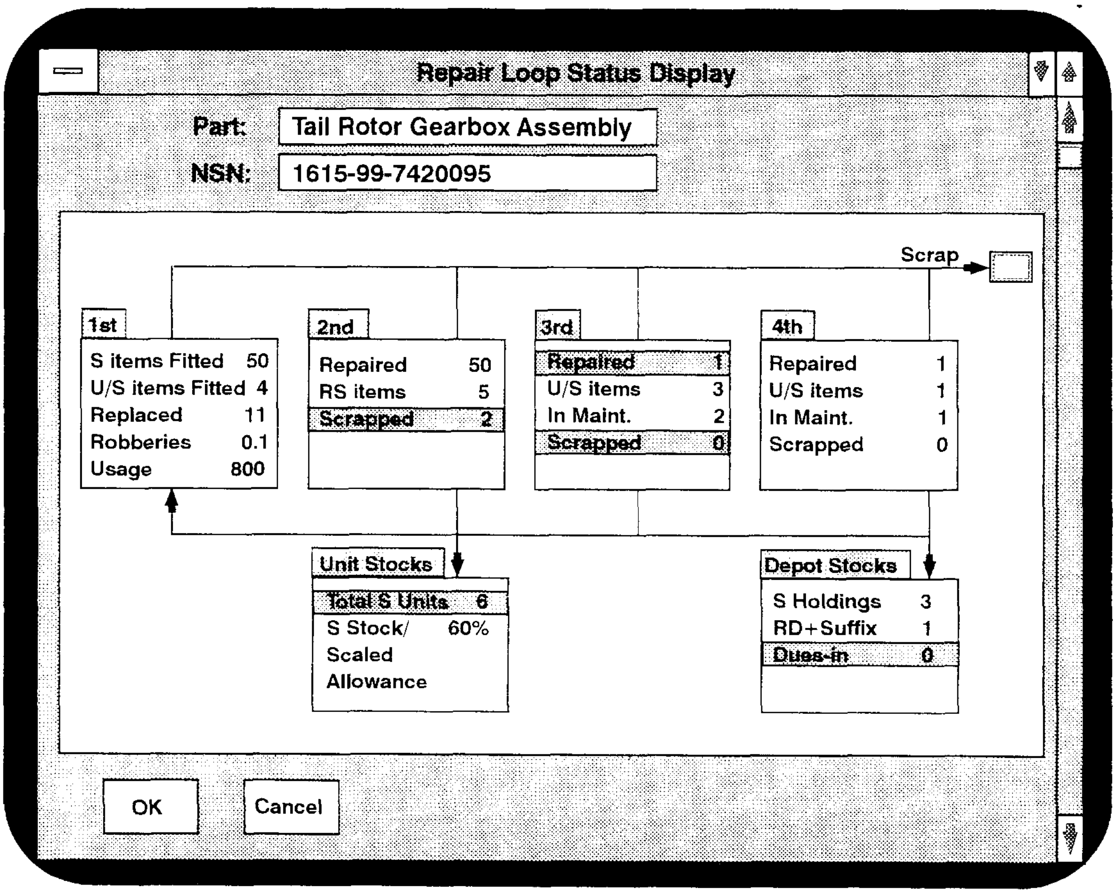

FIG. 6—LOGISTIC SUPPORT STATUS DISPLAY

An example of the Logistic Support Status display above is shown at (FIG. 6). It is intended that, perhaps following a watchdog warning (see below), this display will provide an easily assimilated colour-coded indication of the status of the important logistic performance indicators.

Watchdogs

It was recognized that, with such a vast quantity of logistics data being deposited in the LS database each month, an automatic data monitoring system would be essential. The watchdog sub-application provides both a preset and user-interactive monitoring tool, which gives an on-screen warning if a deteriorating trend is detected (FIG. 7). Where an urgent warning is generated, the LS application also sends an electronic mail message on the FAAIT Infrastructure OA system to the appropriate user.

During the functional design stage a set of required generic monitoring functions or types has been identified. These 18 generic types will comprise the 'watchdog toolkit'. A narrative description of an example watchdog type is:

'Compare latest figure with previous figure, activate warning if deviation is greater than 10%.'

Prior to roll-out, suitable watchdog types will be set against the important logistic support performance indices for the major FAA airborne equipments. Thus a 'turn-key' monitoring function will be performing as soon as the system is delivered to the users.

Post roll-out, authorized users may amend the pre-set watchdogs or set new ones as required. Access to watchdogs will be through the standard Windows menu and navigation system. In addition there will be a range of functions to group, globally change, activate/de-activate etc.

