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Using Opportunities and Possibilities to Realise a Tailor-made ILS Solution (Life-cycle Operational Maintenance & Support for Complex Systems)

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Abstract. Within the field of System Engineering, the importance of the Integrated Logistic Support (ILS) component cannot be understated, underpinning as it does the feasibility and relevance of the "whole system", "whole life", "whole cost" concept and approach. While new technologies are important for ILS, the use of "existing" technologies is equally important, especially when they are "tried and tested" and effectively in use in particular operational environments (thus providing resource and cost reduction opportunities, as well as standardisation benefits).
Exploring opportunities and possibilities for maintenance and support of complex systems can have numerous facets. In exploring solutions, it is important to have good knowledge and understanding of Clients' operational and support needs and requirements, as well as their operational and support environments (including current status). Equally important is the correct mix of capabilities, appropriate tools/technologies, techniques and management approaches, sometimes necessitating combining and synergising the skills, capabilities and tools of more than one organisation.
This paper presents the case of an ongoing initiative to use opportunity, knowledge and understanding, together with possibility, capability and innovation, to develop and provide a tailor-made ILS solution to service the life-cycle maintenance and support needs of large vessels and other complex systems. And as with all potential and possibilities, innovative ventures such as this must be carefully developed, nurtured and supported, in order to have the opportunity and prospect to reach full potential.

1. Relationship of ILS in System Engineering

Within the field of System Engineering, with its fundamentals focused on the realisation of affordable, optimised and sustainable operational and support systems to meet specific requirements and needs, the importance of the Integrated Logistic Support (ILS) component cannot be understated. A system that cannot be used for its intended purpose and/or operated and supported within budget, is a system that is unsustainable. It is therefore vitally important to explore all opportunities and possibilities to provide cost effective ILS solutions, as an integral part of Systems Engineering processes and deliverables. In truth, the ILS process as part of Systems Engineering make the "whole system", "whole life", "whole cost" concept and approach feasible and relevant.

As background for a typical Naval project in the context of logistic support, the basic phases in a Product Systems life cycle are shown in following Figure 1 – Product Life Cycle for Logistics.

Of relevance is how the basic phases relate to Acquisition Logistics (a general term for acquisition of required logistic support) and Operational Logistics (general term for operation of fielded system, using acquired logistic support) (refer following Table 1 – Acquisition and Operational Logistic Phases and Typical Activities).

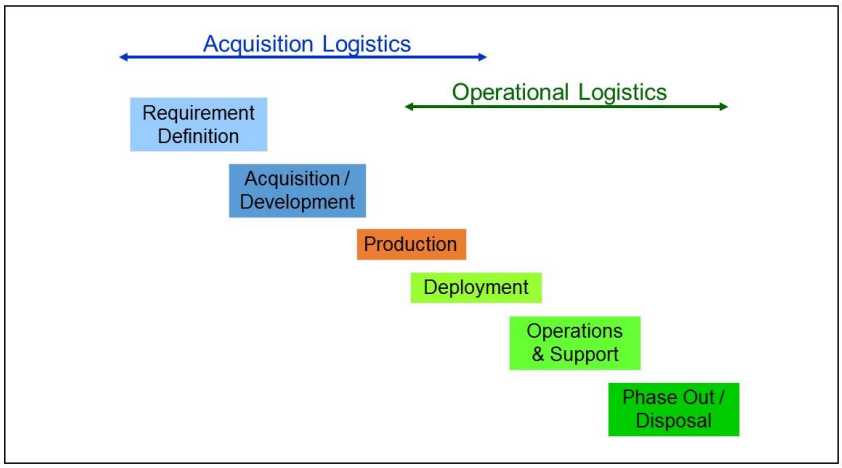

Figure 1. Product Life Cycle for Logistics

For further detail on life cycle processes and phases, refer to the INCOSE Systems Engineering Handbook (System Life Cycle Process Models: Vee).

An example of ILS element focus areas and typical activities for associated ILS / Logistic Engineering (LE) effort is shown in following Table 1 – Acquisition and Operational Logistic Phases and Typical Activities. There is considerable over-lap in tasks and activities between these two basic logistic phases, as part of the logistic support acquisition, implementation and optimisation process. (Acronyms and Abbreviations used are shown at the end of the paper)

Table 1: Acquisition and Operational Logistic Phases and Typical Activities

Acquisition Logistics (with Typical Activities)	**Operational Logistics** (with Typical Activities & Resources)
Design Influence	**Logistic Engineering**
Reliability Analysis and Engineering	LSA and Log Data Development & Rollout
Maintainability Analysis	**Logistic Support Elements and Resources**
Standardisation	Maintenance (PM & CM) and Repair
Logistic Engineering	Supply Support (incl. Supply Chain Management (SCM))
Life Cycle Cost (LCC) & Management	Personnel and Training
Logistic Support Analysis (LSA) / Data	Technical Documentation & Data (hard copy & electronic media)
Support and Maintenance Concepts	
Trade-offs / Optimisation	Maintenance and Support Resources
LSA Record (LSAR)	Facilities Establishment / Upgrades
Maintenance Planning	Support and Test Equipment (S&TE)
Logistic Plans and Specifications	PHS&T
System Specification(s)	Log Information Systems (e.g. OSIS)
Integrated Logistic Support Plan (ILSP)	Client Support Organisations (e.g. Dock Yard, Fleet Maintenance Unit)
Integrated Support Plan (ISP)	
Logistic Engineering Plan	

2. Technologies and Approaches for ILS Processes

While new technologies are important to ILS processes, methodologies and outcomes, "existing technologies" (enhanced through increasing computing power and speeds) used together with new and/or revised techniques and methodologies, also provide support solution opportunities worth exploring. This can result in significant cost reduction and standardisation opportunities and benefits, especially important to large organisations with complex operating systems (and substantial in-house support systems and standards). As such, there is a need to explore and conceive support possibilities using "effective" existing (and in use) technologies and tools, with the aim of facilitating End User focus for maintenance and support (i.e. make work easier at the coal face for maintainers and Client support personnel). Integral to this is the establishment of required support capabilities (in a realistic and sustainable manner).

As with technologies, today's ILS processes and approaches are generally tailored down versions of "tried and tested" military standards, with the focus having shifted to the most important aspects while trimming out "over-kill". In this, the data standards remain largely unchanged (e.g. MIL-STD-1388-2B, Def Stan 00-60), while effort is made to limit information and data to:

1) that necessary to define support system/resource requirement's and needs; and
2) that required and "actually used" in specific operational support environments.

This creates opportunities to significantly reduce support information requirements and associated levels-of-effort (costs).

Of interest is that this approach presents System Suppliers and Original Equipment Manufacture's (OEMs) with not only the need, but also the opportunity, to customise ILS and LE processes to suite their own "availability" and "ability" to source required engineering, operating and support information and data. At the same time, it presents them with significant challenge to get it right in a field which, while applicable, is not generally the System Supplier or OEMs core business or speciality. This is a fairly common reality, usually leading to significant increases in levels-of-effort and cost, rather than the expected reductions.

