PROJECT HORIZON INTEGRATED LOGISTIC SUPPORT ISSUES AND CHALLENGES

Project HORIZON[1]

Project Horizon is a collaborative programme involving the UK, Italy and France, dedicated to a common warship design (with the exception of very few identified national variants) and procurement of a forecast fleet of 22 warships (12 for UK, 6 for Italy and 4 for France).

The project is governed by a Tripartite Staff Requirement (signed in 1992 by the three Chiefs of Naval Staff), a Programme MoU (signed in July 1994) that covers the entire life of the Project, including the in-service period, and specific Supplements that have been or will be signed to enter different phases.

The Project is currently in Phase 1 (which started with MoU Supplement 1 signature in March 1996) that includes:

- Warship Design Definition (WDD)
- Combat System Architecture Design
- Project Definition (PD) of the Combat Management System (CMS), Fully Integrated Communication System (FICS) and Electronic Warfare System (EWS)
- Selection of the rest of the Combat System Equipments, known as Non Development Items (NDIs).

The purpose of Phase 1 is to design an affordable, limited risk, mission capable and sustainable ship which can be operated, maintained and supported as optimized overall cost of ownership by each of the navies involved.

Phase 2, currently forecast to start in 1998, will cover the Detail Design of the warship and the Build of 3 First of Class (one for each nation) whilst subsequent phases will deal with follow on production and In-Service Support.

The Project is managed by a Procurement organization, composed of a Steering Committee (for overall guidance, control and supervision of the Programme) above a Joint Project Office (for overall management of the Programme, including technical, ILS, contract, finance, schedule, etc., aspects), and a Naval organization, composed of a Naval Committee (for overall supervision of Operational Requirement) above an Operational Requirement Staff Team (for management of Operational Requirements matters). The Joint Project Office (JPO) and the Operational Requirement Staff Team (ORST) are co-located in London.

As far as Industry is concerned, the Prime Contractor designate is Horizon IJVC Limited, an International Joint Venture Company set up specifically for the Project. However, PD of CMS, FICS and EWS will each be conducted by two separate consortia working in parallel and in completion, and remain under JPO management in Phase 1 and will then be procured through the IJVC during Phase 2.

1. More details are available in the *Journal of Naval Engineering* Volume 36(2), 1996; article 'PROJECT HORIZON—Design Management in a Multinational environment.'

INTEGRATED LOGISTIC SUPPORT[2] (ILS)

Logistic support

Generally speaking, the Logistic Support (or Logistic Support System) represents all the necessary resources to operate and maintain a 'system' during its life (the system being whatever you want: the HORIZON project, the CMS, or even your own car).

In practical terms, the Logistic Support is made of Logistic Support Elements which are:

Maintenance Plan

Includes all the maintenance tasks you will have to perform on the system during its life (preventive, corrective maintenance, condition based maintenance).

Technical documentation

Includes all the information which is necessary to operate the system and to perform the maintenance tasks of the maintenance plan.

Supply support

All the 'spare parts' (including oil, fuels, lubricants, etc) necessary to operate and maintain the system, and all the information necessary to resupply these items.

Support and Test Equipment (S&TE)

The equipment necessary to perform maintenance tasks (tools, test benches, etc.).

Facilities

Those which are necessary to support and maintain the system (drydocks, piers, workshops, etc.).

Training and training devices

Training that is necessary to operate and maintain the system.

Manpower and personnel

The technical skill needed to operate and maintain the system (e.g. mechanical, electrical etc.) as well as the level of skill you need for each technical skill (e.g. CPO, WO etc.), and the manpower it takes to perform operational and maintenance tasks.

Packaging Handling, Storage and Transportation (PHST)

All the information needed to package, handle, store, transport the system (if applicable) or its spare parts (e.g. dimensions of items, shelf life of items in storage, etc.).

Technical data

All the technical information needed to maintain the system during its life (specification, drawings, etc.) and which will allow modifications to be made if, for example, some spare parts become obsolete.[3]

2. Detailed explanation can be found in various publications such as *'Logistics Engineering & Management' by Benjamin S Blanchard* or *'ILS Handbook' by James V Jones.*

Well, so far so good. All the above is familiar stuff and, coming back to the example of your car, you can imagine that the:

- Maintenance plan is the 10 pages booklet that tells you that you have to foresee some servicing every 6,000 miles.
- Technical documentation is the brochure that tells you where to put the ignition key to start off the engine and to contact your garage if this fails (after verification that the tank is not empty).
- Supply support is made of the few spares you have (fuses, bulbs, spare wheel, oil etc.).
- S&TE include the jack you need in case of puncture.
- Facility is your car park place or your garage.
- Training is the little time you spent in becoming familiar with your new 'Man Machine Interface' before actually (safely) driving.
- Manpower and Personnel is in fact you and your driving licence.