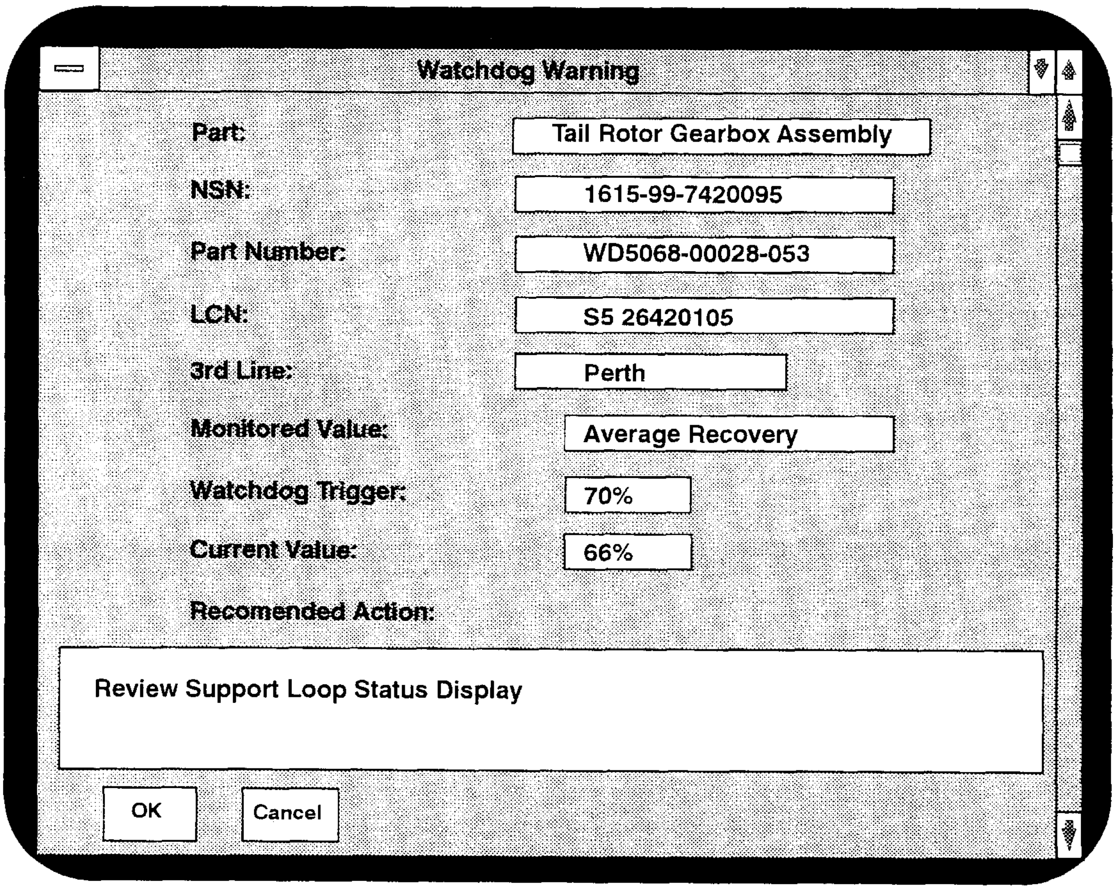

FIG. 7—ILLUSTRATION OF A WATCHDOG

NARO/RAFSCCS stock check

The NARO/RAFSCCS stock check function is similar in principal to watchdogs. The data is accessible today to monitor the availability of spare parts to sustain NARO engine and CRPs, but the data volumes are so large that manual checks are impractical. The result is that shortages are only discovered when they impact the repair lines. This sub-application reconciles repair line production programmes, required spare part lists (100-Off and Forward Provisioning lists) and RAF SCC provisioning data. By comparing supply and demand data, potential shortages can be identified and prioritized thus minimizing the effect on repair lines.