3. Imperatives, Opportunities and Possibilities for Logistics

To be well positioned to explore opportunities and possibilities for maintenance and support of complex systems (e.g. vessels, aircraft, production plant, etc), there are certain imperatives and fundamentals essential to enable any innovative process. In this, the following are important.

3.1 Good Understanding of Client Requirements, Needs and Environments

Exploring opportunities and possibilities for support of complex systems can have numerous facets, but primary and most important is the need for clear and accurate knowledge and understanding of the Clients operational and support needs and requirements, including their operating and support environments (with "current" status). With a clear and unambiguous understanding thereof, opportunities often become apparent, even with the use of existing tools, technologies and resources (usually facilitated by revised and/or new techniques and insights gained during the process of knowing and understanding the Client).

So in this context, is a tailor-made ILS solution far-fetched, that meets all operational maintenance and support needs and requirements for complex systems? No, knowledge, understanding and the resultant possibilities can become the very enablers for concepts, followed by development and provision of affordable, tailor-made maintenance and support solutions, as a natural outcome of the Client/service provider relationship and understanding, and associated information flow and exchange.

3.2 Correct Mix of Capabilities, Tools, Technologies and Approaches

Opportunities for tailor-made support solutions are underpinned not only through clarity of understanding, but also through the use of specific capabilities, used together with appropriate tools/technologies, techniques and management approaches. This fundamental is facilitated and focused through knowing and understanding the Client.
In projects for complex systems, potential (and final) System Suppliers and OEMs are presented with significant challenge in understanding and mapping information and data requirements and needs, with the use of appropriate tools, technologies and approaches for required operation and maintenance/support system deliverables (including use of any mandatory "in-house" systems). This is especially true for ILS system solutions required to meet the complete life cycle needs of the Product Systems being offered.

As further challenge in the Proposal Phase of such projects, System Suppliers and OEMs must support their engineering Offers with coherent and focused Logistic Engineering and integrated logistic support proposals (the requirement for most military and complex system tenders today). The ILS proposal must meet and fulfil many unique, as well as complimentary LE and logistic element requirements and standards, with numerous different and often unfamiliar layouts, formats and media requirements. With a significant amount of "common" information and data hidden to the untrained eye within the required LE processes and various support information and data outputs and deliverables, many possibilities exist to economise and embrace the "capture once, use many times" principle. This is vital, given the large amount and complexity of information and data involved.
These uncertainties for System Suppliers and OEMs in the Naval context generally lead to significant increases in Offer prices. This is done to cater for the risk of uncertainty, arising from the multitude of operating and support information and data requirements contained in specifications, the Integrated Logistic Support Plan (ILSP) and ILS Standards and Procedures (including platforms, data requirements, layouts, formats and media).

With a "horses for courses" approach the logical and most affordable way to resource and provide capabilities, and with core skill sets and resource capabilities differing from organisation to organisation, "one size fits all" usually doesn't work. A complete ILS solution also covers numerous different business focus areas and capabilities, in order to cover all logistic elements (e.g. LE, maintenance planning, technical manuals and data, training and training support, supply support, etc). For the typical scope of required ILS effort, refer previous Table 1 – Acquisition and Operational Logistic Phases and Typical Activities. This challenge presents opportunities to bring organisations together, combining and synergising skills, capabilities and tool sets, to realise affordable and sustainable ILS solutions that fully meet Client requirements.

3.3 Concentrating on Core Skills and Capabilities

Continuing with the "horses for courses" approach, given the challenges facing System Suppliers and OEMs on complex acquisition projects, a sound strategic approach is for Ship/System Suppliers to partner with ILS organisations local to the specific Client and their operational support environment (preferably having track record, knowledge and good understanding of the operating, maintenance and support requirements, needs and resource/facility capabilities). This creates opportunity to conceive and deliver tailor-made ILS system solutions for the Product System(s) being offered. This also allows System Suppliers and OEMs to concentrate on their own focus areas and capabilities (with their core business and capabilities not generally covering a full range of ILS capabilities, products and services).

In addition to the advantage of being able to concentrating on their own core capabilities and skills, this approach also puts the "bidder" in pole-position, through the ability to deliver a tailored-made ILS system (proposal) to the Client, for acquisition, integration and life time support of the Product System being offered (with substantial benefits to both Supplier and Client).

4. Opportunity in the Making

Opportunities in life are a source of inspiration, experience and growth. In the initiative presented in this paper, the benefits cannot be understated, from the opportunity to have participated in setting focussed and realistic ILS requirements and standards for future Naval projects (tailored to what is realistic and achievable on the ground).

The following relates to an ongoing initiative to conceive, design, develop and implement a tailor-made ILS solution (tool set), to service the acquisition and life cycle maintenance and support requirements and needs of large and complex vessels (and associated systems). It will be shown how the forces of opportunity, possibility and innovation, powered by specific capabilities, knowledge and understanding, have synergised to make the realisation of a tailor-made ILS solution to meet these needs not only a credible possibility, but also a source of inspiration and motivation, in support of a long standing Client's maintenance and support needs. A positive outcome would result in major benefit for both Client/End Users, as well as System (Vessel) Supplier and OEMs.

Through the experience of working on Naval ILS requirements and standards, the concept at the foundation of this initiative was borne. In this endeavour, two separate database applications sharing significant "common data", but fulfilling similar as well as different ILS functionalities and capabilities, will be made to work together, with a common "production type" user interface. While the two applications have a degree of overlap in functions, their specific functionalities and the possibilities presented by combining them, are the prime drivers of this conception of a tailor-made ILS system solution. Major benefits can be achieved by providing greater clarity through simplifying procedures and processes, and capturing and managing "common data" in only one place. This initiative also provides a real opportunity to contribute to the establishment of much needed through-life maintenance and support capability and sustainability in the Client environment (for the acquired vessel class).

4.1 ILS Requirements Definition (Future Projects)

The following are the broad areas of consideration in the establishment of Client ILS requirements, needs and standards for the acquisition of new Product Systems (in the case of this initiative, vessels). As will be shown, the requirements correlate exactly with the capabilities of the applications/solutions proposed in this concept of a tailor-made ILS system solution.

ILS Project Management. ILS Project Management is the discipline entrusted with ensuring that the Product System proposed, acquired and delivered includes an effective and efficient ILS system (deliverables). This must be compatible with relevant Client in-house systems and must underpin the required operational availability (reliability and maintainability) and supportability of the Vessel(s), in a sustainable manner for the intended Product Systems life cycle.

A typical example of project phases, baselines and plans relevant to ILS and ILS Project Management is shown in following Figure 2 – Phases, Baselines and ILS Plans. ILS Project Management answers to the ILS requirements and approaches depicted therein, with the main focus areas summarised in preceding Table 1 – Acquisition and Operational Logistic Phases

and Typical Activities. ILS Project Management includes responsibilities for planning, implementing and integrating the required maintenance and support provisioning and optimization processes for the acquired Product System, during the Interim Operating and Support Phase.