Since you are not going to package, handle, store, transport or modify your car, PHST and Technical data are not relevant.

You have got it right, but for your 'level'. You have also to include the same considerations for the 'higher levels', because, when you send your car to a garage for servicing, somebody has to know exactly what has to be done, what has to be removed and replaced, what are the tools that are necessary, etc.

In other words, the Logistic Support System must consider, from the outset, all the 'levels' involved in the operation and maintenance of the system, from the 'crew level' up to the 'manufacturer level' if it is involved.

ILS

ILS is a global and iterative approach which aims to:

- Link the design of a system with its support system by including support consideration during system design (e.g. Reliability, Maintainability, etc.)
- Develop support requirements (i.e. build the Logistic Support System) consistently related to design and to each other.
- Procure a consistent set of logistic support elements.
- Provide the required support during all the life of the system at 'minimum' Through Life Cost (TCL).

This is achievable thanks to the application of Logistic Support Analysis (LSA)[3], which is the mechanism, part of the system engineering and design process, to assist in complying with ILS objectives (Reliability, maintainability, supportability, etc.) in a concurrent engineering environment (to avoid only support to the design).

In a global approach, it is nescessary to consider the design of the system and its support system in their intended environment and according to their intended use, and derive/apportion lower level requirements (top down approach). To continue with the example of your car, that has a sun roof, the manufacturer took into account the fact that the car can reach 70 mph in reverse.[4]

It is an iterative approach because the design (of the system and its support system) is based on assumptions (e.g. for the apportionment of the requirements) that may need to be verified or validated at a later stage and changes

3. Defined in MIL-STD 1388 1A
4. Hopefully not while you drive, but possibly when the brand new car is transported by train from the plant to your dealer. This is a transportability consideration that has an influence on the design.

to the design made where necessary (bottom up approach). For example, the 'spares and tools' that have been provided with your car assume that you will change your wheel during daylight (or in a clear environment). This is generally true for a great proportion of your 'missions'. But in some specific cases (such as crossing the island of Mull during the night), it may be wise to add a torch to your 'on board tools kit'.

TLC

The TLC of a system is made of:

- Acquisition costs (including R&D costs, design cost, production cost).
- Operation and support costs (including personnel costs, maintenance costs, ammunition costs, spare parts costs, fuel costs etc).[5]
- Disposal costs, i.e. the costs you have to pay to destroy the system at the end of its life.

It represents all the expenditures you will have to bear for the purchase and use of your system. TLC (also named Life Cycle Cost) is an important consideration to be taken into account in the design process. However, TLC considerations must be used as an examination of the probable cost consequences of acquisition decisions and as information for the managerial decision process (for example, to compare two design alternatives, or two support alternatives which both fulfil the 'technical' requirements), not as an ultimate goal as such.

Again, for your car, you can find in specialised publications comparisons of the cost per mile of different cars (that take into account the acquisition cost, fuel costs, insurance costs, road tax, depreciation, etc).

These comparisons are valid at the time they are done and may help you to select the 'best cost effective solution' to 'design' your 'transportation system'. But, once selected, do not expect that the forecast cost per mile will be the actual one, simply because of your way of driving, inflation, higher or lower mileage than forecast, unexpected events, etc.

ILS FOR HORIZON

ILS objectives

In a very few words, ILS objectives for the HORIZON programme is as follows:

(*a*) Provide a design with a minimum TLC,

(*b*) Provide the required support to:

- To sustain ships' availability, in their intended environment, according to their intended use and during the life of the programme.
- To comply with the MoU constraints.

Obviously, there are a number of issues behind these top level objectives (especially for a co-operative programme) and a lot of work is necessary to define or clarify more detailed tri-nationnally agreed objectives and requirements, taking account of the phasing of the Programme.

To this end, a set of documents (whose writing involved the JPO, the ORST and the national experts) has been produced during the Feasibility Phase (between TSR and MoU Supplement 1 signatures). This set includes:

5. Makes the link with the Logistic Support

The Use Study Document

Describes the way the nations intend to use and maintain the ships and the national organizations that currently support national fleets.

The ILS Policy Paper

Describes the (tri-nationnally agreed) ILS concept to be applied, the detailed objectives to be reached, studies to be performed to implement an effective ILS, and general guidance to tailor the requirement to implement a cost effective ILS.

The JPO Warship ILS Plan

Details where appropriate the ILS concept and objectives (at warship level) for the Phase 1 of the programme.

The HORIZON Training Needs Analysis

Provides the (tri-nationnally agreed) guidelines/assumptions/directions to be used by contractors when performing their Training Needs Analyses.