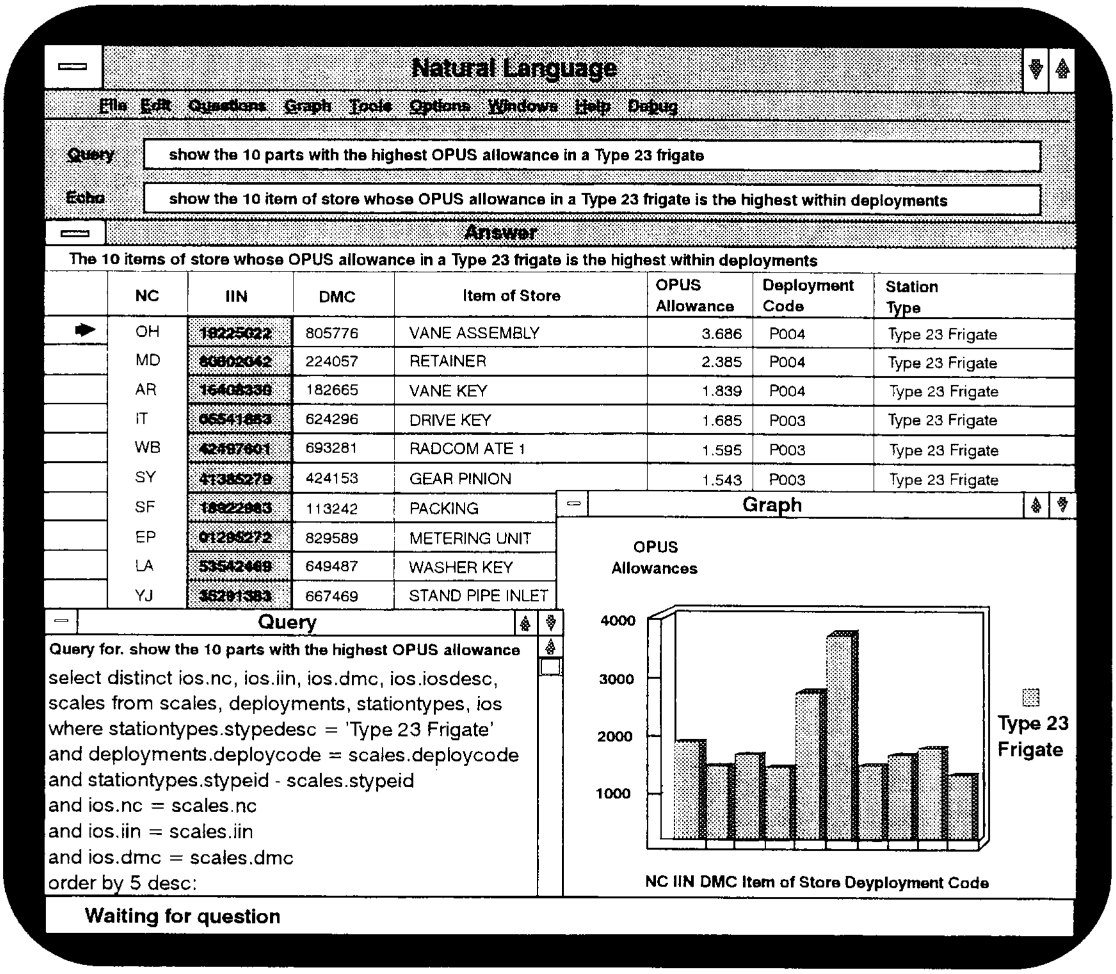

FIG. 8—EXAMPLE NL QUERY

Natural Language (NL)

NL is a database enquiry tool which allows the user to type an english language question, which the tool interprets, echoes back to the user, and then answers. NL is an extremely powerful interrogation tool which also has the facility to set up standard enquiries and reports. (FIG. 8) illustrates:

- A typical ad-hoc question (typed by the user).
- Echo (interpretation written back by the tool).
- Answer (generated from the Database).

Once an answer or report is generated, NL contains a graphing facility to represent the results on-screen or the user can export the text/spreadsheet results to the infrastructure OA system for inclusion in a document. By exploiting the NL built-in reporting facilities, the FAA will adopt some management information system features. This will be achieved by developing, prior to roll-out, a suite of up to 20 complex logistic management reports drawing on data from across the whole database. Examples of the reports are:

(*a*) Produce report of total cost of spare parts consumed by location and by aircraft type/mark and airborne system.

(*b*) Compare scaled allowance with consumption data for each warship/RFA and report parts held in stock with no record of consumption, sorted by cost, aircraft type/mark and airborne system.

ANALYSIS AND SIMULATION TOOLS

Spares Forecasting (SF)

The decision to introduce the use of analytical spares optimization tools (e.g. OPUS9) into the FAA aircraft spares scaling activities, necessitated significant re-engineering of the current business practices. This has been driven by the need to adopt objective and cost-optimized sparing strategies, and to reduce HQ staffing levels.

The functions of the existing PDS provisioning database also needed to be replaced. Scaling data currently in the old database will need to be re-organised and transferred into the LS database during data take-on.

In addition to introducing OPUS, the spares forecasting sub-application will allow the transfer of IP data using the AECMA 2000M protocol, and will improve the interface with the RAF for re-provisioning by introducing the 'single provisioning slip'. The single provisioning slip has been necessary because, historically FAA staff members scaling different equipments (but using the same components) would independently approach the same RAF procurement authority. This system has resulted in confusion and inefficiency. In the future, the FAA will raise one provisioning slip for all FAA requirements of each item and send this to the RAF.