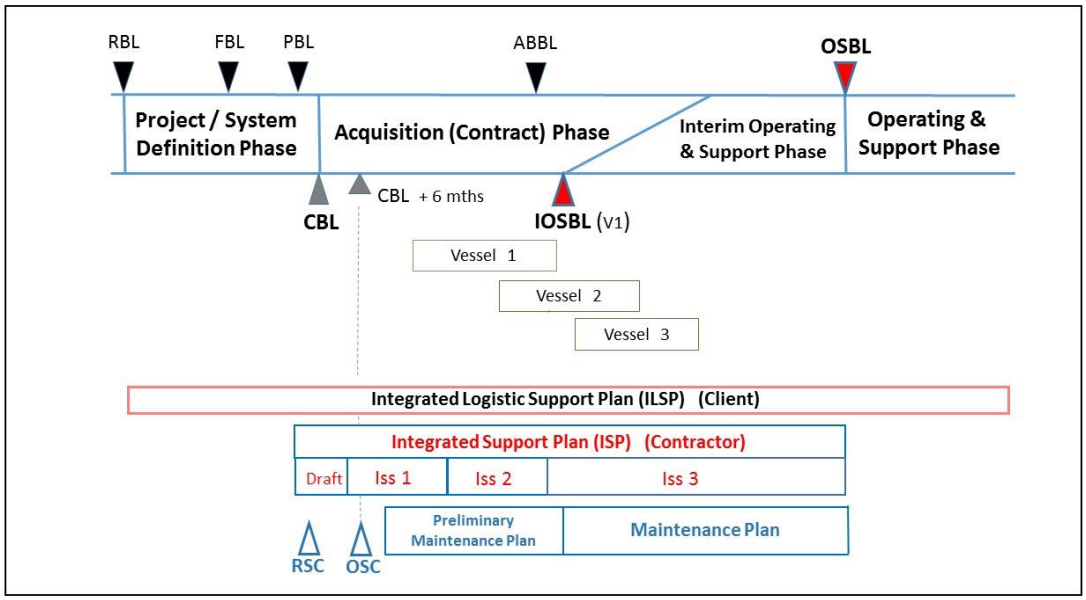

Figure 2. Phases, Baselines and ILS Plans

Logistic Engineering (Front-end and Life-cycle). Of prime importance is Life Cycle Cost (LCC) determination and management. This activity starts at the beginning of the Project/System Definition Phase and continues for the life cycle of the acquired Product System.

The typical high level processes for acquisition and development of required logistic support resources, information and data (with standards, where applicable) are shown in following Figure 3 – Log Info Development Process.

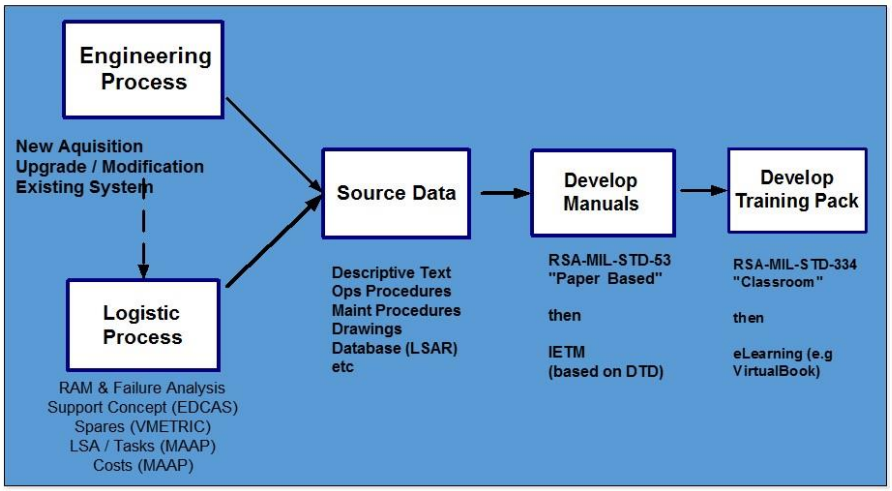

Figure 3. Log Info Development Process

Given the unique opportunity of having participated in the establishment of ILS strategies, requirements and standards for future Naval projects, with insight gained from experience on the supply side, it soon became apparent that the major ILS capabilities, requirements and needs of the Client can be met by the functionalities and outputs of two particular computer applications, RAMLOG and the Maintenance Card Tool (refer following Figure 4 – Applications for Capability Requirements). Between these two applications, the major ILS elements can be effectively handled, for the life-cycle of the system.

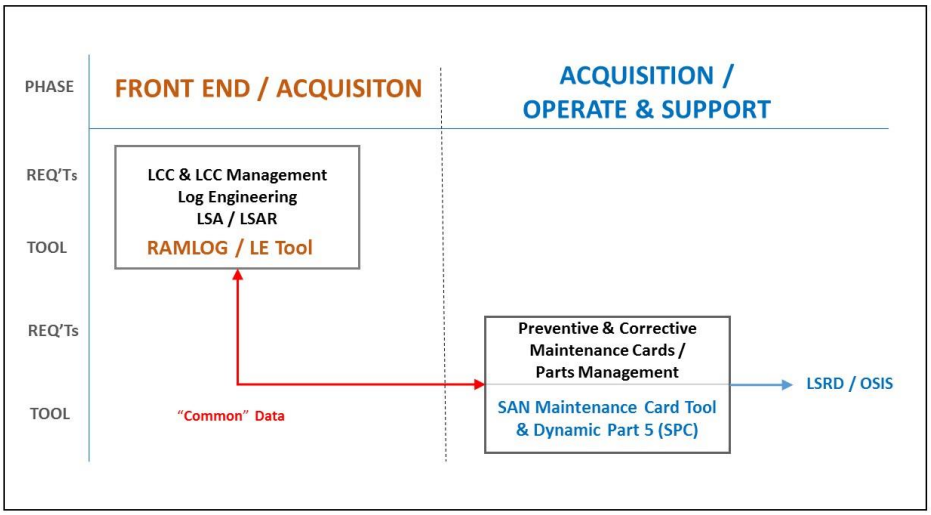

Figure 4. Applications for Capability Requirements

The RAMLOG application has been used effectively in the Naval, as well as wider SANDF support environments (for specific tasks). The Maintenance Card Tool is an existing operational support application of the Navy, setting the standard for certain logistic element requirements for future projects (e.g. maintenance cards). Both applications fall under the LE / information acquisition category, while also servicing important needs and requirements for operation and support of any Product System. The "common" data to both applications covers a wide range, including engineering data such as reliability data, preventive and corrective maintenance task detail and information (e.g. maintenance periodicities, spare parts information, etc).

The "Front-end" processes (Fig 4) comprise primarily LCC/Cost of Ownership (COO) modelling/management and typical system level LE (i.e. Reliability, Availability and Maintainability (RAM) engineering, together with system level Logistic Support Analysis (LSA)), resulting in delivery of a Vessel level LSA Record (LSAR). For the required LCC and LE/LSA activities, significant amounts of information and data must be researched, developed and compiled to meet the logistic requirements and needs of the Navy (as detailed in applicable ILSP's and system specifications). In turn, the information and data acquisition processes must be customised by the Vessel Supplier i.a.w the ILS Standards and Procedures for SA Naval Projects. This means, there needs to be significant data compilation, processing and formatting, making an electronic option essential.