All this documentation formed the basis for the definition of the (tri-nationnally agreed) ILS requirement, initially for Phase 1 (WDD, PDs of CMS, FICS and EWS, selection of NDIs) and then for Phase 2 activities.

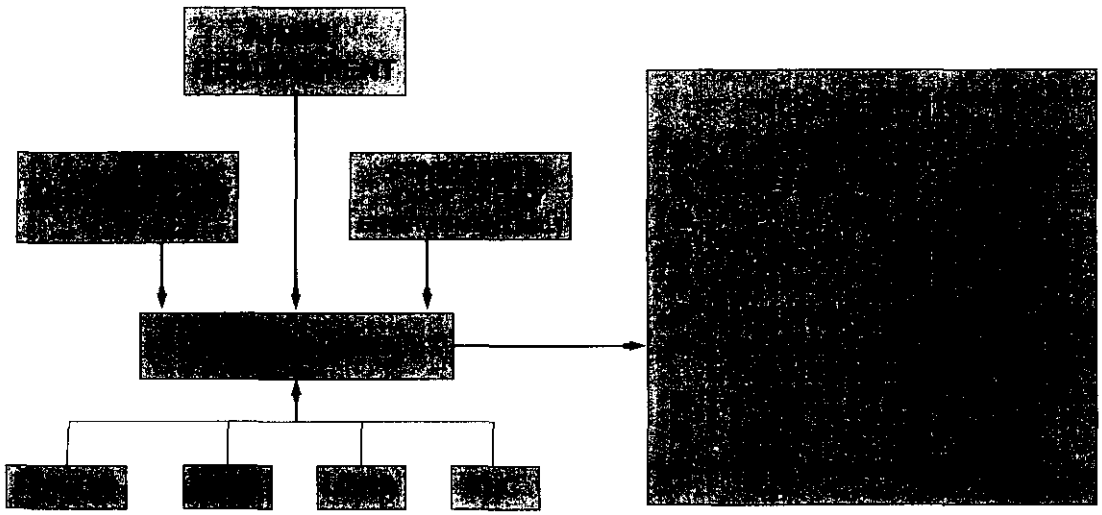

FIG. 1—THE ILS REQUIREMENT

The ILS requirement (FIG.1)

The overall ILS requirement consists in:

- AR&M (Availability, Reliability & Maintainability) requirement.
- 'Mandatory' set of elementary tasks logically chained down: the Logistic Support Analysis (LSA).
- 'Mandatory' tools to be used to support LSA.

necessary to define the Logistic Support Elements needed to sustain ships' availability in a defined context of support assumptions, and taking account of constraints imposed on the programme (eg safety).

The AR&M 'requirement' consists of:

- Reliability and Maintainability 'requirements' to be achieved during a 'N' days mission (that are in fact design targets for each system for Phase 1 and that may be reallocated[6] prior to becoming requirements for phase 2).
- Overall Availability requirement (% of time at sea, time in harbour available for sea and time in harbour unavailable for sea) and a typical Maintenance Cycle of the ships (that is also a design target for phase 1 that is to be studied and validated prior to becoming requirement for phase 2).

The 'mandatory' LSA is a set of tasks extracted from the MIL STD 1388-1A, the basic standard to be applied for LSA, whose outcomes are to be recorded in a LSA Data Base (called LSAR) which must be compliant with the MIL STD 1388 2B (for Phase 1 requirement).[7]

The 'Mandatory' tools to support LSA are:

- Failure Mode Effects and Criticality analysis (FMECA), to define what are the possible failures of the system, their modes (e.g., corrosion, wear and tear, etc.), likelihood, effects (on the system, the wholeship, the crew, etc.) and their criticality.
- Reliability Centred Maintenance (RCM), used for determining the maintenance requirements of an item against its potential failure(s) and the consequences and probability of failure.
- TLC and Level Of Repair Analysis (LORA), used to evaluate the costs of design or maintenance alternatives.

The support assumptions to be used during the ILS process are defined mainly in the Use Study and in the Training Need Analysis documents and range from common missions scenarios defined (by the ORST) for AR&M purposes, or common definition of the maintenance levels and their broad capabilities, to the (common) annual average ammunitions' consumption (to be taken into account for TLC estimates).

Well, you now wonder if ILS is not the 14th[8] of Hercules' tasks, and if this will not take years and £m to be performed when there are just months (and £k) to do it!

You are right, and ILS is an area where you can spend a lot of money (e.g. in extremely detailed FMECA) with almost no return. This is the reason why the ILS effort must always be associated with a **tailoring** approach which reduces the timescales and cost of the upfront investment by targeting the areas which will yield the maximum benefit.