Analysis tools

The four analysis methods that will be available within the LS application are:

1. *LSA tailoring and LSAR review*

   As described above, the FAA policy is to contract the manufacturer to perform LSA. The full procedures of Mil-Std 1388–1A must, however, always be tailored to suit the subject project. This tool assists the user to identify his data requirements and thereby identify which 1388 tasks must be performed. Once the LSA process is under way by the manufacturer, the FAA will receive regular updates of the developing LSAR. To assist the evaluation of the LSAR, a simple LSAR review facility will be provided.

2. *Failure Mode, Effect and Criticality Analysis (FMECA)*

   Whilst FMECA is a design analysis methodology, it is a necessary prerequisite to perform Reliability Centred Maintenance (RCM) and is included to complete the suite of tools.

3. *RCM*

   The LSA programme for each future major FAA procurement should include RCM analysis to determine scheduled maintenance requirements. In the case of most in-service aircraft, no such analysis has yet been performed. In order to optimize the use of maintenance resources and reduce costs, the United States Navy have successfully applied RCM methodology to non ILS in-service aircraft. Whilst this type of analysis is manpower intensive, the provision of these relatively simple off-the-shelf integrated FMECA and RCM tools within the LS application, leaves the option open for the future.

4. *Level of Repair Analysis (LORA)*

   Extensive debate within the FAA during the last 18 months has identified the following applications of LORA:

   (*a*) Definition.

   At the operational requirement stage of a project, users require a tool to compare notional costs of different support policy options. The existing NAVCOST software package will be integrated within LS for this purpose.

(*b*) Optimization.

During the design/introduction to service phase, a tool is required to perform detailed analysis to compare the cost effectiveness of the feasible support options, given the design of the equipment and the FAA deployment and support structure. This requirement will be satisfied by the development of an integrated bespoke LORA tool based upon parallel OPUS9 analysis.

LORA—optimization tool

The LORA optimization tool is primarily intended for use of ILS projects, although it could be used on in-service non ILS equipment. In the FAA, maintenance policies are expressed in terms of lines and depths of maintenance (e.g. 1A-2B-3C/D). To use the tool, the user would categorize the maintenance tasks in the LSAR into depths and then given the feasible options available, select several (perhaps six) maintenance policies to analyze.

The tool computes maintenance costs at each location, for each alternative policy, given the depth the task would be performed, the frequency it would be required and the cost implications of it. This analysis is performed by multiple runs of OPUS 9. Whilst OPUS is a spares optimization tool and not strictly a LORA tool, using it in this way and then manipulating the results in a three-dimensional spreadsheet package will allow users to identify the most cost effective and robust maintenance policy.

(*c*) In-Service.

Although there may be occasions when the maintenance policy is reviewed in-service by using the optimization tool above, in most cases, in-service analysis will be restricted to re-evaluating volumes, flows, manhours and costs in the light of current experience. This requirement will be met by the INSTRATA dynamic simulation tool described below.

Logistic support loop dynamic simulation

Most of the analysis tools described thus far are qualitative and are effective for comparison and decision support. The concept of dynamic simulation does not originate from LSA, but has been introduced by the FAA. It arose from the need to allow quantitative evaluation of the future performance of a support loop given current data, trends, and proposed plans.

Whilst it is intended for use as a quantitative repair volume and flow analysis tool for use in-service, it could equally be used to validate the results of LORA and SF optimizations before an equipment enters service.

The tool will be accessed direct from the menu and navigation system and will be arranged so that a busy user has the option of starting a quick simulation (based on the latest actual data), to get an initial understanding of where support will deteriorate and how quickly. The INSTRATA menu will allow users to view the animated simulation on-screen and interactively evaluate the effect of changes in the run data. As with all LS sub-applications, the results can then be graphically displayed or exported to the infrastructure OA system for inclusion in reports.

Conclusion

Implementation of the FAAIT LS application, and training of the FAA staff, will be completed by mid February 1995. The application will provide the FAA with an integrated logistics data handling and analysis system with the following main features:

(*a*) Interfaces with internal and external logistic IT systems to gather the 'whole picture' on database.

(*b*) A database that caters for old and new aircraft concurrently.

(*c*) Automatic data monitoring to facilitate 'management by exception'.

(*d*) Versatile ad-hoc and pre-set english language reporting.

(*e*) Windows-based graphical HCI to allow intuitive and easy access to the database and other tools.

(*f*) Replacement of the old manually intensive and inefficient sparing procedures with an OPUS-centred optimization system.

(*g*) Improvement in the FAA and RAF provisioning interface, by the introduction of the 'single provisioning slip'.

(*h*) Provision of both qualitative and quantitative analysis tools to assist FAA managers in optimizing support policy decisions.

Acknowledgement

The advice and guidance of COMMANDER P. J. KNOWLING RN and COMMANDER J. D. STRATTON RN (LS Project Manager Aug 91-Aug 93 and Aug 93 to date respectively) is gratefully acknowledged.