As a solution to these requirements, a particular application was considered ideal i.e. RAMLOG (a South African developed software package that provides an integrated environment for Logistic Engineers, as well as Operational Staff). While other applications can do the LE and related work, no alternatives were considered due to the successful track record and association with RAMLOG, as well as its expanded additional functionalities, important to meet all requirements (e.g. maintenance management and support optimisation).

A high-level view of the life cycle capabilities and functionalities of RAMLOG are shown in following Figure 5 – RAMLOG Whole Life Management (with certain specific functionalities shown in Figures 6 to 11).

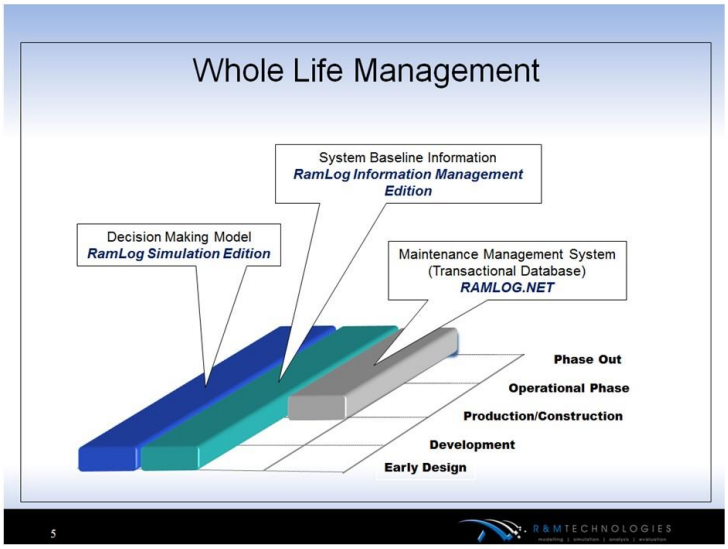

Figure 5. RAMLOG Whole Life Management

For the research, compilation and provision of required LE and logistic information and data, the establishment of applicable accurate baseline information is vitally important. This commences with Baseline Management against applicable standards and the development of Product Breakdown Structures (PBS) and Functional Breakdown Structures (FBS), followed by other required LSA activities and tasks (refer following Figure 6 – RAMLOG Baseline Information).

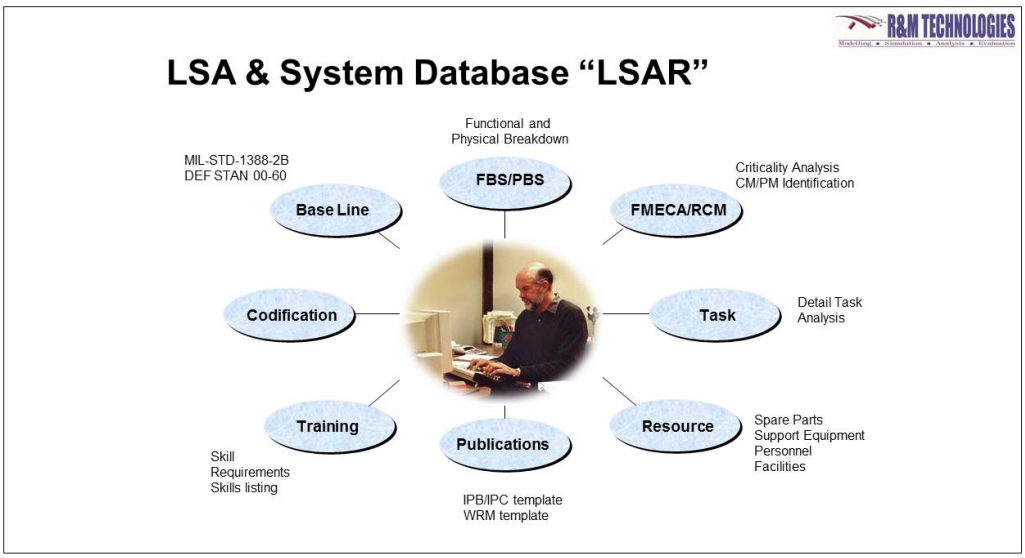

Figure 6. RAMLOG Baseline Information

Amongst the various LSA tasks and activities, failure analyses is of great importance, necessary to focus acquisition processes for cost effective and sustainable maintenance and support requirements and resourcing. This is done using Failure Modes, Effects and Criticality Analysis (FMECA) (refer following Figure 7 – RAMLOG Failure Analysis). This process is done to the

required level, based on the maturity of the system and system components, and availability of specific system and equipment information and data.

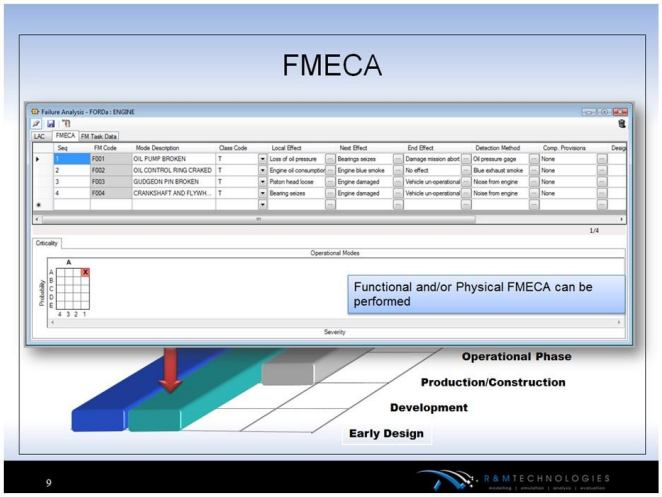

Figure 7. RAMLOG Failure Analysis

For identified failures not resolved through design influence and/or redundancy, as well as for required preventive (scheduled) maintenance tasks, the resultant activities include detail task analyses, support resource determinations, training and skill requirements determinations, etc.

Visibility and clarity in the identification and management of applicable items, spares and repair parts is also vital, given the reality that an abundance of maintenance procedures and Technical Manuals (TM's) is of little use without correct spares/repair parts (refer following Figure 8 – RAMLOG Illustrated Parts Breakdown (IPB)).