The tailoring of ILS effort

For the HORIZON programme, a first tailoring has been made, for example by selecting for Phase 1 in MIL STD 1388-1A those tasks that are relevant to a Design Definition Phase, or by producing 12 contrived standards (most of them obtained by tailoring MIL Standards) to be included in the requirement as appropriate. But overall, the actual detailed tailoring will be achieved by the contractors responsible for the design of the ship or its systems.

6. Depending of the results of NDIs selection for example. This is a good illustration of an iterative process
7. As far as Phase 2 requirement is concerned, the JPO proposed to apply a tailored Def Stan 00 60 (which is the mandated standard for UK procurement) since it is the only available standard that merges MIL STD 1388 2B, AECMA 2000M and AECMA 1000D for LSAR, Illustrated Parts Catalogues and technical publications, thus preparing the move towards the future ISO Acquisition Logistic Standard prepared by the NATO CALS office.
8. The 13th was to produce all the ILS documentation and to have it agreed.

This tailoring process, aiming to indicate the areas where the effort should be concentrated, must take into account a number of parameters, among which the:

- System/equipment under consideration (e.g. to be developed, Commercial Off The Shelf (COTS), modified COTS).
- System/equipment technology (e.g. new or mature technology).
- Cost drivers (from the TLC point of view) and the possible influence you can have on them (this obviously including the cost of the analyses).
- Time constraints, etc.

This will require (both from the JPO and contractors) one of the most important things that cannot be found in books and is not taught at school: common sense, that must continuously remind you what you are trying to achieve in which context.

For example, the JPO will have to assess the Phase 1 contractors' deliverables bearing in mind the aim of this phase and acknowledging that so far, nobody can read the future (i.e. do not require details or justifications that will be available only during Phase 2).

On the other hand, contractors will have to make their design and produce their deliverables bearing in mind that, although they cannot read the future, they may be able to predict what it may be[9] with a reasonable level of accuracy (i.e. use the available data/information on existing systems/equipment and project them into the design of the new system and its support system).

Common Support

Last but not least, one very important issue for the HORIZON programme is Common Support. Both the Programme MoU and the TSR acknowledge the potential for Common in-service Support for the HORIZON Programme where it can be shown to be cost effective to do so[10]. The MoU includes it in the programme phasing, costs and work sharing whilst the TSR provides general objectives concerning Common Support with emphasis on minimization of TLC, increase of readiness and provision of more effective support.

These objectives have been 'interpreted' into a so called *Common Support Policy Paper*, which describes the policy to be applied when defining the contents of the common support and sets up the principles to be applied for the management of the Common Support when the ships are in-service.

Emphasising the importance of the subject, the document was signed in early 1996 by the three Chiefs of Naval Staff and the three National Armament Directors.

Since, the requirement to consider Common Support as an alternative (to be evaluated in terms of TLC by contractors against national Support) has been incorporated in the ILS specifications for Phase 1 and Phase 2, and a Common Support Expert Group, involving the three nations and JPO, is currently working on the documentation that will be necessary to run the Common Support (which ranges from the Common Support Supplement MoU to the detailed documentation that will be necessary to require a spare part) with the aim of having everything ready at least two years prior to the ships acceptance.

9. The most amazing is that this 'prediction' is part of the day to day work of designers, who for example can define the approximate size of a DG (that is a Diesel Generator, not a Director General!) from the power and speed requirement, but they often pretend that they are unable to do so with logistics.
10. The aim of the Common Support is obviously to make overall savings (through life).

Conclusion—the challenges

There are a lot of challenges to be faced in the HORIZON Programme, and, as far as ILS is concerned, two of them are to be highlighted:

First, this is for the three nations the first naval programme where the ILS concept is implemented from the very beginning, meaning that there is very little available experience both in MoDs and Industry. As a consequence, both must be very careful and handle this concept pragmatically, with that common sense without which ILS may easily become a very bureaucratic process, producing tons of paper[11] nobody will read or use.

Then, this is also the first time where the co-operation through Common Support is envisaged for the whole life of the ships. Obviously, Common Support co-operation already exists for some equipments (e.g..for Gas Turbines), but now we are dealing with a whole warship. This is actually a new dimension of co-operation, and one of the major objectives of the Common Support Expert Group is to set up an efficient and cost effective organization[12] for the satisfaction of the ships' needs.

These challenges are not insurmountable, and trade off can be found in accommodating all constraints if JPO is seen as a tripartite organization (i.e. not a 4th nation) committed to the success of HORIZON, and if each participant[13] is committed to this success. But . . . this is another story.

11. A good example of this is the printing of the famous LSA reports from the LSA data base (called LSAR).
12. Here as well, bureaucracy is **The Enemy**
13. And 'it could be you'!