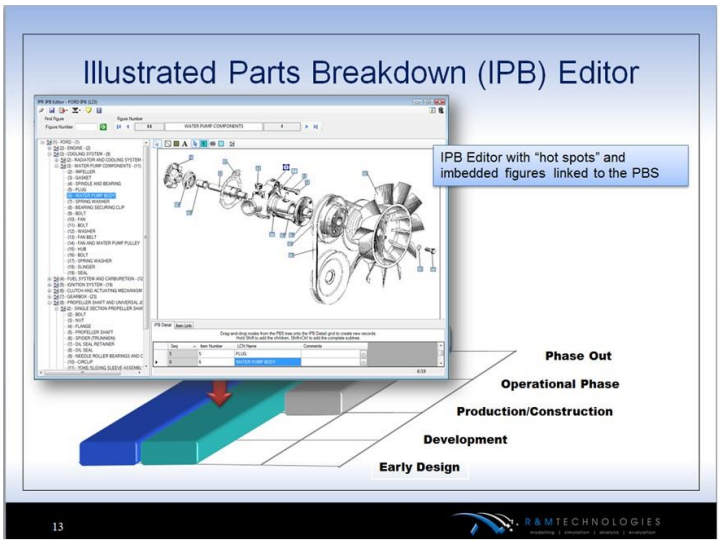

Figure 8. RAMLOG Illustrated Parts Breakdown (IPB)

In addition to the LSA System Database (LSAR) (Fig 6), RAMLOG has a Maintenance Management System module, for maintenance planning and management. This capability meets the requirements for the maintenance management responsibilities of the Vessel Supplier during the planned Interim Operating and Support Phase (refer preceding Figure 2 – Phases, Baselines and ILS Plans, and following Figure 9 – RAMLOG Maintenance Management). Of significance for the required maintenance/support optimisation process during this phase is the Failure Reporting, Analysis and Corrective Action System (FRACAS) capability. This

provides a failure analysis and corrective action feedback mechanism for fielded system(s), as well as associated logistic support.

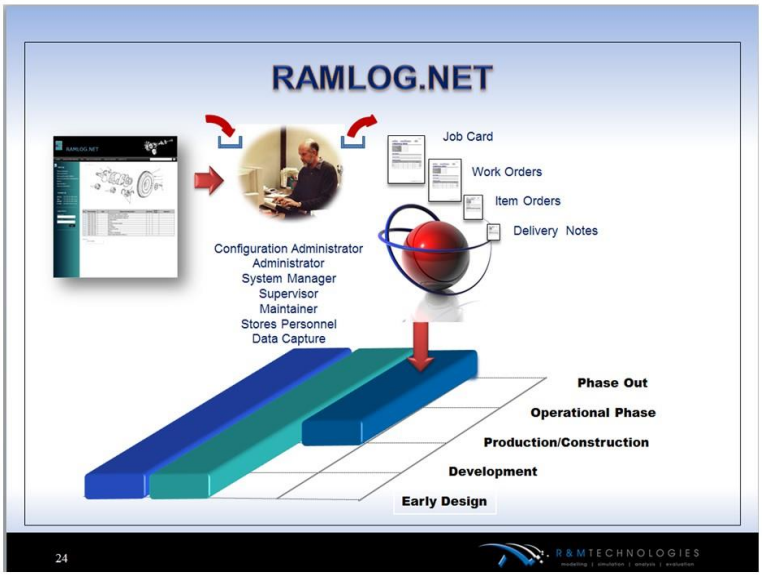

Figure 9. RAMLOG Maintenance Management

In its entirety, RAMLOG provides a wider capability for dynamic business modelling, implementation and management (e.g. management of operations, equipment configurations, Availabilities, maintenance management, etc) (refer following Figure 10 – RAMLOG Dynamic Business Modelling).

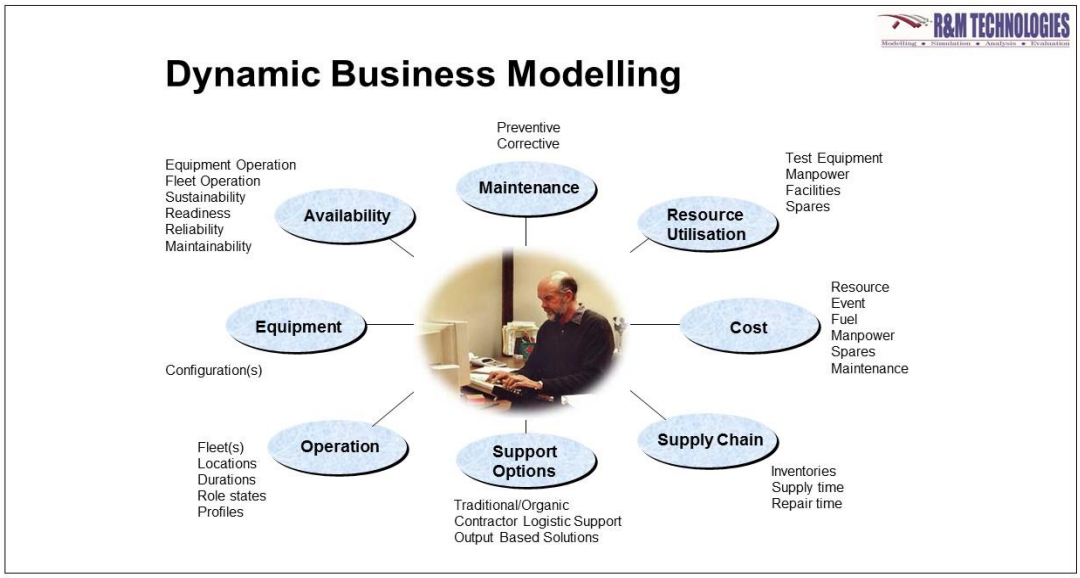

Figure 10. RAMLOG Dynamic Business Modelling

Also important in closing the loop at the highest level, from expectations/estimations to "actuals", is the LCC management capability. This will provide initially the Vessel Supplier, but ultimately Client System Managers, with the capability to do real budgeting, rather than customary "guesstimations" (refer following Figure 11 – RAMLOG LCC Management).

While the "truth" might mean, certain projects would (or should) never see the light of day (being unaffordable over their life-cycle), from a Systems Engineering viewpoint, the whole

system, whole life, whole cost approach is essential to the affordability and sustainability of complex systems.

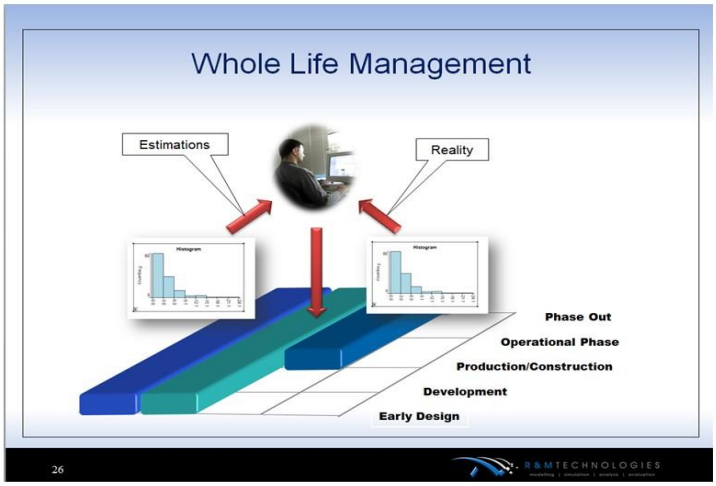

Figure 11. RAMLOG LCC Management

Maintenance and Support (Operational Phase). The third broad area for consideration for ILS requirements definition for future projects was the "actual" operational environment and "existing" maintenance and support approaches and applications already in place and working effectively. In this regard, the requirements and needs for maintenance card (procedures) development and management, spares management and partial TM development and management for a particular class of vessel are currently fulfilled through the use of an existing maintenance card tool (database application) of the Navy (refer preceding Figure 4 – Applications for Capability Requirements and following Figure 12 – Client Tool).

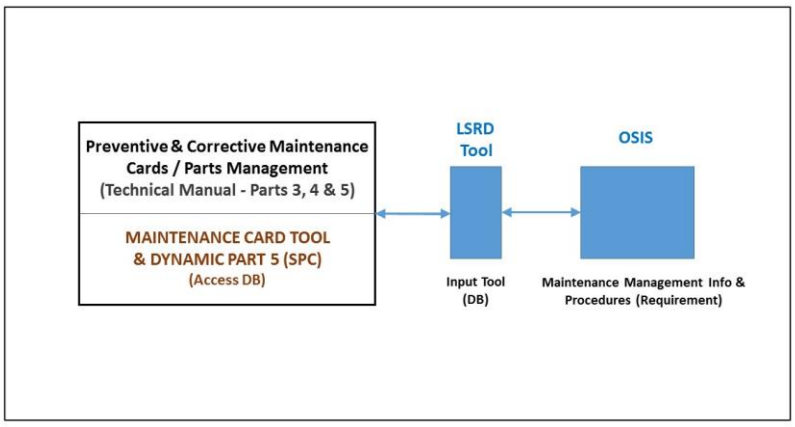

Figure 12. Client Tool

Maintenance card and certain TM information, formats and layouts requirements (standards) for future acquisition projects are now based on this successful database solution. In the envisaged ILS solution, no alternatives were considered due to the need to standardize on this successful and in use tool, that is affordable, familiar and not resource or skill intensive.

The Client Tool has been upgraded and enhanced overtime by Sigma Logistic Solutions, providing the vessel class with required operational maintenance and support information and

data (to Navy content requirements, layouts and formats). This includes an upgraded TM suite (including maintenance cards and dynamic Part 5 – Spare Parts Catalogue). The tool further provides the capability to migrate required maintenance management information, procedures and data, from the Client Tool (where it is managed and kept up-to-date), to the Naval support information system (OSIS). This transfer of acquired and amended maintenance support information and data is a mandatory requirement (including acquisition projects).

With reference to the need for good understanding of Client requirements, needs and support environments (para 3.1), it is important that Vessel Suppliers (as providers as well as users of required logistic support information and data) acquire the requisite knowledge and understanding of the support environments into which their Product System (e.g. Vessel inclusive of delivered logistic support system and services) must be integrated, implemented and supported. In this context, the maintenance and support environment for Naval vessels is shown in following Figure 13 – Naval Support Environment (comprising different facilities, organisations and services).

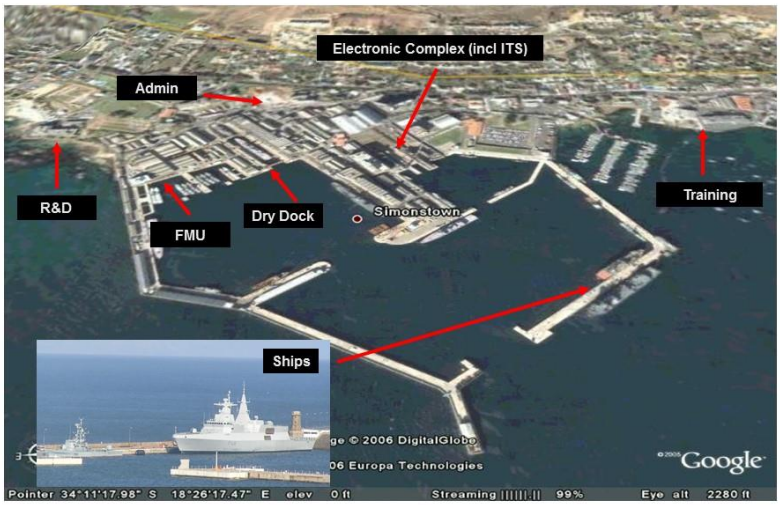

Figure 13. Naval Support Environment

4.2 Production Type Tool (for Tailor-made ILS Solution)

So is a "production type front-end" feasible, for a database toolset tailored to meet Client requirements for LE, maintenance cards and TM development/upkeep, as well as initial maintenance management and maintenance/support optimisation? Considering these two existing database examples (and functionalities), both require the compilation and development of specific maintenance and support information and data, with there existing a significant correlation between the two in terms of information/data to be generated and managed (e.g. LCC and LSA/LSAR activity outputs generate information and data for compilation/production of required maintenance cards and technical manual information, etc). The challenge remains how to use this reality to find ways to combine and synergise, and realise the multiple benefits that accrue in following the "capture once, use many times" strategy (and imperative).

Concept. Understanding the Naval requirements and needs, the three companies involved in this initiative (para 4.3) see opportunity to link RAMLOG (Fig 5) with an enhanced version of the current Client Tool (Fig 12), to provide an integrated LCC/LE/TM/maintenance card and

maintenance management capability. An overview of the integrated database concept is shown in following Figure 14 – Integrated ILS System Solution.

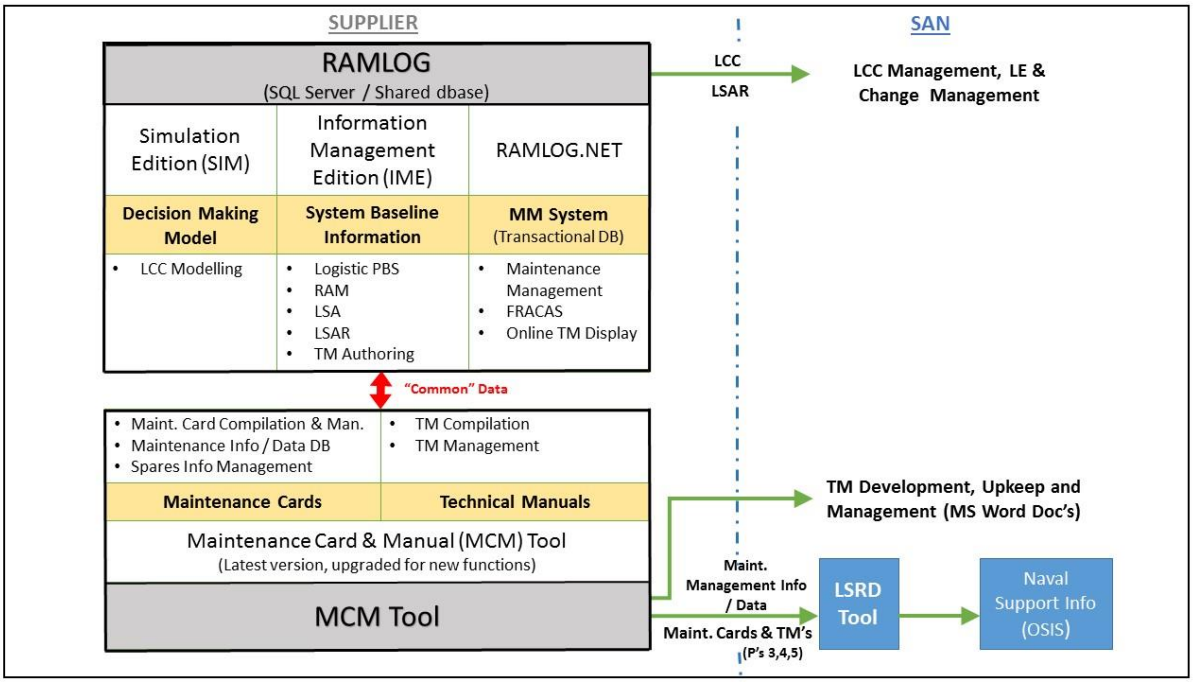

Figure 14. Integrated ILS System Solution

This tailor-made ILS system, in addition to the existing functionalities of the individual applications, will include an expanded Client Tool capable of developing and managing complete TM's (i.e. new Maintenance Card & Manual (MCM) Tool). The full TM's will include new Part 1 – Operating Info and new Part 2 – Technical Info, in addition to the existing Part 3 – Scheduled Maintenance (maintenance cards), Part 4 – Corrective Maintenance (maintenance cards) and Part 5 – Spare Parts Catalogue (including dynamic Part 5) (all with correct content requirements, formats, layouts, media, etc). The Client Tool's functionality to provide direct migration of required maintenance information and data to the Naval support information system (OSIS), will be retained in the MCM Tool (via the MCM Tool-LSRD/OSIS link), providing significant additional benefit by satisfying a mandatory requirement.

The RAMLOG application uses an SQL Server Database for its data repository. The intention is to use this as the shared database between the two applications. The "common" data between the capabilities and functionalities will then reside and only need to be maintained (i.e. kept up-to-date) in one place, for use in the various LE activities and logistic element resource outputs (e.g. specific facilities, support and test equipment, etc; maintenance planning; task procedures in form of maintenance cards; preventive and corrective task spares, etc).

Of real benefit to the Vessel Supplier/OEMs and Client, will be the planned common "production type" user interface, where Log Engineers, OEM engineers and technicians (and eventually Client personnel/End Users) can focus on entering specific engineering information and data for own systems and equipment (and not on how to compile and present, as per applicable requirements).

To be implemented and used extensively during the Acquisition Phase (Fig 2), this tailor-made ILS capability would be an important component of the required Vessel System deliverables (addressing LE information and data, as well as associated logistic element deliverables in form

of TM's, maintenance procedures, support data, support resource management capabilities, support services, etc). At the same time, it would solve the needs of the Vessel Supplier to provide maintenance planning and management, as well as maintenance/support optimisation capabilities and outputs during the planned Interim Operating and Support Phase (Fig 2). Delivery and enablement within the support environment (Fig 13), would need be done prior to (and as part of) establishment of a required Interim Operational Support Baseline (IOSBL) (starting the interim operational phase). During this initial phase, the Vessel Supplier also has responsibilities to assist with planning and management of the required Support Qualification and Transfer (SQT) process (required to be accomplished before completion of the interim operational phase). The proposed Integrated ILS System solution would satisfy the needs for support resources and baseline management required of the SQT process.

The intention would be to entrench and grow the Integrated ILS System capability within the Naval and associated support organisation environment during this interim phase, to be progressively taken over and run by Client personnel, by the start of the Operational Phase of the vessel class (as part of establishment of a required Operational Support Baseline (OSBL)) (Fig. 2). Maintenance management is the only capability of the envisaged Integrated ILS System not relevant to the Operational Phase (where done by Navy).

Opportunity. This concept provides opportunity to offer vessel and/or other Product System suppliers a "tailor-made integrated ILS system solution", covering the most important ILS information and service delivery, integration and operating requirements and needs (applicable to complex systems). To optimise the proposed solution, in addition to the integrated ILS system (Fig 14), the following ILS management and associated support services are necessary and available (i.a.w. Client requirements):

- Project/ILS Management (Acquisition & Interim Operating and Support Phases)
- LCC Modelling and Management (e.g. Cost of Ownership (COO) reduction / minimisation)
- Logistic Engineering, including failure analyses/predictions and LSA/LSAR
- Logistic element deliverables, including:
    - Spares modelling, determination and optimisation
    - Maintenance Procedure cards (delivery and upkeep)
    - Technical Manuals (new and amended), including TM Family Tree (magnetic media source material, plus interactive PDF solution)
    - Information, procedures and data required for input to Client support information systems
    - Training solutions and material
- ILS management and services for interim support, including Support Qualification and Transfer (SQT) management and implementation; and maintenance and Failure Reporting, Analysis and Corrective Action System (FRACAS) implementation and management

Benefits. In addition to the benefits inherent in the integrated ILS capability envisaged in this initiative (and discussed in this paper), the following observations are relevant.

- The Navy need affordable, reliable and available vessels and ships that are sustainable for the long-term, to meet the needs and requirements for specific roles and missions
- The proposed capability presents opportunities for significant level-of-effort/cost benefits for Vessel Suppliers/OEMs and any Acquiring Authority/End User, as well as for projects as a whole (through real opportunities available to identify and reduce

acquisition cost and COO, as well as provide required support information and data with integrity, in an efficient, succinct, coherent and reliable manner)

- The proposed integrated ILS system will simplify LE processes and procedures (with significant data common to both applications, and a common "production type" user interface). This includes the benefit of direct input/migration of required maintenance information and data to Naval support information system(s)
- The concept is largely based on an existing Client Tool, which in the case of certain future Naval projects, has set standards for required Maintenance Procedure Cards and certain TM information and data
- The FRACAS capability is vital to enable required support optimisation (to be done during the planned Interim Operating and Support Phase)
- The concept (in case of Naval acquisition) provides opportunities and possibilities to:
    - Understand and deliver on ILS requirements and standards
    - Effectively optimise the delivered support information system (over time)
    - Establish and grow Client/End User capabilities (for through-life support)
    - Reduce resource level-of-effort and costs
    - Standardise with existing in-house systems (and approaches)
- Inherent in this opportunity are the following:
    - Very good knowledge and understanding of Client/Naval requirements, needs and maintenance and support environment
    - Good background and working relationship with main role players in Client environment
    - Good understanding/insight on workings of Naval projects
- Provides opportunity for the three companies involved (para 4.3), to form long-term working relationships (a win-win for suppliers and Client)
- Can be offered as part of Offer submissions, to meet known ILS requirements (in full cognisance of the Naval operational support environment)
- Suppliers at certain Bidders Conferences were advised to approach local logistics companies, who have experience working with the Navy
- Idea and concept has credibility within Project Executive.

4.3 ILS Suppliers - Capabilities, Backgrounds and Strengths

This endeavour provides opportunity to bring three different local supplier companies (and capabilities) together in collaboration, in a "horses for courses" approach, each with their own specific work focus areas, functions and skills. With similar and different (but complementary) skill sets, tools and methodologies, this prospect provides possibilities to synergise in ways supporting the 1+1+1=4 reality.

IQS Solutions. Extensive capabilities and background in Systems Engineering, front-end and operational logistics, with long term experience and track record on Naval acquisition projects, especially Combat Suite and electronic systems (Frigates and Submarines). Strengths include Life Cycle Cost determination and management, as well as Logistic Engineering tasks, information and data development and compilation (done in conjunction with the RAMLOG application described in this paper). Strengths also include Technical Manual (TM) and training course and material development and provision.
Specific to this ILS solution initiative was the preparation and delivery of a draft ILSP (i.e. Client ILS requirements and strategies document) and LCC Management Plan (for acquisition project).

Sigma Logistic Solutions. Extensive capabilities, background and experience in ILS and ILS Project Management (including international projects), covering the provision of logistic element (ILS) deliverables (e.g. TM's (upgrade and new), maintenance procedures/cards, tailored information database solutions, etc). Extensive experience and track record on Naval acquisition projects includes Frigates (as SA Logistic Partner to overseas vessel (Frigate) supplier, and member of Programme ILS Management Team (ILSMT) (comprising Client/Acquiring Authority and Supplier)), as well as Submarine Projects. Experience includes interim support to assist the Navy with integration of aspects of the delivered Frigate ILS system (deliverables) into the Naval operational support environment. Current involvement includes upgrading and optimising maintenance and support elements for a vessel class, within the Naval operational support environment (and requirements).

R&M Technologies. Extensive capabilities and experience in Life Cycle Cost and Logistic Engineering, including the provision and maintenance of their RAMLOG application and capabilities, to both local and overseas organisations (e.g. SKA Africa and BAE Systems - UK).

In the context of this initiative, IQS Solutions and Sigma Logistic Solutions have relatively recent experience with Naval acquisition projects, having worked together to assist the Navy with logistic studies to "establish End User needs and ILS requirements" to be addressed in ILSP's (i.e. the Client document for project ILS strategies, approaches and requirements). Together, the two companies have an excellent understanding of the ILS requirements (including integration and implementation), as well as the Naval operational support environment (into which any acquired ILS systems must be integrated and implemented).

In the context of this initiate, the author had opportunity to consult to the Navy and assist in ILS requirements definition and finalisation, intended for future acquisition projects. This unique opportunity arose from experience gained on the supply side with Sigma Logistic Solutions and IQS Solutions. This experience of over 25 years' working with the Navy, comes with a proven track record of successful delivery. The purpose of the work was to ensure that requirements and resultant delivered ILS system(s) are realistic and compatible with Client systems, capabilities and needs, and can be effectively used and kept up-to-date by the Navy in a sustainable manner, for the life of the applicable Vessel Product System(s). This included ILS requirements definition and finalisation, ILSP updates and management, rework of ILS Standards and Procedures for SA Naval Projects, as well as mentoring of Client project team personnel for certain ILS elements. This opportunity to assist provided the insight to conceive this initiative, through identifying the capabilities, tools, technologies and required processes necessary to effectively and efficiently meet the Naval requirements and long-term support needs.

5. Conclusion

In exploring opportunities, it is apparent that it is possible to deliver an effective and efficient ILS system servicing the life-cycle needs of the Client (in this case, the Navy), and at the same time, establish and grow specialised maintenance and support capabilities, necessary to do their business. It is also apparent that many complex systems have similar needs.
This initiative arises through past opportunities to gain good knowledge and understanding of the Navy and their maintenance and support requirements, needs and operational support environments, together with the focussed utilisation of specific capabilities, technologies and approaches. Combining knowledge and understanding with specific capabilities and appropriate tools/technologies, techniques and approaches can be a huge catalyst for effectivity and efficiency. In effect, understanding, capability, flexibility and innovation become the enablers of possibilities, as well as key success factors for resultant solutions.

This can create significant opportunity to reduce resource requirements and usage, thus presenting significant potential for cost savings on complex systems, where "operational availability at an affordable cost" is paramount. Effective maintenance and support for complex systems (in this case, vessels) evolves overtime and is seldom in place and working efficiently at delivery. What is important is to have the proper tools and capabilities to firstly define, then acquire, implement and improve/optimize the required support.

And as with all potential and possibilities, innovative ventures like this need to be carefully developed, nurtured and supported in order for them to have the opportunity and prospect to reach full potential (currently, a work-in-progress with this initiative). In this, it's sometimes necessary to think-out-the-box with an open mind, so as to get the best utilisation of available capabilities and resources. All viable possibilities therefore need to be explored and nurtured in the pursuit of affordable and effective ILS solutions that meet the life cycle needs of complex Product Systems. When these objectives are achieved, cost savings can mean the difference between projects seeing the light of day, or not.

References

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Def Stan 00-60	Integrated Logistic Support: Part No: 1: Logistic Support Analysis (LSA) and Logistic Support Analysis Record (LSAR)
SANDES 080-500	ILS Standards and Procedures for SA Naval Projects
RAMLOG	South African developed software package for LCC/LSA and Maintenance and Support Management

Biography

Jonathan Morse holds an MBA from Curtin University of Technology, Australia and is an experienced business, project and logistical manager in the naval and business environments. He is a sound communicator and team player. He has in-depth knowledge and experience on a variety of SA Navy acquisition and operational support projects. He also has extensive experience in managing (and technical writing) on technical documentation projects, for SAAF (aircraft) and Spoornet/Transnet (locomotives).
Jonathan, maintaining his nautical fitness with a passion for surfing, has worked for Sigma Logistic Solutions for more than 25 years, as well as having been a work associate of IQS Solutions since 2012 (and partner since 2015).
Carel van der Merwe has been actively involved in rendering engineering consultation and services to Armscor, the SA Navy, Simon's Town Dockyard and the Department of Science and Technology for many years. Carel is an experienced System and Logistic Engineer and a registered Professional Engineer, holding a Master's degree in Electronic Engineering from the University of Stellenbosch. Carel is qualified as submariner number 321.

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Acronyms and Abbreviations

ABBL	As Built Baseline
CBL	Contract Baseline
CM	Corrective Maintenance
COO	Cost of Ownership
FBL	Functional Baseline
FBS	Functional Breakdown Structure
FMECA	Failure Modes, Effects and Criticality Analysis
FRACAS	Failure Reporting, Analysis and Corrective Action System
ILS	Integrated Logistic Support
ILSP	Integrated Logistic Support Plan
IOSBL	Interim Operational Support Baseline
IPB	Illustrated Parts Breakdown
IPC	Illustrated Parts Catalogue
ISP	Integrated Support Plan
LCC	Life Cycle Cost
LE	Logistic Engineering
LSA	Logistic Support Analysis
LSAR	LSA Record
LSRD	Logistic Support Reference Data
MCM	Maintenance Card and Manual
MIL	Military
OEM	Original Equipment Manufacturer
OSBL	Operational Support Baseline
OSC	Optimised Support Concept
OSIS	Naval Support Info System
PBL	Product Baseline
PBS	Product Breakdown Structure
PDF	Portable Distribution File
PHS&T	Packaging, Handling Storage and Transportation
PM	Preventive Maintenance
RAM	Reliability, Availability and Maintainability
RBL	Requirements Baseline
RCM	Reliability Centred Maintenance
RSC	Recommended Support Concept
SAAF	South African Airforce
S&TE	Support and Test Equipment
SAN	South African Navy
SPC	Spare Parts Catalogue
SQT	Support Qualification and Transfer
STD	Standard
TM	Technical Manual
V1	Vessel 1